Analysis of Drought Incidence, Gendered Vulnerability and Adaptation in Chivi South, Zimbabwe

By

Chineka Jestina

Student No: 14014919

A research dissertation submitted to the Department of Geography and Geo-Information Sciences in fulfilment of the requirements for the Degree of Masters of Environmental Science in Geography
at the University Of Venda.

Supervisor: Prof A. Musyoki

Co-Supervisors: Mr E. Kori
Mr H. Chikoore

April, 2016

DECLARATION

I, Jestina Chineka, hereby declare that the dissertation for the Masters of Environmental Sciences in Geography degree at the University of Venda, hereby submitted by me, has not been submitted previously for a degree at this or any other university, that it is my own work in design and in execution, and that all reference material contained therein has been duly acknowledged.

……

Signature

……

Date signed

DEDICATION

To my parents Tafireyi and Florence Chineka.

ACKNOWLEDGEMENTS

I would like to thank my supervisors, Professor A. Musyoki, Mr E. Kori and Mr H. Chikoore for their unwavering support and guidance throughout this research. A special mention to the Directorate of Research and Innovation for the research grant. To my research assistants, Blessing Mavhuru and John Laisani, may the Lord increase your territories. My sincere gratitude to Ms Tafireyi, the Acting D.A Chivi District for authorising my research as well as Mr Homela, Mr Bodzo and Mrs Madzore from AGRITEX, Chivi District for agricultural production statistics. CARE International Chivi and CADEC, Masvingo for drought vulnerability and adaptation data, Dr Tshilidzi Madzivanzila from FANRPAN for HVI tool techniques. Lastly but not least, I would like to thank my special friend Alugumi S. Ndou, you were awesome throughout the research.

ABSTRACT

Climate change has brought about a number of global environmental challenges and the worst, climatic disasters such as floods and droughts. In Zimbabwe, particularly in the semi-arid Chivi District, droughts have become more frequent. At the household level, there are a multiplicity of vulnerability and coping mechanisms to this scourge, which have gender dimensions. This study analysed the vulnerability of the Chivi South community to drought and its adaptation with specific consideration to the gender dynamics. The specific objectives for this dissertation were to establish the characteristics and extent of drought occurrences in Chivi District in the last 30 years, assess Chivi South's vulnerability to drought, evaluate levels of gender vulnerability to drought, and analyse gendered adaptation to drought. Subsequently, a strategy for drought adaptation in the rural areas of Zimbabwe was drawn. The research was based on the mixed methods approach, as it employed both qualitative and quantitative approaches. Data collection methods included a review of official documents, key informant interviews with community leaders, Non-Governmental Organisations and government officials working in the area, household questionnaires and focus group discussions. The Standardized Precipitation Index was used to determine drought severity. Data was analysed using the SPSS 22.0 software. Capabilities such as Chi-square and cross tabulation were used to effectively analyse data. The Household Vulnerability Index was employed to infer vulnerability and adaptation of the community to drought. Research findings were illustrated using charts, graphs, tables and photographs. The study established the occurrence of droughts in Chivi, with a high prevalence of low magnitude droughts. A decrease in crop food production closely related to drought patterns was noted. Drought vulnerability cuts across the whole gender spectrum, with a sizable number of female headed households being severely exposed. However females adapt better to the effects of drought than males. A holistic approach which seeks to integrate both men and women in decision-making and to improve the community's adaptation to drought and other disasters was proposed.

Key words: Adaptation, Climatic Disaster, Climatic Risk, Drought, Gender.

Table of Contents

Contents **Page**

List of Tables

List of Figures

List of Appendices

List of Abbreviations

ACF	Action Contre la Faim
AGRITEX	Agricultural, Technical and Extension Services
AIDS	Acquired Immuno Deficiency Syndrome
AISA	Africa Institute of South Africa
ALH	Acute Level Household
AVHRR	Advanced High Resolution Radiometer
CA	Conservation Agriculture
CADEC	Catholic Development Committee
CARE	Cooperative for Assistance and Relief Everywhere
CBA	Community Based Adaptation
CBAW	Community Based Asset Weighting
CDF	Cumulative Distribution Function
CLH	Coping Level Household
CRED	Centre for Research on the Epidemiology of Disasters
CRU	Climate Research Unit
ELH	Emergency Level Household
EMA	Environmental Management Agency
ENSO	El Niño Southern Oscillations
ENSURE	Enhancing Nutrition Stopping Up Resilience
ESAP	Economic Structural Adjustment Programme
FANRPAN	Food Agriculture Network Research Policy Analysis
FAO	Food and Agriculture Organisation
FEWSNET	Famine Early Warning System Network
GDP	Gross Domestic Product
GHGs	Green House Gases

GMB	Grain Marketing Board
HIV	Human Immunodeficiency Virus
HVI	Household Vulnerability Index
IBM	International Business Machines
IDMC	Internal Displacement Monitoring Centre
IPCC	Intergovernmental Panel on Climate Change
IRI	International Research Institute
ITCZ	Inter Tropical Convergence Zone
IUCN	International Union for Conservation of Nature and Natural Resources
LVI	Livelihood Vulnerability Index
MDGs	Millennium Developmental Goals
NAPs	National Adaptation Plans
NCCR	National Climate Change Response strategy
NGOs	Non-Governmental Organisations
SAAT	Southern African Aids Trust
SADC	Southern African Development Committee
SAFIRE	Southern Alliance for Indigenous Resources
SDV	Standard Database Value
SEL	South East Lowveld
So VI	Social Vulnerability Index
SPI	Standardized Precipitation Index
SPSS	Statistical Package for the Social Sciences
PRA	Participatory Rural Appraisal
TAR	Third Assessment Report
UEA	University of East Anglia
UMP	Uzumba Maramba Pfungwe

UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNFCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations International Children's Emergency Fund
UNISDR	United Nations International Strategy for Disaster Reduction
WFP	World Food Programme
WHO	World Health Organisation
WMO	World Meteorological Organisation
WRI	World Resource Institute
ZIMSAT	Zimbabwe Statistics
ZIMVAC	Zimbabwe Vulnerability Assessment Committee

CHAPTER 1: PROBLEM DEFINITION AND SETTING

1.0 Introduction

Climate change has become a topical issue the world over. The irrefutable evidence of a rise in catastrophic and slow onset disasters has made it a major concern in the 21st century. The United Nations Development Programme (UNDP) and the United Nations Environmental Programme (UNEP, 2011) note the increase in climatic disasters and their impact on development, especially the drawing back on meeting the global millennium development goals (MDGs). According to the United Nations International Strategy for Disaster Reduction (UNISDR) (2005), Africa is vulnerable to climate change risks. This is due to its multiple stresses, low adaptive capacity arising from endemic poverty, weak institutions, complex disasters and civil conflicts.

Climatic risks, such as droughts, continue to threaten and affect livelihoods in many African countries. Drought presents one of the most challenges to Southern African economies. The African continent has stood first globally on drought frequency for over four decades since 1960 (Shiferaw *et al.* 2014:68). Within the same period 382 drought events were reported. Zimbabwe, of late, faces recurrent climatic disasters in the form of droughts. The country's political situation and subsequent economic challenges have made communities more vulnerable to this phenomenon and the implementation of adaptation plans more challenging.

1.1 Background to the research problem

Evidence is increasing that climate variability due to anthropogenic activities has led to major global consequences. The rise of sea and air temperatures, the melting of polar ice caps and an increase in catastrophic events is notable (IPCC, 2007). In Africa, weather patterns are continuously becoming unpredictable. IPCC (2012) notes that climate is likely to adversely affect the region, thereby increasing risks of water scarcity and food insecurity.

In Zimbabwe, the meteorological records reveal notable rainfall variability and extreme events. According to Guha-Sapir *et al.* (2012:28) drought tops the list of climatic disasters to ever

hit the country, and many people were affected by this hazard between 1982 and 2007. Chagutah (2010) notes that Zimbabwe's heavy reliance on rain–fed agriculture and natural resources for livelihood has made it more vulnerable to drought. Low agricultural yields, food insecurity, fall in economic productivity, retrenchments, and poverty have been some of the effects of droughts in this country.

Chivi District is geographically located between 20° 14' S to 20° 24' S and lies between 30° 13' E and 30° 57' E (Tavirimirwa *et al.*, 2012: 471). The District lies in the low rainfall, agro-region 4 of Zimbabwe, which is characterised by sandy unfertile soils. With agriculture being the main source of livelihood, recurrent drought effects have been felt by both men and women in this community. A number of Non-Governmental Organizations (NGOs), such as Cooperative for Assistance and Relief Everywhere (CARE), Catholic Development Committee (CADEC) and the governmental body Agricultural Research and Extension Services (AGRITEX), have tried to intervene with poverty alleviation strategies. These projects focus on either food relief aid or externally idealised and top down disaster risk reduction projects (Nhodo *et al*., 2010). All these efforts are rather reactive in approach and, in most cases, do not integrate the community's cultural and gender aspects.

Globally, disasters are now perceived as having gendered experiences. Men and Women experience drought differently and have different coping mechanisms. UNISDR (2014) notes that, annually 100 million women and girls are affected by disasters in which female-headed households are often among the poorest and most vulnerable to climate change risks. Current studies, such as Brown *et al*. (2012), view gender mainstreaming as vital in dealing with disasters, which affect communities. Molden (2007:320) argues that climate change presents a significant threat to human security, especially for women who represent 70% of the world's poor population, which relies on rain-fed agriculture. Women are, therefore, more susceptible to the knock-on effects of climate change. Despite women's vulnerability, disaster risk reduction plans and projects do not often involve them. Chagutah (2010) notes the absence of a gender policy framework on management and protection of the environment and natural resources in Zimbabwe as a clear reflection of this.

The Intergovernmental Panel on Climate Change (IPCC, 2012) argues that it is vital to recognise differences in vulnerability within groups and communities. It also questions the failure of developmental projects to define the diversity of the population in category

terms. This often leads to the exclusion of the most vulnerable groups. World Meteorological Organisation, WMO (2014) supports this and adds that, though women are vulnerable to disasters due to socially constructed gender inequalities, they are invaluable in disaster risk reduction and climate change adaptation. The United Nations International Strategy for Disaster Reduction (UNISDR) Hyogo Frame work for Action (2005) cites the gender perspective as an integral part of all disaster management policies. Despite Chivi District being 54.3% female, male councillors dominate the council (ZimSat, 2012).This says a lot about gender imbalances in decision-making processes.

Despite Zimbabwe's ratification to the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 and the Kyoto Protocol in 2009, little has been done to show commitment to National Adaption Plans (NAP's) (Chagutah, 2010). This means that the issues of climate change are addressed under various fragmented frameworks in various government wings. This risks leaving out vital aspects such as gender dynamics in community vulnerability and adaptability. Dodman (2010) argues that a thoughtful and broad effort to integrate gender issues is critical to Zimbabwe's reaction to climate change. Gender disaggregated data on vulnerabilities is needed across all levels for sustainable adaptation strategies. It is against this background that the study seeks to explore the vulnerability and coping measures, of men and women to drought.

1.2 Problem statement

Drought in Zimbabwe has become a fact of life. Masendeke (2003:3) noted a drought frequency of three in every five years. Mudzonga (2012) supported this view and adds that drought even recurs in two farming seasons. Despite structural drought characteristics, Unganai and Mason (2002) and Dube (2008) noted spatial variations in drought across Zimbabwe. In Chivi District, agricultural yields and water supplies seem to go down every other year while the food crisis is deepening.

Communities are heterogeneous entities, underlined by cultural diversity and gender dimensions. Many developmental projects operating in disaster management are doomed, due to failure of unveiling these social dimensions. Vincent *et al.* (2007) points out that gender dimensions are a perennial, cross–cutting concern within communities, hence only a holistic analysis of gender vulnerabilities is crucial to develop gender sensitive adaptation programmes.

They query failure of developmental projects to consider diversity and differences that define population categories. Gender dynamics need to be unpacked so as to establish social constraints that bind the community, making it susceptible it to climatic risks.

Past research in Zimbabwe, has focused much on the vulnerability of agro-communities with the aim of bettering technologies and farming methods. Various coping measures were recommended but adaptation levels still remain low. The view of a community as non-uniform but complex unit, characterised by gender and cultural attributes has remained a grey area. Hence, this research seeks to explore this under researched dimension in climatic disaster vulnerability and adaptation.

1.3 Objectives

1.3.1 Research aim

The aim of this study is to examine drought spatial and structural characteristics, impact on food production and to analyse gendered vulnerability and adaptation in Chivi South, Zimbabwe.

1.3.2 Specific objectives

The objectives of the study are to:

- Establish characteristics and the extent of drought occurrences in Chivi South since 1983;
- Assess changes in food crop production in Chivi District;
- Evaluate gendered levels of vulnerability to drought in Chivi South; and
- Analyse gendered adaptation to drought in Chivi South

1.3.3 Research questions

- What are the characteristics and the extent of drought in Chivi South?
- How has food crop production in Chivi District changed over the past 30 years?
- From a gender perspective, how does drought affect Chivi South community livelihoods?
- How do gender differences impact on adaptation strategies in Chivi South?

1.4 Delimitation of the research and study area

1.4.1 Scope of the study

This study focused on droughts that have occurred in Chivi District since 1983. It covered all the droughts declared and undeclared national disasters. It sought to establish the drought as impact on food production. It, subsequently, analysed gendered vulnerability and adaptations. The study looked at Chivi South case as representative of rural communities exposed to drought and other climatic disasters. The community's heavy reliance on rain-fed agriculture and the high female population makes it an ideal representative of Zimbabwean rural communities.

1.4.2 Study area

Chivi South is one of the three main communal areas constituting Chivi District. It is a politically demarcated area, together with Chivi North and Central, they divide Chivi District into three sub-districts. Chivi South lies on the South-western part of Masvingo Province in Zimbabwe (Figure 1.0). According to ZimSat (2012:138), the community has a population of 67 385 in 11 wards, with 45.6% males and 54.4% females. The study focussed on ward 22, 24, 25, 31 and 32 in the Southern part of the district. The community has an average household size of 4.3 people (ZimSat, 2012:138). The region consists of mainly communal lands in which subsistence farming is practised (Madzvamuse, 2010).

Topography

Chivi District lies in the low, lying semi-arid Agro-ecological region 4 and 5, in which semi extensive farming is practised and it is characterised by low growing periods and low agricultural productivity (Mudavanhu and Chitsika, 2013: 29). According to Chiripanhura (2010:11), one third of the District is in region 4 and the rest in region 5. Chivi is characterised by sandy soils. Makuvaro *et al.* (2014) point out that soils range from sands to vertisols but they are mostly coarse grained sands, very infertile and prone to forms of erosion. The District has low agricultural potential and crop growing period (UNDP, 2012). Thorny and Colophosepermun (Mopane) trees characterise the vegetation scene in Chivi (Chikodzi and Mutowo, 2013).

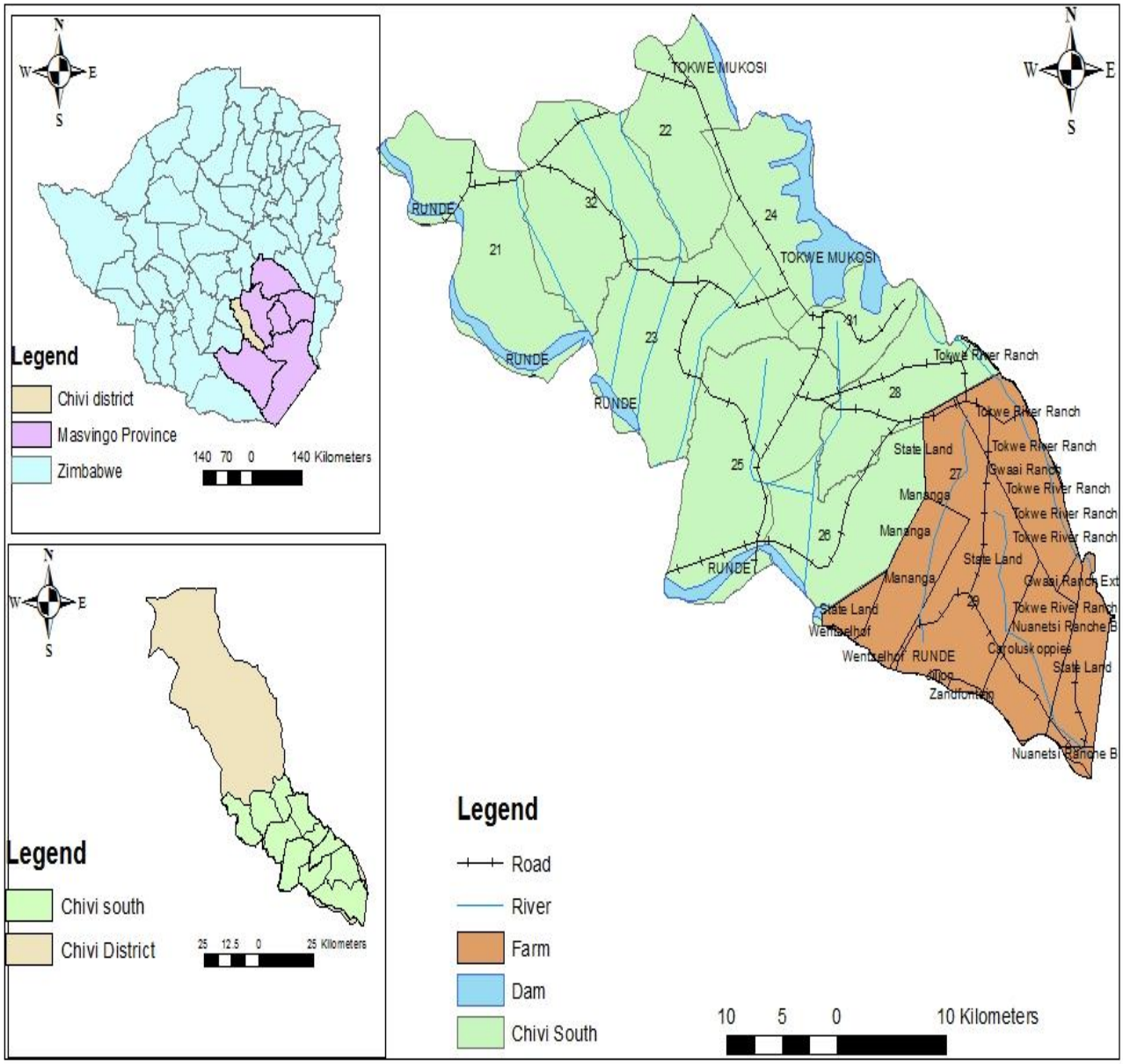


Figure 1.0: Chivi South Map (Source: Author using ArcGIS, 2015)

Mean climate of Chivi District

The District forms part of the South East Lowveld region of Zimbabwe (SEL). The area receives low, unreliable rainfall with a mean annual of 530 mm. This threatens food security (Mapanda and Mavengahama, 2011:2919). Maximum daily temperatures average 28℃ (Mudavanhu and Chitsika, 2013:29). This often results in high evapotranspiration rates and useful soil moisture content reduction. The area is characterised by low erratic rains (Mudzonga, 2012). Rainfall in Chivi is ostensibly variable in time and space, with a variation coefficient of greater than 35% (UNDP, 2012:7).

Chivi is often marked by below average rainfall and frequent drought (Chikova, 2013). Chiripanhura (2010) informs that crops fail in this district, frequently due to drought. Mudzonga (2012) concurs with this view and notes that though droughts are frequent in this district they are magnified by deep poverty which affects 70% of the rural people in Zimbabwe. According to Unganai and Mason (2002), inter-annual rainfall variability is mainly influenced by the El Niño Southern Oscillations (ENSO). A marked trend towards reduced rainfall inter-seasonally, has been noted in this area.

1.5 Significance and justification of the study

The rationale for this study stems from the need to examine the susceptibility and adaptation of men and women to drought in Chivi District. This is critical in the drawing up of effective adaption plans for climatic disasters and various developmental projects in the area. Droughts, in Zimbabwe, are on the increase. Guha-Sapir (2012) notes that, in the 21st century, dry spells characterise each season in Zimbawe. Zimbabwean communities continue to feel the scourge of drought. According to UNFCCC (2008: 67), persistent droughts in Masvingo will result in 42% of communal land being marginalised for food crop production. It is within these parameters that the need to propose effective adaptation plans arises.

According to Donald *et al*. (2014), addressing climate change challenges should ultimately incorporate the reduction of greenhouse gases (GHGs), in order to mitigate climatic impacts that are expected to occur. However, it is widely accepted that disasters are not only unavoidable

interruptions to development, which can only be addressed through rapid delivery of emergency relief, but that they also occur as a result of unmanaged risks within the development (Turnbull *et al*., 2013). Disasters are created when a hazard occurs where people, assets and systems are exposed to its effects. Thus, associated risks can be addressed through decreasing factors which expose the communities to the hazard and its risks.

UNISDR (2012) views disasters as complex problems demanding a holistic response from different disciplinary and institutional groups. Hence, there is need to explore the nature of drought and its impact on food production, which, in turn, brings about gendered vulnerabilities to communities of Zimbabwe. An understanding of how men and women adapt to these changes is essential if effective disaster reduction plans are to be drawn. Supporting this view, Dodman (2010) argues that a deliberate and extensive effort is needed to integrate gender issues to Zimbabwe's response to climate change. Gender dimensions and their impact on community vulnerability and adaptation need to be known.

The accentuated proneness of men and women and their coping measures to climatic risks should be acknowledged, researched and integrated into planning and policies of climate change and disaster management. Chagutah (2010) identifies gender mainstreaming as imperative for the country's sustainable development. Drought, like any other disaster, requires a holistic approach, and communities should not be regarded as homogeneous entities. Gender variables and dimensions need to be analysed so as to draw effective developmental plans which can benefit these communities.

1.6 Definition of key terms

- **climatic disaster** refers to a climate variability induced hazard which causes a serious disruption of the functioning of a community or society, causing widespread human, material, economic or environmental losses, which exceed the ability of the affected community to cope using its own resources.
- **Climatic risk** is a probabilistic of occurrence of a particular hazard or extreme event. It is a disincentive for development, characterized by huge impact on socio-economic development. Potential climate hazards include droughts and floods.

- **Drought** refers to prolonged dry weather in which a region experiences a deficit in moisture, thus adversely affecting vegetation, animals and human beings. This could be due to natural rainfall variability or climate change. Drought can be subdivided into four types, namely meteorological, agricultural, hydrological and socio-economic drought. Meteorological drought refers to periods of months to years of below normal mean annual rainfall. Agricultural drought is the short term moisture deficit in the soil surface layers during critical periods of a specific growing period. Hydrological drought is a prolonged shortage in precipitation which compromises surface and subsurface water supplies affecting groundwater recharge, reservoirs and stream flows. This lasts even after meteorological drought has ended. The socio-economic drought refers to the compound effects of all droughts on livelihoods and the economy. Drought impact varies with households due to different economic statuses and entitlements.

- **Vulnerability** is a result of social, economic, environmental or physical factors which increase people‘s susceptibility to the adverse effects of the disaster event. This increases loss of life and or property. It is the exposure of livelihoods to risks and failure of people to cope. It is compounded effect of the character, magnitude and frequency of climate variation to which a system is exposed, its sensitivity and adaptive capacity or the extent to which a community or system is failing to adapt to the impacts of climate change, variability and extreme events.

- **Adaptation** refers to the resilience or coping mechanisms of an individual or community to the risk at hand. Its levels are influenced by the socio-economic environment and political climate of the affected community. Adaptation points to all adjustments made in natural and human systems in response to a climatic risk so as to reduce its impact. It can be ex post or ex ante. It is more temporary and often targets current or expected harm.

- **Household** The definition of household in an African setting is controversial. It varies from one household to another. In this study, it refers to an individual or a group of people living in the same homestead, who share chores and meals. This applies to people who have been living together for over a month.

- **Household head** means the leader of a household, the one with the last say in critical issues. In polygamous households, the husband only count as a household leader in the first wife's household and the rest of households are compounded under the one main household.

- **Gender** refers to the social and cultural construct that assigns status and roles to males and females. Unlike sex, human beings are differentiated by socially assigned roles and status. This often causes inequality between sexes. Gender is a social attribute and is reversible. It is also dynamic, varies with space and time. It is also an analytical tool for inferring social patterns and behaviour in relation to development.

- **Gender analysis** means assessing the vulnerabilities and inequalities between men and women before, during and after a disaster event. It requires the collection of sex disaggregated data for baseline and situational analysis.

1.7 Conceptual framework

This section presents the Conceptual framework, which reflects theoretical dimensions used to analyse the research problem. The study follows the Havard or Overholt (1985) framework of gender analysis. Climate change related drought risks are felt in a society which is exposed economically, socially, geographically and politically. The framework shown in Figure 1.1 emphasises the importance of establishing gender dimensions within the community, using its profiles that is activity profile, access and controlling profiles. It stresses the importance of exposing gender issues, which underline the community, to ensure effective adaptation strategies and disaster management. However, gender variables are affected by these factors differently, thus forming various gender dimensions. The key to effective vulnerability reduction and sound adaptation strategies lies in a clear gender analysis and in addressing these dimensions.

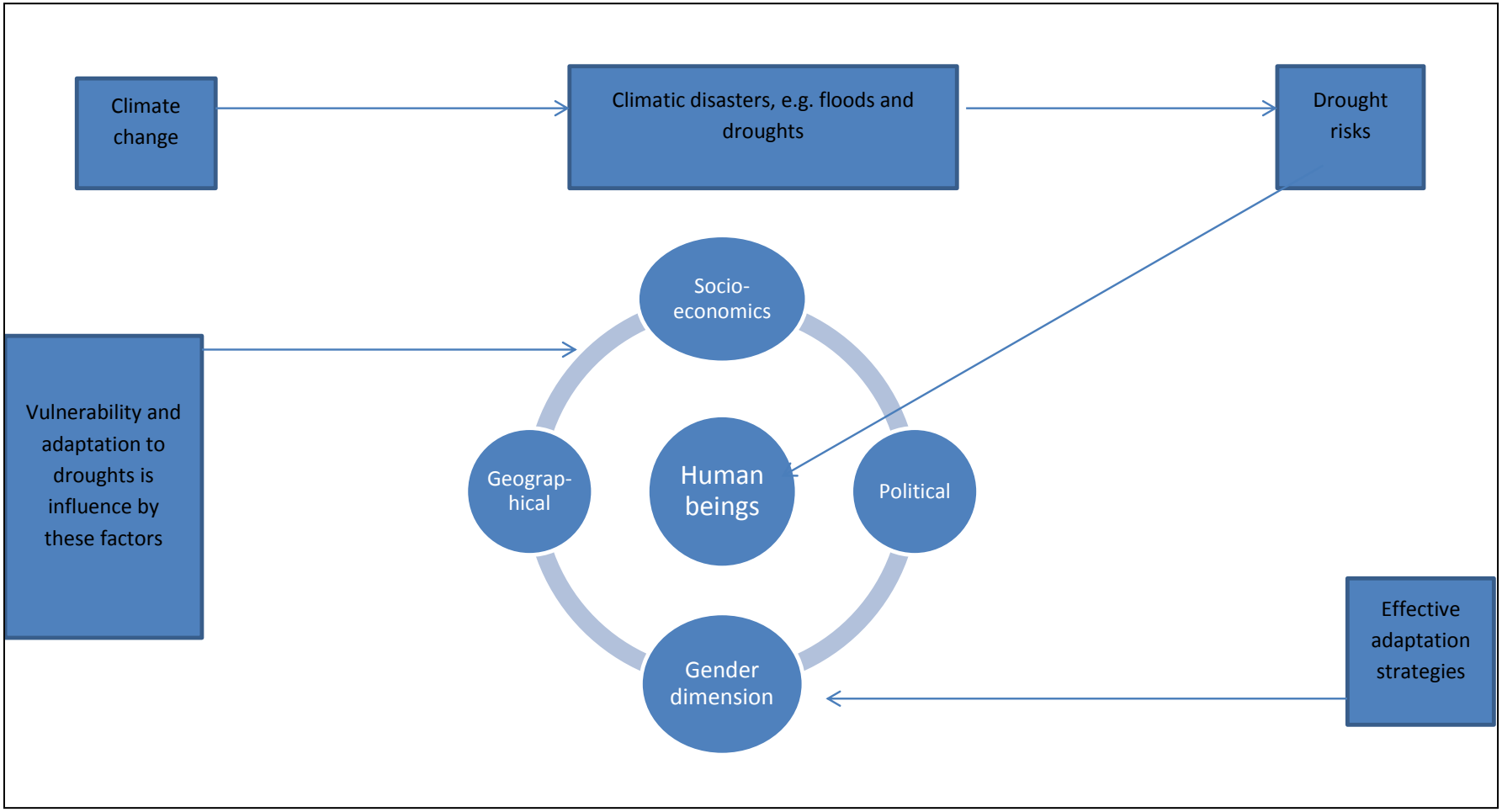


Figure 1.1: The conceptual framework, Adapted from Overholt (1985)

It is crucial to note that the framework portrays gender not only as a social attribute, but as one of the influential factors in determining the vulnerability and adaptability of a community.

1.8 Chapter summary

Climate change effects are being felt all over the world. In Africa, heavy reliance on natural resources for livelihoods has made the continent more vulnerable to climatic disasters like drought. In dry areas, such as Chivi District in Zimbabwe, drought occurs every other farming season with a possibility of recurrence which affects food production. Vulnerability, in this community, continues to increase. Thus, poverty and effective adaptation plans have become critical. However, recent studies, globally, reveal that drought, like any other disaster, has gendered experiences. Hence, a clear understanding of the climatic risks, its effects and gender dynamics on community development is key to effective adaptation strategies.

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction

Climate variability has opened up a multiplicity of research issues such as the nature and extent of climate change globally. In addition, its related effects, disasters, vulnerabilities and coping mechanisms have been the focus of many theses. In Zimbabwe, there has been a lot of research on climatic risks, especially floods and drought (Brown *et al*., 2012; Chagutah, 2010; Madzvamuse, 2010; Mudzonga, 2012). Climate risks are brought about by both short term fluctuations from the mean climate, which is climate variability and long term fluctuations, which refer to climate change. This chapter reviews literature on climate in Southern Africa, climate variability and change, food production changes in Zimbabwe, drought vulnerability, gendered vulnerability and adaptation to drought.

2.1 The mean climate of Southern Africa

Southern Africa generally lies within the subtropics, extending from the equator up to 35° South. It is characterised by a wide range of climatic characteristics (UNEP, 2008:8). The South western part climate ranges from sub humid in the eastern countries such as Angola to semi-arid towards Namibia, Botswana and Zimbabwe to the western tip, to moist laden mid-latitudes in Tanzania, Mozambique and Swaziland and Mediterranean in the far southern tip. The climate varies substantially due to its positioning in relation to oceanic circulations (Davis, 2011). The location of the Atlantic ocean to the west and Indian ocean to the east and topographical variation in the central part of the region influence its climate. Southern African climate is a result of the oceanic and continental pressure systems interaction (Jury, 2013).

2.1.1 Temperature

Temperatures of Southern Africa are generally warm (UNEP, 2008). They vary with altitude and latitude, as well as seasons. They range from warm in the tropics to hot in the semi-arid regions and low lying areas such as the northern parts of South Africa, Zimbabwe and Mozambique. Most parts of the region experience a mean annual temperature of 17℃ +. With mean minimum temperatures ranging from 3℃ to 25℃ (Davis, 2011:12). Summer maximum temperatures, range from 25℃ in the southern parts of the region to 35℃ + in the areas north of the tropic of

Capricorn towards the equator (Davis, 2011:48). Temperatures vary from cool day time to freezing point nights in winter and autumn (March to August) and hot to cool nights in spring and summer that is from September to February. While diurnal temperature ranges are generally low and become more significant in the interior plateaus and highlands, however, monthly variations tend to be more gradual (Davis, 2011). Temperatures also show an east to west variation across Southern Africa (Jury, 2013). The temperatures tend to be warmer along the eastern coastline and cooler towards the western coast. Davis (2011) supports this and notes that temperatures along the coast are influenced by the warm Agulhas currents in the east and the cold Benguela currents in the west coastline.

2.1.2 Rainfall

Precipitation patterns in Southern Africa are incoherent and are characterised by spatial and temporal variation (Dube, 2008). Its variability is notable across the sub-continent. Rainfall patterns and distribution are influenced by the region‘s position in relation to major circulation systems of the southern hemisphere, oceanic currents and diverse regional topography (Davis, 2011). Precipitation fluctuates over the annual cycle due to solar positioning and the north to south displacement of the Hardley cell (Jury, 2013). Most rainfall is received during summer (October to March) and minimal to no rainfall in winter which is from March to August (Dube, 2012). An east-west gradient characterises rain in this region. High rainfall along the east coast is a result of the warm moisture laden Agulhas currents from the equator flowing southwards. Along the west coast, in contrast, the cold Benguela currents from the Atlantic ocean blow dry air, causing semi-arid to arid climates in countries such as Namibia and Botswana (Dube, 2008).

The interior of Southern Africa is characterised by low lying plateaus and highlands stretching up to a maximum of 3000m in height. Rainfall distribution varies spatially (Davis, 2011:8). In high altitudes, such as the Zimbabwe’s eastern highlands, there is a strong rainfall gradient and it falls with low lying plateaus such as the Zambezi and Limpopo valley basins (Mdoka, 2010). The exception applies to the low lying south and west Cape regions of South Africa, which receive relatively high rainfall even in winter, due to the influence of maritime climatic conditions (Davis, 2011).

The central region‘s rainfall is mainly influenced by the Inter Tropical Convergence Zone (ITCZ) movement between the equator and the tropics (Jury, 2013).The movement of the ITCZ southwards to the Tropic of Capricorn between November and March results in high rainfalls

being received from Tanzania to southern countries. Minimal to no rainfall is experienced when ITCZ migrates to the north in July (Dube, 2008). However, at times the ITCZ is pushed north by the Botswana High pressure system resulting in pronounced drought in many Southern African countries (Unganai and Mason 2002).

Inter-annual rainfall variations also characterize Southern Africa and this is mostly linked to ENSO (Anyamba *et al.*, 1996). During El Niño events, the region becomes a bit drier and too wet during La Niña

(Dube, 2008). However not all research relates all drought events occurring in Southern Africa to ENSO. Climate variability and change have also been explored as a potential cause.

2.2 Climate variability and droughts in Southern Africa

Southern Africa is characterised by frequent severe droughts. According to Unganai *et al.* (1998), droughts have become a major climatic disaster throughout the region. In Zimbabwe, drought accounts for 6 out of 10 top disasters between 1982 and 2011 (Zimbabwe National Contingency Plan Committee, 2013:8). Extreme weather events have been a persistent phenomenon over Africa. However, recent research informs that they have become more frequent. Kandji *et al.* (2006:8) noted that droughts are diverting from the normal 10 to 20 year frequency. Mudavanhu and Chitsika (2013: 29), in support to this, noted a steep rise in drought frequency in semi-arid parts of Zimbabwe of a 3 year interval.

Most research link drought to the ENSO patterns that is regional sea surface and global atmospheric circulations. According to Clay *et al.* (2003), during El Niño events, south eastern Africa becomes a bit drier and too wet during La Niña. Hence Southern Africa experiences drought during the onset of El Niño. Anyamba *et al.* (1996) using the Advanced High Resolution Radiometer (AVHRR), noted a periodical variability over Southern Africa which correlates with the ENSO Index derived from Pacific atmospheric pressure systems. This is also supported by Mason *et al*. (1997) who linked the quasi-periodicities in rainfall in Southern Africa over an 18 year cycle to variations in sea surface temperatures in the Eastern Pacific and Central Indian Oceans.

Despite the view that rainfall in Southern Africa is moduinated by ENSO, the causes of a continuous increase in drought frequency has opened up an area for further research. In Zimbabwe, the National Contingency Plan Committee (2013) noted that drought which cannot be comprehensively explained by ENSO movements is becoming chronic especially in semi-arid regions. Clay *et al.* (2003) argues that not all droughts can be linked to ENSO; atmospheric-oceanic circulations over Indian ocean and South Atlantic ocean also have a role to play. He linked rainfall variability in Southern Africa to Tropical and mid latitude weather systems and convective variations to topography and regional surface temperatures. Unganai and Mason (2002) also noted anticyclonic conditions which disturb the Inter Tropical Convergence Zone (ITCZ) steep movement further into Southern Africa as one of the causes of droughts in this region.

However, the increase in drought frequency is now being associated with climate variability and change. IPCC (2001) shows that there is growing complex rainfall variability across Africa, which it relates to global warming and climate change. This climate variability and change has been portrayed as a disastrous phenomenon threatening the whole world. It is believed to have emanated from the anthropogenic activities of centuries ago. Patt *et al.* (2005) trace it back to the industrial revolution in the eighteenth century. This has been labelled the dark century where air pollutants and changes in land use ravaged the environment. The burning of fossil fuels and land use change triggered the accumulation of greenhouse gases in the atmosphere, resulting in continuous global warming (Joseph-Brown, 2012). In support of this, IPCC (2001:1) projected a temperature rise 0.2^{o}C by the year 2021.

Globally, the effects of climate variability and change are becoming more visible, for example heat waves, recurrent floods and droughts. Joseph–Brown *et al.* (2012:14) point out to continuous floods in the Caribbean-Pacific Islands and the rapid destruction of the mangroves and coral reefs. Stehilik *et al*. (2000) discusses recurrent droughts in the eastern parts of Australia. Musyoki *et al*. (2012) note the escalating droughts in Kenya, Uganda and Rwanda while Benson and Clay (1997) inform that most parts of sub-Saharan Africa are vulnerable to droughts.

2.3 Zimbabwean climate and climate variability

Zimbabwe lies between 15° 30’ and 22° 30’ South of the equator and 25° and 33° 10’ East of the Greenwich Meridian (Chifurira and Chikobvu, 2010:2). It occupies a generally stable plateau

which subsides in the Northern part, along the Zambezi valley and in the South, in the Limpopo basin, characterised by moderate to high maximum temperatures and evaporation rates often exceeding the rainfall limiting subsurface recharge (Davies and Burgess, 2005:1). However temperatures vary with seasons. The country generally experiences a semi-arid, savannah climate, characterised by two seasons of wet and dry weather (Mutasa, 2008). The rainfall season runs from October to March and the dry season stretches from April to September (Brown *et al.*, 2012). However, the onset varies temporally and spatially, with the North-western and southern parts of the country receiving early rains.

Zimbabwe is found within the South Western Indian zone. In this region, low pressure, tropical cyclones, characterised by clockwise, centre focussed circulations of moisture laden strong winds, bring torrential rainfalls to the South and Western parts of the country (Chifurira and Chikobvu, 2010:3). However, rainfall intensity and amount depends on the passage of the upper westerly waves. Rainfall in the Northern upper part of the country relies on the ITCZ movement. The Southward oscillation of the ITCZ brings heavy rains which reach peak in December and January (Dube, 2008). However, its movement is influenced by pressure patterns such as the Botswana high (Unganai and Mason, 2002).

There is a general consensus that, Zimbabwe has, of late, been characterised by erratic rainfalls and extreme events (Brown *et al*., 2012; Mudzonga, 2012; Chifurira and Chikobvu, 2010). According to Unganai and Mason (2002:1092), the country's entire rainfall seasons show a high inter-annual variability of a coefficient of 26% in the North and 36% in the South. The dry spells are also persistent. The Zimbabwe Meteorological Services (quoted in Brown *et al.* 2012:3) and Chagutah (2010:4) notes a rise in daily minimum and maximum temperatures by 2.6℃ and 2℃ respectively over the previous century (Figure 2.0).

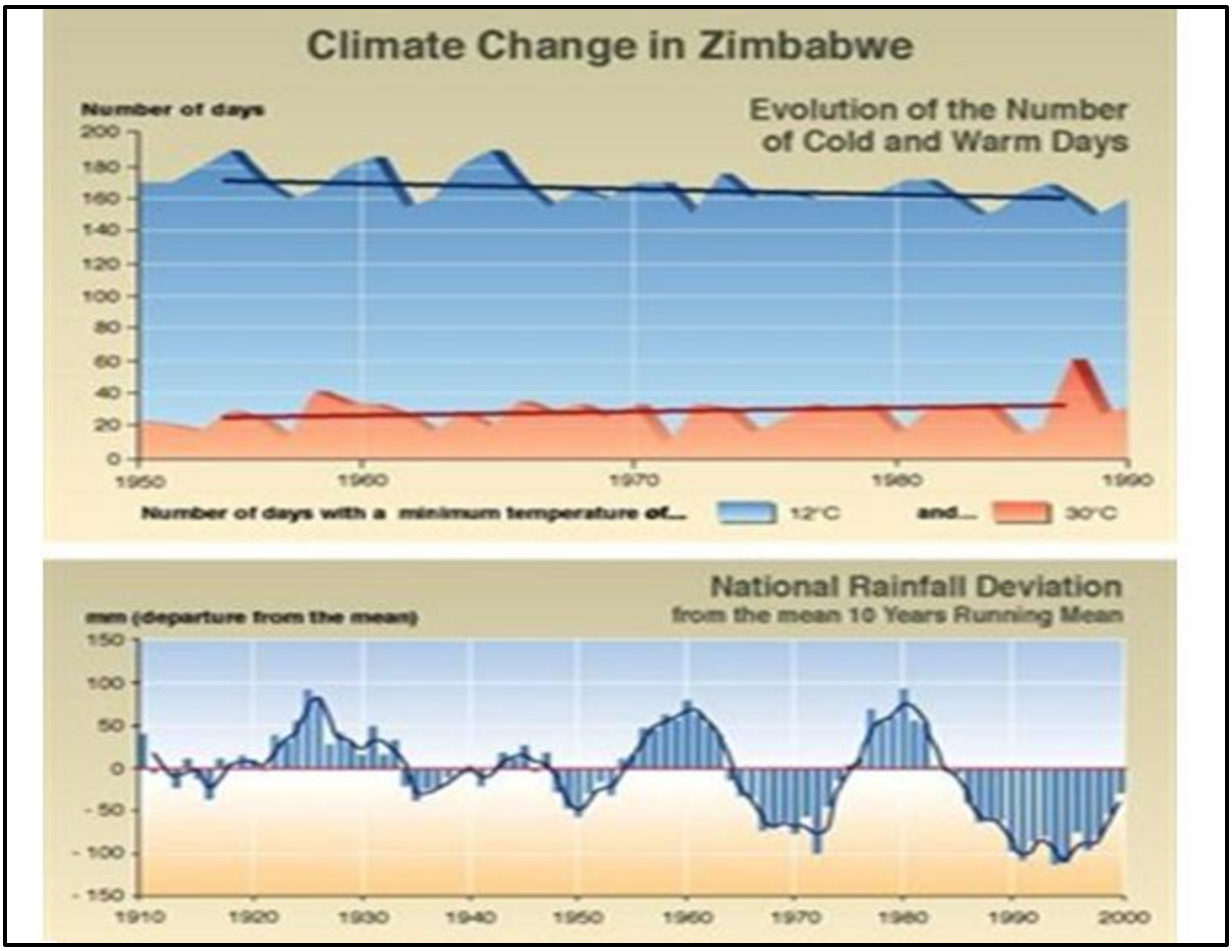


Figure 2.0: Climate variability in Zimbabwe (Source: Zimbabwe Department of Meteorological Services, 2005)

The extension of aridity has also been noticed. Rainfall characteristics have shifted across all agro-ecological zones in the country. Chinhoyi and Chibhero regions have shifted from region two to three, while the Kwekwe area has moved to agro-ecological zone four from three (Brown *et al.,* 2012). Changes in rainfall patterns directly affect food security. This adversely affects food production, availability and its accessibility.

2.4 Food security in Zimbabwe

The FAO(1986) defines food security as ensuring maximum physical and economic access to basic food. Food security is a multi-dimensional phenomenon which can be enhanced or compromised by economic, political, social and environmental factors. Food security is defined by the World Food Summit (1996) as a state when all people have access to sufficient, safe and nutritious food to maintain a healthy and active life all the time. Food Security Network (2014)

informs that food security entails a sustainable food production system which promotes economic vitality, environmental health, social equity and human health.

In the early 2000s, food insecurity was only a concern to a few poor Zimbabwean households (Manyeruke and Hamauswa 2013). Bird *et al.*(2003) support this view and argue that Zimbabwe used to export food to its fellow SADC countries and other regional countries such as Ethiopia. In recent years, food aid, acute food shortages and food imports characterise Zimbabwe's food security status. Mukarumbwa and Mushunje (2010) trace the food security declining trend to the 1990s. They attributed food insecurity to institutional, policy and climatic factors. About 60% of the Zimbabwe's population are poor communal farmers most of whom are located in semi-arid regions. Mudimu (2003:13) notes that food insecurity has two dimensions, the inability of a household to produce its own sufficient food and the inability to acquire food on the market. However there is a general consensus that food insecurity in Zimbabwe is influenced by a fall in agricultural production among other factors (Mudimu, 2003; Maiyaki, 2010; Scoones, 2013).

2.4.1 Food crop production trends in Zimbabwe

Maize, wheat and small grains such as rapoko, sorghum and millet are the major food crops in Zimbabwe (Mukarumbwa and Mushunje, 2010). However, maize is the most preferred staple food crop with 80% of the population directly involved in its production (Mudimu, 2003; Maiyaki, 2010). Food crop production in the country has been characterised by a fluctuating trend (Mudimu, 2003). Maize production levels fell to below half a million tons by 2008 (Munyanyi, 2013). In the early 2000s, agricultural production grew by less than 2% per anumm (Kalyanapu, nd: 2). Anseeuw *et al.* (2012:34) note that the 2000-2008 production tonnage fell to half a million from a 10 year average of 1.6 million tons in the previous decades. Scoones (2013) pointed out the dramatic fluctuations in maize production in Zimbabwe from 1961 to 2021, as shown in Figure 2.1.

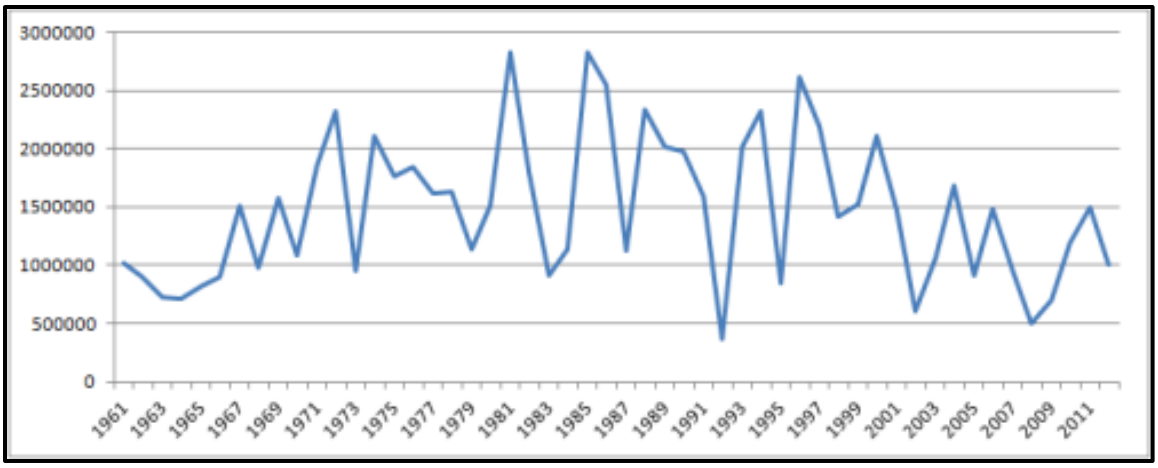


Figure 2.1: Maize production trend in Zimbabwe (Source: Scoones, 2013)

Scoones (2013) observed that rainfall patterns have, of late, been closely linked to maize production patterns. Climate variability and change has compromised maize production (FEWSNET and WFP 2014). Mugandani *et al.* (2012) corroborate this and inform on shifting Agro-ecological regions due to climate change, which has resulted in maize production viable regions shrinking and semi arid regions expanding. However, maize production trends emanate from a diaplothera of factors such as structural changes, shifts in political, social and economic environment (Anseeuw *et al*., 2012). In this, the underlying factors included promotion of agricultural production between 1980 to 1990, structural changes such as Economic Structural Adjustment Programme (ESAP) in 1991, the Fast Track Land Reform in 2000 and hyper inflation.

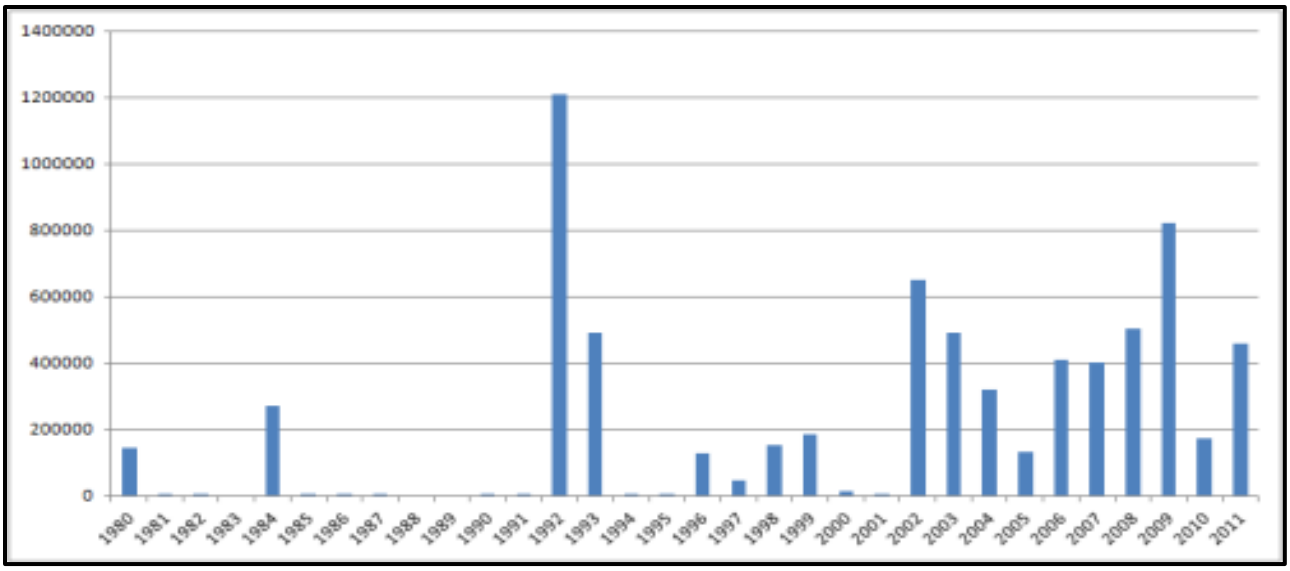


Figure 2.2: Maize imports in Zimbabwe, 1980-2011 (Source: Scoones, 2013)

National policies such as monopolisation of the Grain Marketing Board (GMB) and its later liberalisation and poor farmer payment models have hampered food crop production (Lyddon, 2013). Monopolisation of GMB meant no competition and this crippled service quality. Farmers would not get inputs on time and their returns would be minimal to sustain their agricultural activities.

HIV/AIDS has had its fair share in declining maize production trends as well. UNAIDS in (Mudimu, 2003:34) estimate that about 2.3 million Zimbabweans were HIV/AIDS positive and of this figure 2 million were the active population of 15 to 49 years under which 60% were women. Mudimu (2003: 34) added that Zimbabwe lost 9.6% of its agricultural labour force to HIV/AIDS in 2000. HIV/AIDS, being a chronic disease, does not only wipe out the labour force, but it takes agricultural productivity time in caring for the sick and has high medical bills.

Despite declining trends in maize production at a national level, small grains survived all environmental factors (Makuvaro, 2014). Sorghum and millet production trends have been generally stable (Figure2.3)

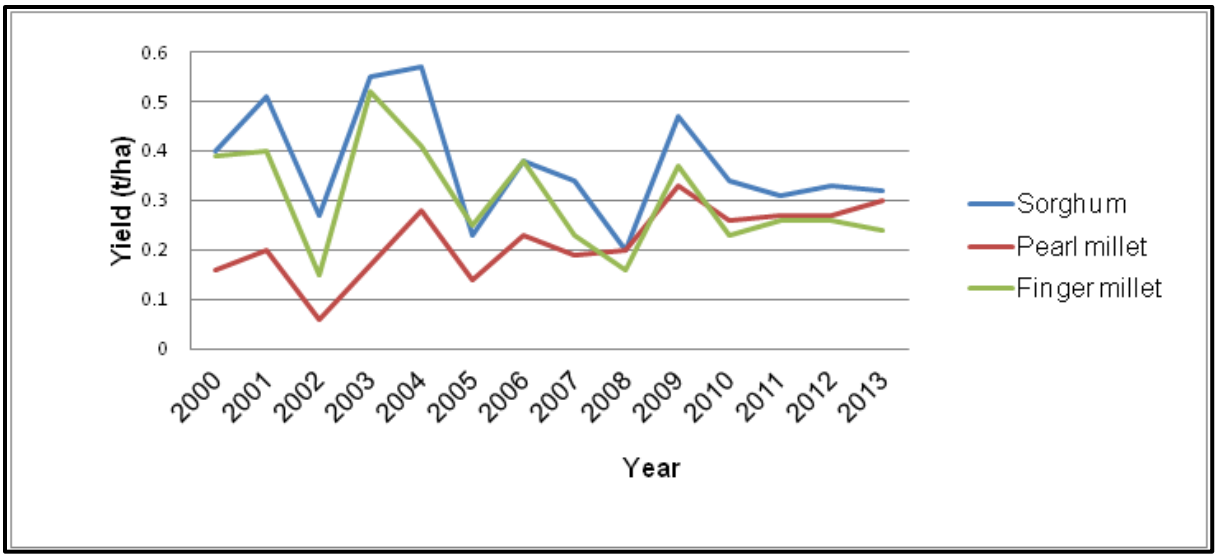


Figure 2.3: National production trends for Small Grains (Source: Zishiri, 2013)

According to Zishiri (2013), small grains are tropically adapted C4 crops, characterised by effective water use and their ability to tolerate hot environments, low water retention soils and early maturity. There is a general consensus that small grains are the closest option for semi-arid regions in Zimbabwe (Mudimu, 2003; Mukarumbwa and Mushunje, 2010; Zishiri, 2013). However, small grains remain unpopular in most areas across Zimbabwe, judging from its hectarage over the years. Small grains lack efficient post harvesting technology are labour intensive and vulnerable to Jessa and Quelea birds (Mukarumbwa and Mushunje,2010). Sukume *et al.* (2000) concur and note that small grains are not the only option but that short time maize varieties are a potential subsitute. Research and innovation on maize varieties as well as technical support on Conservation agriculture (CA) have been noted to increase maize production.

2.5 The vulnerability concept

Vulnerability has multiple definitions from various fields of study. The word vulnerability originates from the 16th Latin word “vulnerare”, which means to wound (Webster, 2015). This word is synonymous with words such as “endangered”, “exposed”, “open”, “sensitive”, “subject to” and “susceptible”. In ordinary terms, vulnerability refers to susceptibility to harm. It is the extent to which a system or individual is likely to be exposed to danger (Taylor and Butterfeld, 2011). Due to its multidisciplinary use, the term has a wide range of definitions. Research shows

two main fields in which the term vulnerability is mainly used, that is health and earth sciences (WHO, 2002; UN, 2000; UNISDR and WMO, 2012).

In health studies, vulnerability refers to the magnitude at which an individual, population or nation fails to adapt or recover from an emergency or disaster impact (WHO, 2002). The concept of vulnerability is centred on the physical and emotional well-being of human life, safeguarding its impairment and ill health for economic growth. The shocks are generally health risks and vulnerability assessments are in the form of malnutrition, reproduction, mortality and morbidity (WHO1992). Recent vulnerability assessments in relation to climate change, however, involves identifying potential health risks, examining the magnitude of the risk factors and assessing adaptive capacities (Manucci *et al.*, 2011). The concept, unlike in past research, captures the socio-economic paradigm of vulnerability. However, vulnerability levels vary with the level of development of respective communities (Cooperative for Assistance and Relief Everywhere (CARE, 2015). Despite these variations in vulnerability across the globe, vulnerable groups often entail children, women and marginalised societies (UN Women Watch, 2004; Chaguta 2010; Turnbull, 2012).

In earth sciences, vulnerability is often defined as the exposure to disasters and natural hazards (IPCC, 2001; UNSDR, 2007; UNISDR and WMO, 2012). The concept of vulnerability hinges on exposure to the hazard and assessment focus on magnitude and frequency of exposure and risk mapping (Zimmermann, 2005). The Government of Trinidad and Tobago (2013) defines vulnerability as a multi-aspect phenomenon, arising from social, physical, economic and environmental factors. In this definition the risks arise from architectural faults, poor information exchange and environmental management. It categorized the vulnerability aspects into physical, social, economic and environmental vulnerability. Under physical vulnerability aspect, vulnerability arises from overpopulation, marginalisation and poor infrastructure. Economic vulnerability is centred on economic growth and status of individuals, communities and nations, while the social aspect looks into socio-cultural systems, environmental vulnerability deals with degradation and depletion of resources.

Eakin and Luer (2006) also identified 3 facets in the multi-dimensional use of vulnerability term, namely political economy, risk and hazards, as well as ecology. In political economy the concept “vulnerability” focusses on the adverse effects of hazards on people and places at a local and regional scale. Research under this category assesses vulnerability at different socio and spatial spheres. Under risk and hazards, the concept is focuses on the magnitude of exposure to

hazard (IPCC, 1997; Vogel 1994), while in ecology vulnerability focus is on ecological systems and their response to risks.

2.5.1 Vulnerability concept in climate studies

Vulnerability forms an integral part of climate change. In the field of climate and climate change studies, the concept of vulnerability centres on the IPCC (2001; 2007; 2014) definitions (Olomos, 2001; Chaudhuri, 2003; Taylor and Butterfield, 2011). The initial and second IPCC assessment reports defined vulnerability as the magnitude to which the system is exposed to the impact of climate change. The third assessment report revealed a paradigm shift in concept from hazard or risk oriented to a social science focus (Olomos, 2001). Brooks *et al.* (2003) concede that the IPCC's initial and the Third Assessment Report (TAR) definitions are very different and inconsistent. The initial definition conceptualised vulnerability as a function of the system's sensitivity, while the TAR views it as a subset of sensitivity. Vulnerability was defined as the magnitude of exposure and sensitivity and the system's incapacity to adapt to climatic risks.

The TAR concept divides vulnerability into three components, namely sensitivity, exposure and adaptive capacity (Taylor and Butterfield, 2011). The IPCC (2001; 2007 and 2013) embraces the proneness of the geo-physical, socio-economic and ecological systems to the adverse effects of climate change. The concept defines vulnerability causative factors as hazards, susceptibility of the systems and lack of adaptive capacity. Brooks (2003) divides vulnerability into two concepts, namely social and biophysical vulnerability. In biophysical vulnerability focus is on the physical hazards and risks. Vulnerability is viewed as a precondition the system exists in before it is affected by the hazard. Thus for instance, societies in low lying areas are prone to floods even before any flood event. Social vulnerability views vulnerability as a result of weakness within the system irrespective of external hazards. In broad terms, biophysical vulnerability is a product of frequency and magnitude of a hazard while social is not.

The concept of vulnerability climate studies is multidimensional. There are several concepts of vulnerability ranging from social, economic, environmental, food security, natural hazards and climate change effects (UNEP, 2003). This has resulted in vulnerability being assessed from physical exposure, access to resources and examination of the socio-economic status. Wisner *et al.* (2004) supports the multidimensionality of vulnerability. They note that vulnerability is a composite of socio factors such as religion, ethnicity, age, gender, access and control over

resources. This is supported by Gitay *et al.* (2011) who noted that vulnerability in modern climate research takes a human related social science approach.

UNEP (2003) divides vulnerability into two concepts, namely exposure to hazards and resilience. It informs that vulnerability is a function of adverse effects rather than an agent. In this concept, communities are vulnerable to loss of livelihoods and resources and not to climatic risks. Therefore, vulnerability assessment focuses on individuals in relation to their social systems. Hence geographical locations can only acquire vulnerability classification in relation to their occupants. This results in a shift from hazard characterization to a social system evaluation paradigm.

Though vulnerability is a result of many factors, it is solely linked to adaptation (Kelly and Adger, 2000). Resilience is increased by reducing vulnerability. Ibarraran *et al.* (2008), in their assessment of vulnerability of coastal regions, support this view. They reveal that, though climate change adversely affects the planet, the impact on regions is hugely dependent on the magnitude of vulnerability of the ecosystem. Hence an upgrade of infrastructure will strengthen coping mechanisms. However, vulnerability is not uniform and consistent within communities. It varies with space and time. Downing and Patwardhan (2002) support this and note that vulnerability corresponds to the present prevailing conditions. Therefore, vulnerability is a product of a situational analysis. In this view vulnerability is a result of presently noted risks subtracting adaptation. However, if it is extended to the future, it will be a reference of current socio-economic vulnerability status. All in all, vulnerability is a multidimensional concept and it varies spatially and with time.

2.6 Drought vulnerability in Southern Africa

In Southern Africa, climate change-related droughts have become a primary concern. The frequency of drought has increased in the Sahel and Southern African regions where water is critical in agriculture and is projected to severely diminish by 2020 (Brown *et al*., 2012). These effects of climate change are exposing communities to deep poverty. Vulnerability in the context of disasters is generally defined as the susceptibility or exposure of an individual or community to the impact of the hazard (Turnbull *et al*., 2013; IPCC 2001; Bohle *et al.,* 1994). However, Bohle *et al.* (1994) alludes to aspects of vulnerability such as the internal and external vulnerability. Internal vulnerability generally refers to the individual or community's capacity to

deal with the shock at hand, while external entails exposure to risks. IPCC (2007) supports this view and defines vulnerability as the magnitude of exposure, failure to cope and character. This definition summarises vulnerability of an individual or system as the function of sensitivity and adaptive capacity. However, vulnerability is a result of many factors. According to UN Women Watch (2004), it is a function of a variety of social, economic and political factors that influence the distribution of risk across society.

Africa has become more vulnerable to drought (FAO, 2007). IPCC (2007) notes that the continent suffers various severe climate change related risks. A number of countries have been heavily affected by drought. Kandji *et al*. (2006) note that the Zimbabwean GDP fell by 11% in the 1992 drought, South Africa recorded 0,4 -1,0% in economic growth while the Zambian GDP fell by 2,8% during the same period. Droughts are not restricted to Southern Africa only. Millions of Kenyan and Sudanese pastoralists have been displaced by droughts (Yonetani, 2014). However, the link between droughts and climate change in Africa remains a grey area. Moreover, enormous climate variability and extreme events are already visible in African weather patterns (Dube, 2008; Unganai, 2009).

Vulnerability in Africa is caused by a myriad of factors such as people overcrowded in high risk areas, low adaptive capacities, poverty and more dependency on climate sensitive resources, IPCC (2007). Chagutah (2010) corroborates this view and highlights heavy reliance on rain fed agriculture as the major cause of drought vulnerability in Southern Africa. Most people in developing countries rely on subsistence farming, which makes them vulnerable in dry seasons. Madzvamuse (2010:36), using Uganda, Tanzania, Botswana and South Africa cases notes that 96% of sub-Saharan Africa rely on rainfall for agriculture and predicts a 50% fall in yields by 2050 due to climate change. With IPCC (2007) projecting a 3℃ temperature rise by 2100, Africa remains susceptible to drought risks.

Among the multiple stresses which make Africa vulnerable to climate risks such as drought, is poverty. FAO (2007) asserts that poor countries are more vulnerable to climate variability risks due to low adaptive capacities. This is in contradiction to Eriksen *et al*., (2003)'s view that there is no synonymy between poverty, social class and vulnerability, drought risks cut across the social spectrum. Murendo (2012) argues that, though drought affects mostly poor communities, the magnitude of shock varies among individuals due to their personal adaptive capacities. This

is corroborated by Madzvamuse *et al. (*2010) who notes the disproportional vulnerabilities among communities and argues that drought may exacerbate social inequalities.

However, research by Madzvamuse *et al.* (2010) and Murendo (2012) show that factors which make communities vulnerable to droughts in Africa are not restricted to geographical, economical and physical dimensions, social issues have a significant role too. Brown *et al*. (2012) argue that multiple stresses and low adaptive capacities arising from weak institutions, complex disasters and social issues expose African societies. Socio-cultural and gender issues expose many African countries to global change risks Africa Institute of South Africa (AISA, 2014). All this literature reveals that vulnerability in Africa is a reality of life, hence the need to comprehensively address all factors which expose communities to these disasters.

2.7 Drought vulnerability in Zimbabwe

In Zimbabwe, vulnerability is more pronounced in rural areas, especially in the semi-arid agro-ecological regions 4 and 5. According to Unganai (2009), these regions receive very low average annual rainfall of between 400 to 800mm. Chagutah (2010) noted a low mean annual range of between 200 to 500 mm for some of these regions. Increasing aridity in these communities has also been noted. According to Mugandani (2009), aridity is intensifying in all agro-ecological regions of Zimbabwe, with region 4 and 5 getting more drier. Besides receiving low rainfall annually, these regions are also characterised by poor loam sandy soils with low water retention capacity.

Most of the susceptible communities are within dry geographical locations, where rainfall, exhibits considerable spatial variability (Brown *et al.*, 2012). However a number of studies on Zimbabwe, for example, Chagutah (2010) and Mudzonga (2012), relate vulnerability to overdependence on rain-fed agro-pastoral farming. Brown *et al.* (2012) base their argument on economic growth levels which showed a high Gross Domestic Product (GDP) of 5.5 % between 1980 and 1990, and then a drastic fall between 2000 and 2008. They relate vulnerability to the challenges associated with the land reform programme. This view, however, does not account for marginal areas like Chivi and most communal areas, where land was not repossessed on a large scale.

Like many other developing countries, Zimbabwean communities are vulnerable to drought. Research in Gwanda, Lower Gwelo and Masvingo revealed reduced agricultural yields, loss of livestock and poverty as some of the effects of drought in Zimbabwe (Mapfungautsi and Munhande, 2013; Chagutah 2010; Nhodo *et al*., 2010). One school of thought notes that drought vulnerability in Zimbabwean communities is disproportionate to gender. Drought is seen as a significant threat to women. Dodman (2010) argues that climate change will exacerbate gender dimensions of vulnerability, which arise from inequalities and gender divisions. This view is supported by Madzvamuse (2010) who adds that 70% of women depending on small holder farming are particularly vulnerable to the knock–on effects of climate change. In the light of these views, it is imperative that focussed solutions to address the root causes of vulnerability be sought.

2.8 Gendered vulnerability to drought in Southern Africa

Extreme weather events, notably droughts, have a devastating impact on food security and livelihoods. However, one school of thought argues that climatic risks pose gendered experiences as well as responses and, in worst case scenarios, they exacerbate gender inequalities (Chagutah, 2010; Mudavanhu *et al.,* 2013). There is a general consensus that women and children are more vulnerable to drought than men. Cultural gender roles tend to give women more household duties including full time caregiving. According to Musyoki *et al.* (2012) and Turnbull (2013), women organise day to day meals for their families, making them primary users of natural resources. Hence they are mostly affected in the aftermath of any climatic disaster. Being custodians of almost all household chores, women are more household bound around than men. UN Women Watch (2004) notes that these gender roles make women barely travel far off compounds to find employment or socialise. This restrictive nature of gender roles exposes women to drought and other climatic risks.

Rural populations are more prone to drought. According to the World Bank (2010) and FAO (2007), over reliance on natural resources and poverty exposes these communities to drought risks. These are the same communities with higher percentages of females (Zimbabwe Statistics, ZIMSAT, 2012; Madzvamuse, 2010). UN Women Watch (2004) concedes this view and alludes to over-representation of women in vulnerable areas. There is a common view that climatic risks often strike traditionally female working environments (UN Women Watch, 2004 and FAO, 2007). According to Mudavanhu and Chitsika (2012), 60% of farmers in Zimbabwe

are female. Besides demographic imbalances in rural areas, gender relations also expose women to drought.

Patriarchal systems in many African countries tend to exclude women from decision-making, as well as policy making. FAO (2006) notes that gender relations have, over the years, moulded a culture and social systems that marginalise, impoverish and leave women economically insecure. The exclusion of women from decision-making, especially in development or climatic risk reduction plans, derails the whole aim and often leads to unsustainable policies and programmes. UN Women Watch (2004) notes that the exclusion of women from decision-making leads to them being portrayed as “needy victims” in many disaster experiences, overshadowing their capabilities and resilience. This gender bias is due to second part narratives from men discussing disasters through the eyes of women.

Social inequalities also make women more vulnerable to climatic risks such as drought. According to FAO (2011) and Dankelman (2010), women are more susceptible to climatic stresses because of their gender roles which prohibit them from engaging in modern jobs and activities. In Zimbabwean rural areas, women travel long distances to fetch water and firewood (Mudzonga, 2012; Madzvamuse, 2010). This does not only affect their time but has a health implication. WHO (2011) notes that this causes malnutrition and health risks. Multiple stresses such as ill health and malnutrition further expose them to drought risks.

Women, in most African rural areas, have no control over vital resources. Musyoki *et al.* (2012) note that women lack control over livestock, land and houses in countries such as Kenya, Botswana and South Africa. Chagutah (2010) supports this view when he also points out that Zimbabwean women also lack control over essential assets. Women, in most cases, own small crops such as vegetables and small income generating livestock such as goats and chickens, which cannot boost them during drought seasons. Despite a consensus that women are hugely affected by drought, males are not spared either (Turnbull *et al*., 2013). This draws research back to (Erickssen and Naess, 2003)'s view that drought vulnerability cuts across the social fabric and is divided or shaped by age, ethnicity, physical ability and gender. Hence, the socially excluded and economically insecure are worst affected.

2.9 Vulnerability assessment methods

Vulnerability in Climate studies is unanimously defined as a measure of a system or individual's susceptibility to climate risks (Brooks *et al.,* 2005; Vincent, 2007; Eakin and Bjorquez, 2008). Despite this consensus, quantification of vulnerability remains difficult (O Brien *et al*., 2004). It is practically impossible to scientifically identify which systems are most susceptible and why without some criteria by which standards are set. Moreover defining criteria for vulnerability quantification has demonstrated that it is difficult partly because it is not a discernable phenomenon.

The acceptability of vulnerability assessment tools to accurately capture the significance and relative nature of vulnerability in particular spaces is challenging (Brooks *et al*., 2005). At household level, generation of indices to quantify vulnerability poses several challenges. Data from these surveys can cover important local unevenness and sensitivity in assets and powers and thus often unsatisfactorily distinguishes households in terms of vulnerability (Vincent, 2007). Eriksen and Kelly (2006) equates vulnerability to bliss; it is an anthropological state or situation that cannot be measured directly in an impartial manner. Chaudhuri (2003) supports this view, and informs that vulnerability is an ex-ante measure of well-being, reflecting not so much how well off the household currently is but what its future prospects are. He alienates it from poverty which is stochastic in nature and measures ex-post household welfare. Hence the need to consider assessment of factors contributing to capricious levels of vulnerability.

Spectrum of assessment methods have been used to illustrate vulnerability among humans and the environment. Hahn *et al.* (2009) noted that various methods have been employed by different organisations. World Food Programme (WFP) and World Health Organization (WHO) have attempted to integrate multidimensional factors such as health status and poverty as indicators for vulnerability assessment. Poverty and health status, whilst they can satisfy a timely survey for a specific objective, are rather too narrow to be streamed into an index for policy formulation purposes. Adger (2006) corroborates that many formulations lack robust and credible measures to encapsulate the diverse nature of vulnerability. Luer *et al.* (2003) argue that vulnerability assessments should divert from attempting to measure vulnerability of a place and concentrate on selected variables of concern and on relevant dimensions.

Hahn *et al*. (2009) note that traditional vulnerability methods include the Development Index, which incorporates life expectancy, health, education and standard of living. The Gap method is another example. The method quantitatively assesses deviation from the global standards. An example would be using this tool to measure water distribution and deviation from the conventional water supply. The other related method is the Participatory Rural Appraisal (PRA). The tool qualitatively gathers data on food security and social characteristics of populations but needs to be augmented with a quantification tool for clear elaborations on vulnerability.

It is within these parameters that modern assessments, such as climate vulnerability assessment, seek to both assess the socio-economic status of people and to quantify communities' adaptation to global changes. However, assessments of vulnerability to climate change vary. Fussel and Klein (2006) categorised them into first and second generation. The focuses on climate impact evaluation comparative to baseline data, while the second integrates adaptive aptitude. Fusel and Klein (2006) also concluded that most methods rely on rather erudite climate projections and databases. These might be difficult for grass root level planners to employ or for households to comprehend.

Due to the realisation of the huge impact of climate change on community livelihoods, assessment methods now focus more on the socio-economic systems to indirectly infer the exposure magnitudes (Adger *et al*., 2009). These are called social vulnerability assessments and are aimed at differentiating vulnerability levels in populations (Eakin and Bojorquez, 2008). The methods employ indices to quantify vulnerability and to deviate from previous methods which are rather qualitative. The Social Vulnerability Index (So VI), developed by Cutter, Boruff and Shirey (2003) is one of these methods. The tool uses a package of indicators to infer social

vulnerability within localities (Madhuri and Bhowmick, 2014). It recognises that variations within households which incapacitate climate risks ranges from physical, natural, social, human and financial assets and uses these factors as indicators of vulnerability.

According to Hahn *et al.* (2009), one such method is the Livelihood Vulnerability Index (LVI). It is derived from the Sustainable livelihood approach and uses five household assets to measure vulnerability. The assets include physical, social, human, financial and natural assets. Though this approach has been effective in assessing vulnerability at household level, it does not integrate climate exposures (Adger *et al*., 2009).

The LVI assessments use indices derived compounding indicators weight, which falsely assumes that all assets are equally crucial in withstanding shocks (Eakin and Bojorquez, 2008). This method either accepts uncertainty associated with equal weighting or assigns personal weights to indicators using a scientific method. This leaves inadequacies and research to subjectivity. They also propose a method which seeks to avert subjectivity in assigning weights - the fuzzy logic. The method creates defined levels to assess household vulnerability. However, spatial and temporal inconsistence of the indicators makes the method ideal at a specific time and society (Brook, 2005; Eakin and Luers, 2006).

The more recent method is the Food Agriculture Network Research Policy Analysis (FANRPAN, 2005) Household Vulnerability Index. The method was formulated to cater for a multiplicity of external vulnerabilities associated with global change so as to safeguard rural households, especially in Africa (FANRPAN, 2011). It categorises households through examining external and internal vulnerability. The method has an index which classifies households into coping, acute and emergency levels. It adopts the Sustainable livelihoods five indicators and employs the fuzzy logic for analysis. Unlike the previous method, weighting of indicators can be standard based on or community formulated. Variables can be expanded to specific dimensions to closely capture vulnerability of a specific household. Most importantly, the (HVI) measures vulnerability and adaptation simultaneously.

2.10 The concept of adaptation to climate change

The Third Assessment Report (TAR) by IPCC (2001) defines adaptation as adjustments in natural and human systems in response to the potential or expected climatic risk. This refers to

all the efforts which moderate harm, either anticipatory or reactive. Adaptation to climate change involves all efforts to reduce the impact of climate change on human well-being through improving social economic activities (Olmos, 2001). Adaptation is a process which consists of entities and systems and requires resources (Eisenach and Stecker, 2012). The World Bank (2011) adds that adaptation is not a once off action, but an on-going cyclic and dynamic process which needs constant reviewing. This is corroborated by Leichenko and O'Brien (2002), who noted that adaptation processes involve agency and institutions interdependence. However, the proclivity of systems to adapt is influenced by systems inherent determinants such as vulnerability, sensitivity, adaptive capacity, susceptibility and resilience (Olmos, 2001). According to Adger (2009), adaptation can be an individual or societal effort. The whole process involves actors, intention, stimuli and exposure unit (Eisenack and Stecker, 2012). In this concept, stimulus is the climatic risk either in meteorological or statistical parameters and adaptation only becomes an option when stimulus affects the exposure unit.

Eisenack and Stecker (2012) identified four types of adaptation. The first one is where the receptor is also an exposure unit and activities are geared up to improve the system affected. The second one is rather indirect, that is the receptor and exposure unit are different and action enables the receptor to cope. The third type involves operators facilitating adaptation of actor. Subsequently, reflexive adaptation occurs when the operator acts for his/her benefit. However, in this concept, indirect and facilitating adaptation overlaps.

The IPCC, Third Assessment Report (TAR) divided adaptation into anticipatory, autonomous, planned, private, public and reactive categories. In anticipatory adaptation, measures are proactive to curb climate change impact, while autonomous adaptation is a rather spontaneous action. Private adaptation is when an individual enhances coping, while the public is, at a community level, externally or internally formulated. Reactive is when adaptation measures are taken in response to a threat. Gaudioso (2010) using the IPCC (2001) attributes and concepts of adaptation, categorised adaptation into autonomous, which is planned action, and anticipatory, which is more of preventive measure. Gaudioso (2010) incorporated temporal and spatial scopes to form the short or long term adaptation and localised or widespread adaptation categories. Retreat, which is a preventive adaptive action, structural and effective adaptation were drawn from functional effects, form and performance valuation concept.

However, in a broader way, adaptation can be categorised into national policy initiatives and community based adaptation (Spearman and McGray, 2011). While adaptation to climate

change and variability is key in policy development and vice versa, community based adaptation has gained popularity (UN Women Watch, 2004; Chaguta, 2010; Mudzonga, 2012; Mapfungautsi *et al*., 2013). Adger (2003) notes that societies have the potential to cope with climatic risks. However, these capabilities are embedded in their ability to act collectively. He informs that formal decisions can be made by governments, civil societies, communities or individuals, but all prevail on one set of interests over another, thus create winning and losing adaptation strategies. He also noted that there is need to review limitations to adaptation.

2.11 Challenges in adaptation to climate change

A discourse on limitations to climate change adaptation has recently emerged. (Adger et al., (2009) argue that the related barriers are a set of absolute thresholds in natural, economic and technological parameters. According to Chameleon Research Group (2012), some barriers are generic and some process model based. The group subcategorised these challenges into missing operator, in which there is no adaptation due to total ignorance. Missing means, which implies budgets constraints or institutional capacity and unemployed means, refer to misaligned economic incentives and complex actor relations. This is where the institutional system is too complex for effective decision-making. Adger *et al.* (2009) who focused on communities, noted that issues of values and ethics, as well as culture construct a society and hence influence adaptation. However, such barriers can be averted.

Institutional capacities affect adaptation in most developing countries. Most African countries lack a coherent climate change adaptation policy framework (Chagutah, 2010). Madzvamuse (2010) notes that Zimbabwe and Nigeria lack effective adaptation policies and adaptation tends to be addressed by a surfeit of disjointed environmental and developmental policies. Where the National Adaptation Plans (NAPAs) and National Climate Change Response Strategies (NCCR) are, they are narrowly engaged on biophysical vulnerabilities, follow sectorial and project approaches to adaptation, hence fail to assimilate responses, as well as account for micro-level adaptation requirements. In most of these cases, women, the poor and rural societies bear the brunt. He emphasised the need to actively involve different players and responses at different levels for effective adaptation strategies. Adequate knowledge, access to information, stakeholders' involvement in decision making and gender mainstreaming are crucial in shaping pertinent and responsive interventions, (Madzvamuse, 2010). Wamukonya (2001) supports this view. Studies in Zimbabwe, Botswana, Kenya, South Africa, Uganda and Tanzania revealed that gender is not mainstreamed into adaptation responses. Property rights tend to marginalise

women and women constitute a higher percentage of lower literacy levels. Thus, there is need to familiarise with gender barriers to climate change adaptation for countries to develop gender sensitive responses.

2.12 Adaptation to climatic risks in Africa

Adaptation is defined as the adjustments by the human and natural system in response to actual or expected climatic stimuli or other effects which moderate harm so as to take advantage of opportunities (IPCC, 2001). It refers to the capacity to adopt a coping strategy so as to minimise the effects of climate change (Mabe *et al*., 2012). According to the IPCC (2001), African countries are more prone to the effects of climate change due to low adaptive capacities. Vulnerability and coping to climatic risks are more a matter of equity and the impacts disproportionately affect those least able to bear them (Habtezion, 2012). IPCC (2007) informs that poor, marginalised communities, especially those occupying high risk areas, have low adaptive capacities and tend to rely on sensitive resources.

Globally, women are considered to be less adaptive to the adverse effects of climate change (IPCC, 2007; UN Women Watch, 2004). United Nations Development Programme, UNDP (2010) revealed that traditional cultural norms often affect women's ability to adapt to climate change. For instance, women in Niger, are not allowed to move outside their villages. Mubaya *et al.* (2010) reveals that men cope better than women as they have a better chance to take up a variety of jobs and purchase more livestock.

However, Habtezion (2012) arguess that, despite women being considered more exposed to climatic risks, they are more prepared for behavioural change and most likely to support climate change adaptive policies. This is corroborated by (UNDP, 2010) which noted that despite gendered vulnerabilities, women are not simply victims to climate change. Their wisdom in resources management furnishes them with exclusive skills that are prized for the design of community based adaptive solutions. Heifer International (2010) noted increased adaptation to drought and floods by empowering women in Mumbwa, Zambia, while (Ribeiro, 2002) pointed out to the resilience and resources knowledge of women in Gaza Province, Mozambique when they were empowered to make decisions. Resources Report (2011) observed that coping initiatives that are not gender sensitive face the risk of inadvertently duplicating gender disparity. Hence, there is need for gender sensitive adaptation practices.

While climatic risks, such as drought, continue to threaten livelihoods and undermine community resilience, households have contrived coping mechanisms to survive with these adversities (Mudavanhu and Chitsika, 2013). Coping strategies used by communities in Zimbabwe, range from food aid, relief, barter trade, food for work, drought resistant crops, water harvesting, irrigation, cross border trade and livestock selling. At household level, coping strategies are based on skills and available resources. Munhande *et al.* (2013) corroborates, that adaptation strategies are often differentiated by wealth or class. The poor and middle class, for example, resort to conservation farming while the rich diversify their livestock.

Mabe *et al.* (2012), inferring adaptation to climate change among rice farmers in Northern Ghana noted that a farmers' adoption of technology is dependent on crop type being cultivated. They also found out that farmers are highly adaptive to the use of chemical and organic fertilizers, moderate on drought tolerant rice varieties use, mixed cropping, construction of fire belts and low on crop rotation and tree integration strategies. Mudzonga (2012), investigating influential factors to farmers' choices of coping methods in Ward 23, Chivi District, noted that household characteristics, institutional factors such as experience, level of education, household size, access to climate change information and access to credit facilities determine adaptation methods.

2.13 Adaptation to drought in Zimbabwe

The continuous scourge of drought in Africa makes coordinated actions, careful planning and a holistic approach critical for effective disaster risk reduction. There is a view that disasters with a slow on set, like drought, are manageable as people can prepare for them and are able to address the root causes. Turnbull *et al.* (2013:2) states that:

> It is now widely accepted that disasters are not unavoidable interruptions to development, to be dealt with solely through rapid delivery emergency relief, but are a result of unmanaged risks within the development process itself. They occur when a hazard occurs where people are exposed and vulnerable…Conversely, disaster risk can be significantly reduced through strategies that seek to decrease vulnerability.

This precipitates the need for proper adaptation measures to climatic disasters. The drought scourge is manageable if holistic and effective strategies are drawn. African communities have

seen a large number of strategies being explored to cope with drought. These range from the top-down governmental interventions, externally idealised participatory NGOs initiatives to the most recent Community Based Adaptation (CBA) (Mudzonga, 2012; Nhodo *et al*., 2010; Musyoki *et al*., 2012). If the conflict over the top down approaches in Chivi noted by Nhodo *et al.* (2010) and the shunning of externally conceived conservation approaches by Shangani people in Chiredzi, in Zimbabwe is anything to go by, the community-based approach is the most popular approach. Musyoki *et al.* (2012) support this view because of the success of the bottom up approach in the drought case of the Sakai region of Kenya.

However, this approach has been criticised by some scholars. Action Aid International (2005) points to the limitation of the community-based approach. They argue that these projects are located at a very low level to contribute significantly on substantive issues and even understand the role of governments, thus often lack proper distribution of resources. Mahan (2002) concedes that, though community-based adaptation strategies empower communities, they do not address structural inequalities. Therefore, a more stakeholder inclusive approach remains critical in adaptation strategies.

2.14 Coping strategies at community level in Zimbabwe

The Zimbabwe Vulnerability Assessment Committee (ZIMVAC, 2009) noted that rural Zimbabwean communities reduced consumption and rationed meals to cope with food insecurity. Jerrie and Matanga (2011) found out that households in Mberengwa engage in destocking either through slaughtering or livestock sales. While Nhemachena and Hassan, (2007); Mapfungautsi and Mutekwa (2009) and Murendo *et al.* (2012) argue that conservation farming and crop change as major adaptation strategies in semi-arid Zimbabwean rural areas, in some rural areas these are less practised. In Bikita, farmers employ crop diversification and livelihoods activities diversification (Gukurume, 2013). This involves co-operatives (mushandira pamwe), conservation farming (dhiga udye) and selling of assets. Gukurume (2013) argues that the latter is very unsustainable considering that the source of risk is climate variability, hence it is a short lived event with a potential of recurring.

In Chikomba District, of Zimbabwe, coping strategies include fruit gathering, food rationing, marrying off daughters, staggering crops and communal granary (zunde ramambo), as well as humanitarian aid (Mutasa, 2011). Mutasa (2011), however, noted that some strategies, such as

mukwerera and zunde ramambo, were less practised due to cultural erosion. This is corroborated by Progressio Zimbabwe (2009) which noted, that in Uzumba Maramba Pfungwe (UMP), very few communities practised rain making rituals and communal granary as compared to neighbouring areas such as Murehwa. It also found out that farmers practising conservation farming yielded better in dry seasons. However conservation farming lacked popularity due to its labour intensive nature, use of holes which are a hazard to livestock and the fact that it does not incorporate legumes which have high water use efficiency and women's crops.

The study also revealed that the conventionally poor households trade their labour during drought for seeds and draught power and as a result plant late, making them perpetual victims to this vicious cycle. In Chiredzi, 31% of the farmers practice mixed crop production, while 69% practise mono cropping of either one or two crops (Unganai, 2012). Chagutah (2010) informs that while communities have developed many varied ways of coping with climatic risks such as perennial droughts, very few studies have systematically recorded these coping strategies and data are only available for isolated cases.

There is need to mould adaptation strategies at both macro and micro level (Mapfumo et al., 2013). Their study recommended convenient and timely access to affordable inputs, traditional social safety nets to safe guard exposed social groups, providing prospects for co-learning and access to climate information and knowledge access. The study also identified the use of suitable production technologies, improvement of poor soils, environmental safety, consolidation or developing local market channels, as well as access to external output markets and involvement of communities in outlining their vulnerability as crucial for effective adaptations.

2.15 Gender mainstreaming in adaptation strategies

The latest emerging facts from research show that women are the hardest hit by climatic disasters. Ngigi (2009) and Joseph-Brown *et al*. (2012) argue that gender balancing is a tool for effective disaster risk reduction. Elaine (2000), looking at the cases of Hurricane Mitch in Honduras, conflicts in Guatemala and floods in Mozambique, concedes that gender imbalances accentuate disaster risks. This view is also supported by Women 2000 and Beyond (2004:6) who state that:

> Dominant views of disaster remain framed by gender biased perspectives which distort experiences, seeing disaster through the eyes of women, challenges the notion of people in hazardous environment as disaster victims and girls and women as "special population in special need of emergency relief.

This school of thought perceives that the special treatment of females exacerbates women subordination. Joseph-Brown *et al*. (2012) supports this and argues that, climatic risk reduction needs gender representation for clear understanding of how respective roles are affected. These views augment international frameworks such as the Hyogo Framework of Action (2005), which calls for the inclusion of gender and cultural diversity in disaster management.

In Zimbabwe, the lack of a gender dimension in environmental policy frameworks (Chagutah, 2010) hinders proper disaster management. Various gender imbalance issues indirectly surfaced in a number of research studies carried out in Chivi District. Mudavanhu *et al*. (2013) using a qualitative approach, note that, despite various coping mechanisms by farmers in Chivi, poverty is increasing and the food crisis is deepening. Mudzonga (2012) looking from an economic point of view, employed the logit model to infer efficiency of farming technologies. She found that there is a wide gap between the rate of climate change and farmers' adaptation. She attributed the draw backs to the level of education, access to resources and recommended better institutional mechanisms to help farmers.

Mapfungautsi *et al.* (2013) used a risk chain analysis, and found out that there is a higher frequency of 40% to food insecurity in male-headed households as compared to 29% in female-headed households. This was attributed to the high participation of women in disaster risk reduction projects such as food for work. However, Mudavanhu *et al*. (2013) note that this same project resulted in the withdrawal of children from school to help their mothers and often adults and the elderly were left out. Despite these contradictions, all these studies indirectly show that inadequate gender dimension influences the community's coping measures. It is this gap that the study seeks to fill through a gender analysis of the vulnerability and adaptation of the community as a whole.

2.16 Chapter summary

Various perspectives have been discussed in this chapter. There is a general consensus that climate variability and change are altering global weather patterns and, subsequently, climatic risks such as drought are on the rise. Vulnerability to drought is viewed as more common in developing countries. However, vulnerability is not spatially uniform and neither is adaptation.

Gender variations have also been noted by researchers. It is against this background that recent research supported by International frameworks such as Hyogo, advocate for gender mainstreaming in adaptation plans. This will reduce vulnerability, as well as build sustainable communities.

CHAPTER 3: RESEARCH METHODOLOGY

3.0 Introduction

Research methodology refers to the scientific and systematic way of solving a research problem. According to Dawson (2002), methodology showcases the logical steps taken by the researcher in a study. This chapter presents methods, techniques and procedures used in data acquisition and analysis. The objectives, research questions, data collection and analysis techniques are presented and summarised in Table 3.1. Different techniques were used to infer gender vulnerability and adaptation in Chivi District.

3.1 Research design

This research takes a mixed methods design, using the case of Chivi South community in Masvingo Province of Zimbabwe. The study used quantitative and qualitative approaches in a complimentary or triangulation way to yield an in-depth analysis of a complex human and environment interaction. The mixed methods approach sought to ensure maximum data capturing. This might not be the case when a single method is used (Kumar, 2005). Lawson and Staeheli (1990) define triangulation as the use of more than one design to validate and confirm the findings of the study. Therefore, both methods were used to infer reliability of data, add value to theoretical debate and to overcome bias inherent in single method designs.

The researcher used various data sources. Rainfall data for Chivi District was crucial in this research to determine, the nature and characteristics of drought affecting the District. The East Anglia Climate Research Unit (CRU) database was used to get satellite rainfall data. The satellite point data were preferred over the aerial meteorological observations records to avoid incomplete data. Chivi District is served by very distant, sparse meteorological stations based at Rupike, Buffalo Range and Masvingo airport which are approximately 65km, 150km and 70km away, respectively. The study area is located 20^0 30'0 South and 30^0 34'60''E. However, rainfall data were taken from the grid point 19 .5^0 to 21^0 5' S and 29^0 5' and $31^0$5' E to extensively cover the area. Zimbabwean meteorological records were, however, used to get the district and national mean climate.

The study needed data on drought vulnerability and coping mechanisms from households, community leaders, NGOs and District Agricultural Extension officers. Authority to carry out the study, in Chivi, was sought and granted by the District Administrator for Chivi District. This permission enabled the researcher to gather relevant data across the District. Table 3.1 shows a summary of research objectives, questions, data collection methods and analysis.

Table 3.0: Research matrix

Research Objective	Data collection Methods	Data Analysis	Target group	Assumptions
- to establish the spatial-structural characteristics and extent of drought occurrence in Chivi since 1983	-The East Anglia Climate Research Unit (CRU) rainfall database review -Zimbabwe Meteorological Services records review	- SPI -IRI SPI -time series analysis	- University of East Anglia (Climate Research Unit) precipitation database	-drought is frequent, wide spread and recurrent in Chivi District
- to assess changes in food crop production in Chivi District over the past 30 years	-Key informant interviews -Focus group discussions	-Microsoft Excel - time series analysis capabilities	Agriculture, Research and Extension officers, Community leaders, non-governmental officials and the local community	Food crop production in Chivi has decreased over the years
- to evaluate gendered levels of vulnerability to drought in Chivi	-HVI questionnaires -focus group discussions -key informant interviews	-HVI - SPSS , IBM Version 22.0- for capabilities such as cross tabulation, chi-square tests and regression	-households -community leaders -NGOs	- women are more vulnerable to drought
-to analyse gendered adaptation to drought in Chivi	-HVI questionnaire -focus group discussions -key informant interviews	-HVI -SPSS ,IBM Version 22.0	-households -community leaders and NGOs	- the female gender struggle to adapt to drought

3.2 Methods of data collection

The purpose of data collection is to acquire adequate information for record-keeping, decision-making and to develop an information pool (Leedy and Ormrod, 2010). This research adopted Waddick's (2015) three phases in building a sound data collection, namely pre-data collection, during data collection and post data collection phases. The initial phase was a desktop data collection planning process. It included defining goals and objectives of data collection, sourcing relevant rainfall data and delimiting the essential food crops. The phase also involved drawing up of sample sizes, putting in place data collection tools and drawing up checklists. This was followed by applying for research clearance, drawing a data collection work plan and making appointments.

The second phase started with downloading rainfall figures for Zimbabwe, getting research authorisation from the Chivi District Administrator, as well as from the paramount chiefs. AGRITEX was visited for food crop production figures. A pre-test of the household questionnaire was run among five households and the questionnaire was cleaned for the actual survey. A household questionnaire was administered with the help of three research assistants to 100 households, as well as key interviews and focus group discussions. The post data collection phase involved data cleaning and ensuring completeness, accuracy and reliability of data collected. The research used both primary and secondary data sources. For secondary data, official documents were reviewed while key informant interviews, household questionnaires and focus group discussions were used to collect primary data.

3.2.1 Secondary data

The East Anglia Climate Research Unit rainfall database for Chivi District was examined to determine the nature and characteristics of drought in the study area. This also helped the researcher establish drought vulnerability in Chivi over a 30 year period. NGOs such as Cooperative for Assistance and Relief Everywhere (CARE), Word Vision and Catholic Development Commission's (CADEC) policies, project plans and reports were also studied and used to get an insight into the extent of droughts and the responses. The researcher also examined community roles in developmental project plans, as well as gender mainstreaming. To get the extent of drought risk in the district, the researcher assessed food crop production,

using government records from the Agriculture, Research and Extension (AGRITEX) department.

3.2.2 Primary Data

3.2.2.1 Key informant interviews

Community heads, NGOs such as CARE, CADEC, and AGRITEX were interviewed using face to face unstructured interviews (Table 3.1). This helped the researcher establish food crop production trends and the levels of vulnerability in Chivi South, as well as coping mechanisms. The interviews also established the level of community involvement and gender mainstreaming. These interviews gave insight into drought effects in Chivi.

3.2.2.2 Household questionnaires

The Household Vulnerability Index (HVI) questionnaires adapted from the FARNPAN (2005) were self-administered to the respondents. The questionnaire adopted Sustainable Livelihoods' five indicators of vulnerability, namely human, social, physical, financial and natural assets for in depth inference of household issues. The questionnaire was subdivided into six sections (Appendix 4). The first section dealt with household head personal information. The other five sections assessed the status of each household. To bring out the gender based vulnerability and adaptation, the questionnaire targeted 50 female and 50 male headed households. Profile aspects of the Overholt (1985) gender analysis conceptual framework such as gender roles, decision-making and access and control to resources were infused into the questionnaire, focus group discussions and key informant interviews to ensure a thorough gender analysis in the study. These aspects also helped to establish the gender dimensions in Chivi and how they influence the community's coping mechanisms.

3.2.2.3 Focus group discussions

The researcher conducted focus group discussions in ward 25, 31 and 32. Three wards were randomly chosen from the five wards under study. Pre-arrangements were made with the Ward leaders to set up the groups. However, the participants were conveniently selected depending on their availability. In Ward 25 the group consisted of four males and six female vendors at

Ngundu business centre. The discussions were held to determine the magnitude of drought shock, community vulnerability over the years, the role of community in developmental projects, access to services like water supply, transport network, access and control over resources, as well as establishing their drought coping mechanisms. These discussions were done with the help of research assistants to enable maximum data capture. The research matrix summarises the research data collection methods which the researcher used. In Ward 31, the group consisted of the chief, seven chief advisors and seven village heads. The Ward 32 group consisted of an AGRITEX officer, two youth Ward leaders, seven men and ten women. In Ward 31, the group consisted of the chief, seven chief advisors and seven village heads.

3.3 Sampling methods, sizes and unit of analysis

Sampling refers to the process of selecting a subset of units to be observed from a population, in order to form the basis for estimating a fact, situation or outcome of a bigger group (McClendon, 2004). Selection of proper sampling techniques is crucial so as to limit bias and to ensure representation of the whole population group. In this study, different sampling methods were used to produce a sampling unit for the household survey and focus group discussion. Key informants were not sampled as these are readily available relevant people.

3.3.1 Sampling Frame

Chivi South was targeted for its representation of the most remote areas of the District as well as semi-urban areas along transport network nodes. Household heads, chiefs of the community, agricultural officers, NGO officers and community members formed the sampling frame for the Household questionnaire and focus group discussions respectively (Table 3.1). Household questionnaires were distributed in five Wards, namely 22, 24, 25 31 and 32. Villages in each Ward and their respective household populations as given by the village heads were listed. One village per Ward was selected randomly. Five villages namely Berejena in Ward 32, Gomana in Ward 31, Ngundu in Ward 25, Magomo in Ward 24 and Gwezuva in Ward 22 were selected. Households were divided into two strata of female and male headed for each village. The household sample size per village was selected using the systematic sampling method. In this one in every five households was chosen in both stratus per village. Proportionally, 50% of the total households per village, were sampled systematically.

The sample sizes for the households were obtained as follows:

Berejena= $\frac{Total\ number\ of\ households}{100}$ ×50

Thus 210/100×50 =105 households

A systematic sampling of 1 in every 5 households came up with 21 households

Ngundu= $\frac{Total\ number\ of\ households}{100}$ ×50

Thus 650/100×50 = 325 households

A systematic sampling of 1 in every 5 households came up with 65 households

Gwezuva= $\frac{Total\ number\ of\ households}{100}$ ×50

Thus 60/100×50 =30 households

A systematic sampling of 1 in every 5 households came up with 6 households

Magomo= $\frac{Total\ number\ of\ households}{100}$ ×50

Thus 56/100×50 =28 households

A systematic sampling of 1 in every 5 households came up with 5 households

Gomana = $\frac{Total\ number\ of\ households}{100}$ ×50

Thus 36/100×50 =18 households

A systematic sampling of 1 in every 5 households came up with 3 households

Table 3.1: Sample frame

	Ward 32	Ward 31	Ward 25	Ward 24	Ward 22	Total
Sampled villages	Berejena	Gomana	Ngundu Halt	Magomo	Gwezuva	5
Household questionnaire Sample size	21	3	65	5	6	100
Focus group: discussion participants sample size	20	15	10	0	0	45

3.3.2 Sampling method

The research adopted a multistage cluster sampling method, for the household survey. Purposive sampling was used to select the Chivi South community from the whole Chivi District. This area was selected for its pronounced vulnerability to climate change risks (Mudzonga 2012, Chagutah 2010). The area also has a mixture of remoteness and under development, as well as modified semi-urban characteristics in areas along the transport network nodes such as Ngundu. Five wards were chosen using purposive and systematic random sampling, to ensure wider involvement of subjects, as well as ensuring feasibility of the study and an in-depth research.

Villages contained in the chosen five wards were systematically sampled to come up with manageable but representative five villages. This ensured time management and in-depth data collection. Households per village were selected using systematic sampling. A list of households per each village, attained from the village heads, was drawn under two strata, namely female and male headed households. The researcher then picked one in every fifth household, alternating both male headed and the last female headed household for every village. This was done to include both female and male-headed households in the study and to ensure a balanced gender analysis. One hundred household heads participated. The survey only

targeted present household heads. Child headed household heads were also allowed to take part in the study and were categorised by gender.

For focus group discussions, the researcher used purposive sampling to select participating community members. The three wards, two with the largest number of villages and one with the least participated in this research. This ensured that more people from the community participated thus increasing objectivity in the subject matter discussions. Both gender variables, and youth were involved in these discussions to get balanced data on gender issues

3.3.4 Ethical considerations

Throughout the study, the researcher conformed to ethical issues such as seeking permission from the District administrator, District Agriculture Extension officer, NGOs Program directors, Chiefs and village heads before starting the research. Participants volunteered to take part in the study. No force or trickery of any kind was used. Their consent was sought before participation, (see consent form in annexure). Information provided by participants was treated with confidentiality and names of household heads were not taken.

3.3.5 Theoretical framework

The study adopted the FANRPAN HVI theoretical framework to guide its methodology and analysis (Figure 3.1). The concept behind the theory is that vulnerability is a result of external shocks and internal resilience. Shocks, in this case drought, are not uniformly felt across households or individuals. Each household's vulnerability is a product of its compounded strength especially with regard to financial, physical, social, human and natural assets. The framework classifies a household by assessing its external and internal exposure to the risk. Hence, a Coping Level Household (CLH) denotes an adapting household, an Acute Level Household (ALH) a struggling household and Emergency Level Household (ELH) shows a hard hit household which cannot cope on its own.

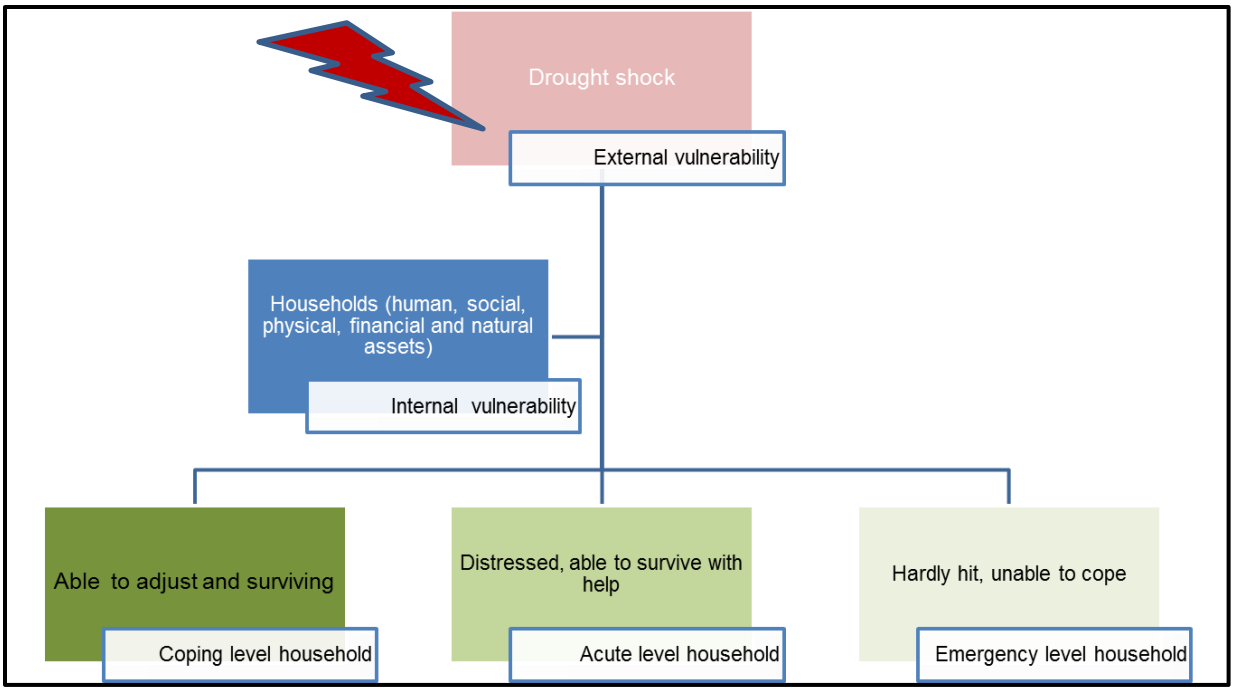


Figure 3.0: Household Vulnerability Index Theoretical framework (Source: adapted from Kureya, 2013)

The HVI theoretical framework facilitates vulnerability mapping, especially in areas of limited resources. It is a very powerful framework which, if adopted, could define the real needs of different households.

3.4 Data presentation and analysis

A number of techniques and software programmes were used to present and analyse data. These included Standardized Precipitation Index (SPI). Its capability to depict moisture deficit was used to assess drought occurrence in Chivi. International Research Institute Standardized Precipitation Index (IRI-SPI) software was also used to map drought intensity and spatial extent. Microsoft Excel was used to analyse and present food crop production figures. To analyse gender vulnerability and adaptation, a Household Vulnerability Index (HVI) was used. Statistical Software Package for Social Sciences (SPSS) and Excel's capabilities such as cross tabulation and time series analysis were also employed. Data was presented in graphs, charts and narratives.

3.4.1 Standardized Precipitation Index (SPI)

The Standardized Precipitation Index SPI (McKee *et al.,*1993) was employed to determine the nature and characteristics of drought occurring in Chivi. The SPI is a computational tool used to quantify precipitation deficit or rarity of moisture for the given timescales within a period of time (World Meteorological Organisation WMO, 2012) It is based on the cumulative probability of a given rainfall event occurring at a place. The SPI is a probability index based on precipitation, developed to monitor and assess drought using historic data (Solanki and Parekh, 2014). According to Loukas and Vasiliades (2004), SPI gives a better representation of abnormal dryness, as well as wetness.

The SPI is the simplest index to infer drought severity (WMO, 2012). It requires only precipitation for inputs. This makes it ideal when dealing with remote rural areas such as Chivi, where complete historical weather data is not easy to find. This index is so versatile that it can be computed for different time scales ranging from 1 month to 72 months (Loukas and Vasiliades, 2004). This enables drought to be assessed across its entire spectrum from meteorological, agricultural, hydrological and socio-economic perspectives.

SPI can be calculated for different time scales, from 1 month to 72 months. However, very low timescales of less than a month and over 24 months can be unreliable (WMO, 2012).

a) One month SPI

It represents monthly precipitation totals hence 1 month SPI at the end of December compares to 1 month precipitation totals of that particular year and compares to December precipitation total of all the years being monitored. It depicts meteorological data and short-term soil moisture conditions.

b) Three month SPI

It monitors a 3 month compounded precipitation. A 3 month SPI at the end of March compares January to December precipitation totals of all years under study. It shows medium term soil moisture and gives a seasonal estimation of precipitation (WMO, 2012). However, it can be misleading if monitored in isolation of mean climatic data of the area under study.

c) Six month SPI

It assesses precipitation over 6 month period of historical data under study. It indicates seasonal to medium trends in precipitation. It is more sensitive to conditions, can be effectively used to assess anomalous stream flows and reservoir levels depending on region and time of the year (WMO, 2012).

The SPI was calculated in three time scales of 1, 3 and 6 month intervals, based on University of East Anglia historical rainfall data for Chivi (Appendix 2). A Windows SPI program version was used. A 30 year rainfall data based on grid point19.5^0 to 21.5^0 S and 29.5^0 and 31.5^0 E was fitted to a probability distribution which was subsequently transformed into a normal distribution to give zero as the mean SPI for the selected location and period. The algorithmic computational process involved the following process (Rahmat *et al*., 2013:4):

1. Fitting a cumulative probability distribution function (usually gamma distribution) on Aggregated monthly precipitation series (where *k = 1;* 3 or 6 months, timescales used in this study). The gamma PDF is defined as,

$$(x)=\frac{1}{\beta\alpha\,\Gamma(\alpha)}\;x^{\alpha-1}e^{-x/\beta} \qquad \text{(Equation 1)}$$

Where β is the time scale parameter; α denotes shape parameter, which can be estimated using the method of maximum probability; x is the amount of precipitation; and (α) is the gamma function at α.

The estimated parameters can be used to find the cumulative probability distribution function of precipitation events for the given month and particular time scale.

Cumulative probability is obtained by integrating *Equation 1*,

$$G(x)=\int_0^x g(x)dx = \int_0^x \frac{1}{\beta\hat{\alpha}\Gamma(\hat{\alpha})}x\hat{\alpha}-1_{e^{-x/\hat{\beta}}}\;dx \qquad (2)$$

$$\text{where } \hat{\alpha} = \frac{1}{4A}\left(1+\sqrt{1+\frac{4A}{3}}\right) \qquad (3)$$

$$\hat{\beta} = \frac{\hat{x}}{\hat{\alpha}} \qquad (4)$$

A= $\ln(\bar{x})$ - $\frac{\sum In(x)}{n}$ (5)

n = number of precipitation observations (6)

2. Convert cumulative distribution function (CDF) to the CDF of the standard normal distribution with zero mean and unit variance, n as follows:

$SPI = \psi^{-1}[G(x)]$ (7)

The converted probability is the SPI.

Since the SPI is the normalised distribution of precipitation, the mean SPI for the case under study became zero. Therefore, the wet and dry periods could be read or defined using the SPI value table (Table 3.2).

Table 3.2: Standardized Precipitation Index (Source: Adapted from WMO, 2012)

≥2.0	Extremely wet
1.5 to 1.99	Very wet
1.0 to 1.49	Moderately wet
-.99 to .99	Near normal/ mild drought
-1.0 to -1.49	Moderately dry/ moderate drought
-1.5 to-1.99	Severely dry/ severe drought
≤-2	Extremely dry/ extreme drought

Drought was defined using this index in all 3 timescales when the SPI is negative. The drought event would end when the SPI value becomes positive. Since a positive SPI series shows a wet period. Therefore the duration, frequency and magnitude of drought could be observed. The nature and severity of drought in Chivi was presented using the time series graphs and maps.

The output SPI data was formatted into Excel data sheet (Appendix 3). Time series and trend lines were plotted to analyse data across the three time scales that is 1, 3 and 6 monthly periods. The 1 month SPI represented monthly precipitation totals, hence it was used to compare monthly precipitation over the years, and make assessments using a time series analysis. Month to month variations could be compared. Total monthly precipitation of all the years was analysed. This was also checked against the mean climate data of the area, to establish meteorological drought and short-term soil moisture variations.

The 3 month time scale was used to assess short to medium term moisture deficit and variation. The mid seasonal moisture variations were analysed using the December, March, June and September 3 month SPI. Much attention was given to the December and March SPIs as they reflect the rainfall season onset and end respectively. The rainfall season starts in October, hence the 3 month SPI is read in December and the end of rain period in March. Assessment of these two intervals was also used to establish agricultural drought in the District.

The 6 month SPI was used to assess medium to long term moisture deficit and variation. Seasonal moisture variations over the 30 year period could be established. The March and September 6 month SPI were used and time series analysis was done. The October to March SPI was used to determine inter-annual precipitation deficit and variations. This time scale could establish long term manifesting droughts such as agricultural, hydrological and socio-economic droughts. The severity of drought was interpreted by using the SPI index table, presented in Table 3.4. Analysis of drought of various magnitudes over the 30 year period also allowed calculation of drought frequency in the area. Drought frequency was calculated by a summation of droughts of a specific magnitude observed within the 30 year period under study. This gave the nature and patterns of drought in the District. Probability of these droughts occurring or recurring could be established by dividing the period under observation by drought frequency figure within various severity categories. Drought frequency rates mirrored the overtime drought exposure in Chivi while probability of occurrence or recurrence gives projected drought exposure within the same community.

Analysis of the spatial extent was done using the 6 moth SPI values for all the years in which drought was noted. The IRI SPI mapping software based on East Anglia SPI database was used to generate maps showing the spatial extent of droughts of different magnitudes that occurred in Chivi. Comparisons of drought maps over the years also gave clues as to the nature of drought occurring in Chivi and possible causes of this drought. However the database used had limited data of up to year 2000. The other available databases had crude resolution which was not ideal for small areas such as Chivi. The results on the characteristics and extent of drought in Chivi gave the community's external vulnerability; internal vulnerability was analysed at household level using the HVI.

3.4.2 The Household Vulnerability Index (HVI)

Vulnerability in climate change sphere refers to the magnitude of damage the community, system or region has been subjected to due to climatic risks (Adger, 2009). It defines a compounded effect

of the risk and inability to cope (World Food Programme, WFP 1999). That is external and internal vulnerability. In which external vulnerability refers to the outside prevailing systems, processes and institutions while internal denotes the capacity of an individual household to withstand the shocks.

Estimation of vulnerability, in research, has been a bone of contention due to different definitions associated with vulnerability in different fields (Leichenko and O' Brien, 2002; Vincent, 2007; Eakin and Bojorquez, 2008). However, vulnerability estimation methods can be grouped into two approaches, namely the econometric and indicator approaches (Deressa *et al*., 2009). The econometric approach evaluates the socio-economic data of a community to infer vulnerability while the indicator employs various indicators based on expert judgement, principal component or comparison to past events. This study adopted an indicator approach based on both the component under analysis and expert judgement. Households are not uniform, human lifestyles and behaviours are heterogeneous. Hence, to get the real situation on the ground, the issues exposing Chivi past research and different methodologies were reviewed as well as scientific theories. The Household Vulnerability Index (HVI) questionnaire data (Appendix 4) were analysed using the data analysis method adapted from the Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN, 2005).

Vulnerability in Chivi District was weighed across five assets adopted from the Sustainable Livelihoods approach. These indicators were human capital, social, physical, financial and natural assets. Three specific dimensions adopted from (FANRPAN, 2011) were attached to each indicator. Table 3.3 presents the indicators or dimensions analysed and their respective variables.

Table 3.3: Household Vulnerability Dimensions and Variables

Dimension	**Specific dimensions/ Variables**
Human	Farm labour, gender composition and dependants
Social	Extended families, social support (formal/informal) and information
Physical	Livestock, equipment and services
Financial	Savings, salaries and remittances
Natural	Land, soil and water

15 dimensions were assessed and weighted using the Community Based Asset Weighting system (CBAW). Section G in Appendix 4 presents the CBAW section on the questionnaire. This allowed

the community to decide on indicators which best defines their vulnerability and adaptability. Unlike the normally used Standard Database Value (SDV), CBAW, revealed assets which most expose them to or cushion from drought risks.

Vulnerability was calculated using SPSS 22.0 version for IBM based spread sheet application. The data review, cross tabulation and Chi-square test capabilities were used to analyse levels of vulnerability. The model computed the sum of the weighted variables across all dimensions to give the particular households total vulnerability $Vhhi$ to drought as follows:

(Equation 8)

$$Vhhi = \sum_{j=1}^{m} Xwj \Big/ \sum_{j=1}^{m} wj$$

Where
j = dimension of impact
m= specific dimensions of impact
w= corresponding weighted vulnerability
$Vhhi$= sum of the weighted vulnerabilities across all dimensions and this gave a particular household's total vulnerability

1. Data from 100 household questionnaires were captured, in ascending order of the Wards from 22 up 32. Data was cleaned to avoid outliers.

2. An HVI variable input table was formed (Appendix 5). This consisted of five dimensions and variables tracked as they appeared in the questionnaire.

3. Weighting of each dimension was done based on the results of the Community based asset weighting. Human assets got a weight of 17, social assets 18, physical assets 19 and financial and natural assets 23. The total weight of all five dimensions was 100.

4. Each variable was attached a weight within its cluster based on predetermined importance of the variable. This was determined based on the nature, extent and severity of the impact a specific variable has in regard to households' exposure to drought risk. On the nature of variable influence on drought exposure, short to long-term effects were assessed, on extent potential ripple effects

were considered, as well as the depth of impact a variable has. A scale of 5 in which 1 denotes a mild impact, 2 a moderate impact, 3 a medium impact, 4 a severe and 5 an extreme impact. A scale of 4 and 5 was also placed on crucial assets in the context of Chivi rural community. For instance, lack of income in a rural community where agriculture is no longer viable, which means that a particular household cannot subscribe to any social scheme nor could it start any other income generating project, since it lacks capital. Also in the case of a household with no livestock, in an area where livestock is a form of draught power, transport to fetch water or take produce to market, form of nutrition, educational insurance for children, as well as a buffering asset during a drought.

5. Setting scores for each variable: scores were set at a range between 0 and 1 in which 0 meant no impact and 1 full impact. The consistency in this scale allowed comparison of results.

6. The boundaries for each variable were set and variables were transformed. Transformation took a number of approaches. The method depended on each particular variable. In straightforward variables, a 0 score would be used for no impact and 1 for a full impact. In dummy cases, the yes or no responses, a 0 or 1 would be attributed depending on the direction of variable impact. In other cases, 0 meant no impact, 0.25 slight impact, 0.5 average impact and 1 full impact. In multi response variables, cut off points were set and transformed into various scores between 0 and 1. The complex ratio cases were transformed by attaching a value Y for a maximum value and X for the actual value, then$V = (\frac{X}{Y})$ would get a score between 0 up to 1.

7. The Household Vulnerability Index was then computed for the total score of each household. HVI table was used to categorise households, as shown in Table 3.6.

Following this method, different levels of vulnerabilities among households were established using the FANRPAN HVI (2005). If the Vulnerability level is 1 it means a Coping Level Households (CLH); this household is in a vulnerable situation but can cope (Table 3.4).

Table 3.4: Household Vulnerability Index

HVI Level	Vulnerability	Adaptation
1 Coping Level Household (CLH)	Not vulnerable, though in a vulnerable situation	coping
2 Acute Level Household (ALH)	vulnerable	Not coping, need assistance
3 Emergency Level Household (ELH)	Most vulnerable	Extremely not coping, needs resuscitation

In Vulnerability level 2 refers to Acute Level household (ALH). This implies that the household has been hit hard and needs assistance, while level 3, the Emergency Level Household (ELH) showes an intensive care situation, which needs immediate resuscitation. The HVI results answered the research questions on vulnerability and adaptability of men and women in Chivi District. In this HVI, level 1 denoted high adaptability and minimal vulnerability; level 2 showed less adaptability and high vulnerability; and level 3 depicted the highest vulnerability and the least adaptability.

Household Vulnerability Index is a good tool for assessing livelihoods assets in remote areas to help in policy making and developmental decision making (FANRPAN, 2011). The index allowed a detailed assessment of household livelihoods to give internal vulnerabilities. The household vulnerability index having the ability to measure adaptive capacity and vulnerability simultaneously both gendered vulnerability and adaptation were analysed at the same time. This tool is ideal for proper vulnerability mapping and drawing up of effective adaptation strategies.

3.5 Key informant interviews and Focus group discussion data

Supporting data from Key informant interviews and Focus group discussions to establish levels of drought vulnerability, gendered vulnerability and adaptation strategies were analysed under various related themes. This was compared with past research outcomes, as well as related theories such as Sustainable Livelihoods, and International standards or frameworks such as the United Nations poverty datum line and United Nations Hyogo Framework 2005-2015. Data was either presented on its own or used to support results of other data sources.

3.6 Data presentation

Data is presented in the form of graphs, charts, tables and computational worksheets using Microsoft Office Excel 2010. The worksheet tables explicitly show the calculations, statistical processes and results. Descriptive statistics, such as frequencies, standard deviations, percentages, Chi-square and mean were presented in graphical form for vivid visual effect. Qualitative data was presented in narrative form.

3.7 Chapter summary

This chapter gave a description of data collection processes, theoretical framework and analysis techniques followed by the study. The broad objective of this study was to examine spatial-structural characteristics of drought, its impact on food crop production and to analyse gendered vulnerability and adaptation to drought in Chivi South. Key informants and focus group members were purposively sampled, while households were selected using the multi-stage random, purposive and systematic sampling. Drought severity in the area was assessed using the Standardized Precipitation Index; changes in food crop production were analysed using Microsoft Excel, while the Household Vulnerability Index was used to analyse vulnerability and adaptation to drought among 50 female and 50 male-headed households. Data was cleaned, captured and put into SPSS 22.0 for analysis. The next chapter provides the analysis and interpretation of data.

4.0 Introduction

This chapter presents, analyses and interprets research findings of spatial-structural drought characteristics, changes in food production, as well as gendered vulnerability and adaptation to drought in Chivi South. The first section gives an analysis of drought vulnerability in the District over the years. It presents and discusses results on the nature and characteristics of drought occurring in Chivi District, as well as changes in food crop production in Chivi, from 1983 to 2013. The second part gives a situational interpretive analysis of household vulnerability and adaptation through a gender lens. Demographic composition of the household survey sample is presented in relation to drought vulnerability and adaptation. Subsequently, the results on gender vulnerability and adaptation to drought from key informants and focus group discussions are presented. Data is presented in tables, charts, graphs, maps, input and output data sheets as well as paragraphs.

Satellite based rainfall data used in the study was taken from the grid nodes 19° 5' to 21° 5' S and 29° 5' to 31° 5' E. Chivi lies between coordinates 20^0 30'0" South and 30^0 34'60''E. Historical rainfall historical data was taken from East Anglia Climate Research Unit (CRU) for the years 1983 to 2013 (Appendix 2). This database was used to avoid data gaps, often associated with meteorological observations data sets. Complete historical rainfall data covering 30 years was used. A minimum of 20 to 30 year climate cycle is preferable in analysing climate patterns (Guttman, 1998). Monthly rainfall figures for each of the 30 years under study were used. Following this introduction, is a presentation of the characteristics and extent of drought in Chivi.

4.1 Characteristics and extent of drought in Chivi District

To establish the nature and characteristics of drought in Chivi District, the Standardized Precipitation Index (SPI) online program ran in Windows was used. The SPI analysis was done using 1, 3 and 6 month timescales. The results revealed both positive and negative SPI in all 30 years, depicting wet and dry cycles. However the negative SPI results dominate the whole period under study, implying that drought was prevalent as shown in Figures 4.0, 4.1 and 4.2.

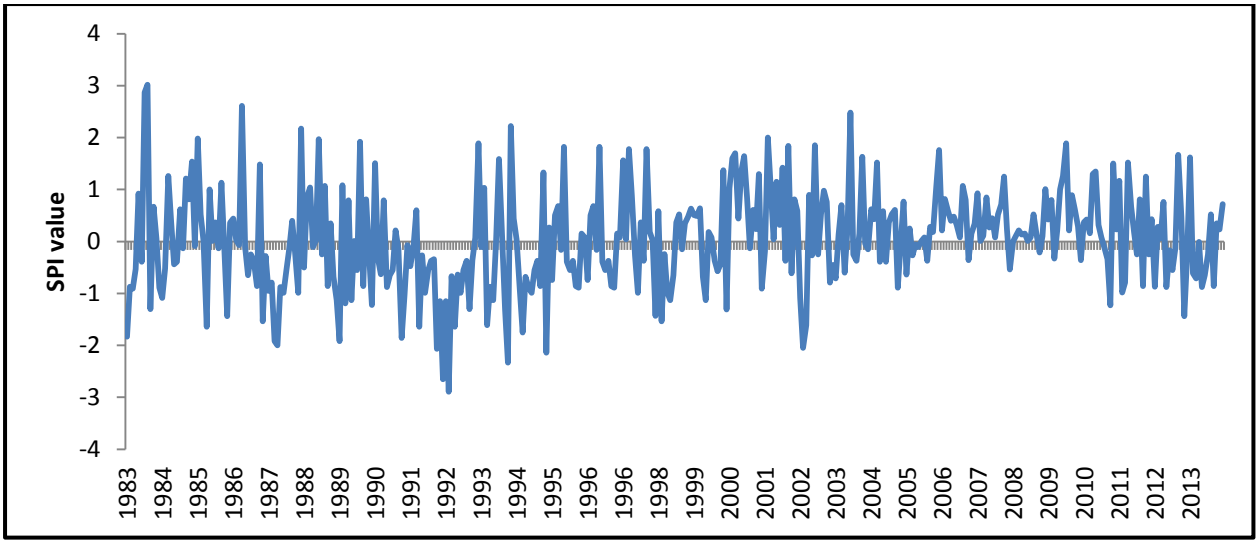


Figure 4.0: Standardized Precipitation Index :1 month time scale (Source: Fieldwork, 2015)

The 1 month time scale SPI in Figure 4.0 shows monthly wet and dry conditions patterns. It shows a normalised monthly rainfall distribution over a 30 year period. The SPI results reveals pronounced dry periods between May and September and some wet cycles from October to April. The same periods form the normal dry winter period and wet summer period respectively on the mean climate of this region. Chivi experiences a lot of meteorological drought. As shown in Figure 4.0, most years are characterised by dry monthly cycles. More so 24 out of 30 of the periods under study showed negative SPI values even during the normally wet summer period. This implies high drought periods.

Meteorological drought is becoming less prevalent in recent years (Figure 4.0). Monthly dry cycles are prevalent in the first two decades (1983 to 2003) as compared to the last decade (2004 to 2013). However, this could be attributed to a general fall in the amount of precipitation received in recent years, hence deviations from the average annual figures of the same period have also become too minimal to reflect this drought. There is not much variation between the positive and negative SPI values in the whole period under study, implying that a moisture variation between months is not much. Chivi, being a generally dry area, although monthly variations are not huge, they are significant. However, this is a one month time scale, the results can be revealing the weakness associated with short term time scales.

4.1.1 Mid seasonal drought patterns in Chivi

The 3 month SPI time scale shows moisture deficit compounded at 3 month intervals. This time scale was used to show short term, mid-season moisture conditions. Figure 4.1 shows mid seasonal moisture deficit in Chivi from 1983 to 2013.

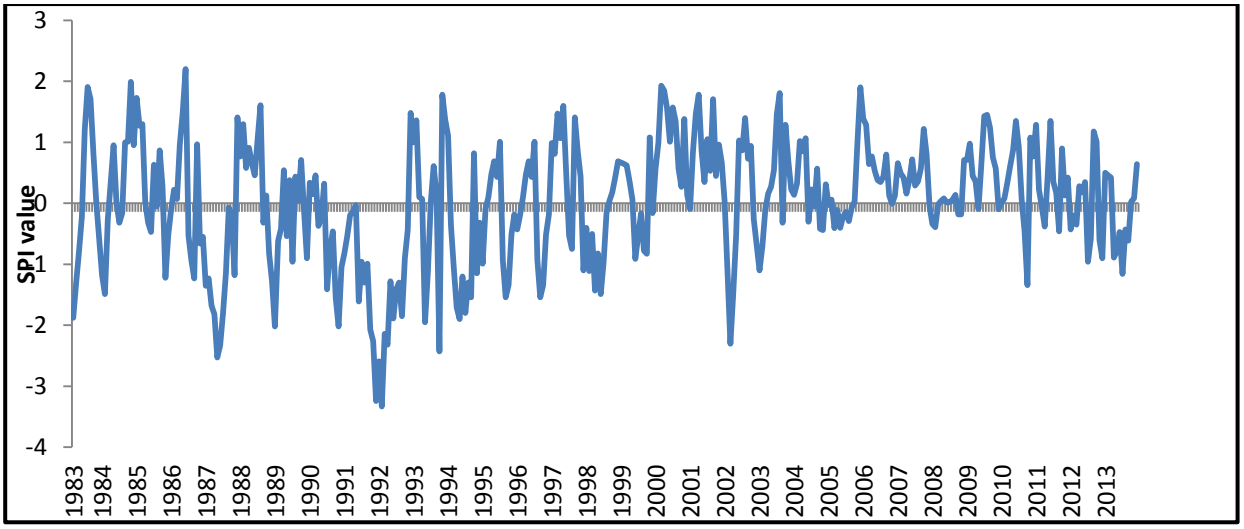


Figure 4.1: Mid seasonal droughts (Source: Fieldwork, 2015)

The 3 month time scale showed more dry cycles as compared to the 1 month time scale SPI results (Figure 4.1 and 4.2). This reflects pronounced short to medium drought, meaning that Chivi experienced meteorological and agricultural drought. As in the 1 month time scale results, the 3 month cycles also showed less dry seasons in the last decade as compared to the first two decades.

To ascertain agricultural drought, the quarter year or mid seasonal moisture deficit cycles were used as shown in Figure 4.2. Each year was divided into four periods of 3 month cycles for a clear, mid seasonal pattern analysis. That means the 3 month time scale SPI values for December, March, June and September of all the years under study, were used. Under normal conditions, these two seasons should reflect positive SP values, while the other two periods should be negative, depicting a dry period. The results showed a 66.7% positive SPIs in the first quarter. This reflects high moisture, in the October-December period, which corresponds with the mean climate of the area. The other 33.3% period shows agricultural drought in Chivi. The period coincides with the growing season of the District, in which soil moisture is critical. March cycles show a 50% moisture deficit, implying that there was agricultural drought.

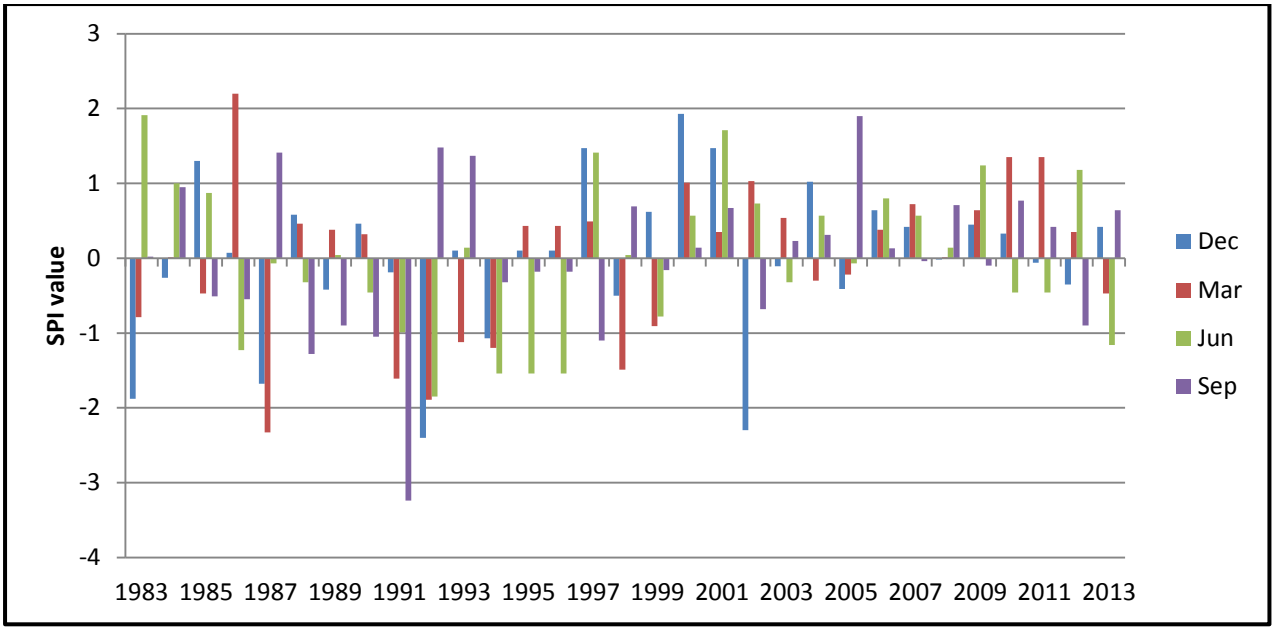


Figure 4.2: Mid seasonal moisture pattern (Source: Fieldwork, 2015)

These droughts could be regarded as less influential in the agricultural production of the District, as the growing season starts early. However sensitive crops, such as maize which require high soil moisture throughout their growth cycle, are affected. According to data from community members, this crop is most preferred in the area. The March SPI values of 2000 to 2013 showed that, 84% of these wet cycles have occurred between 2000 and 2013. The same period shows 40% wet cycles during the October-December period.

4.1.2 Seasonal moisture deficit patterns in Chivi District

The 6 month SPI shows precipitation distribution over a 6 month period. It reflects the medium seasonal drought characteristics as shown in Figure 4.3.

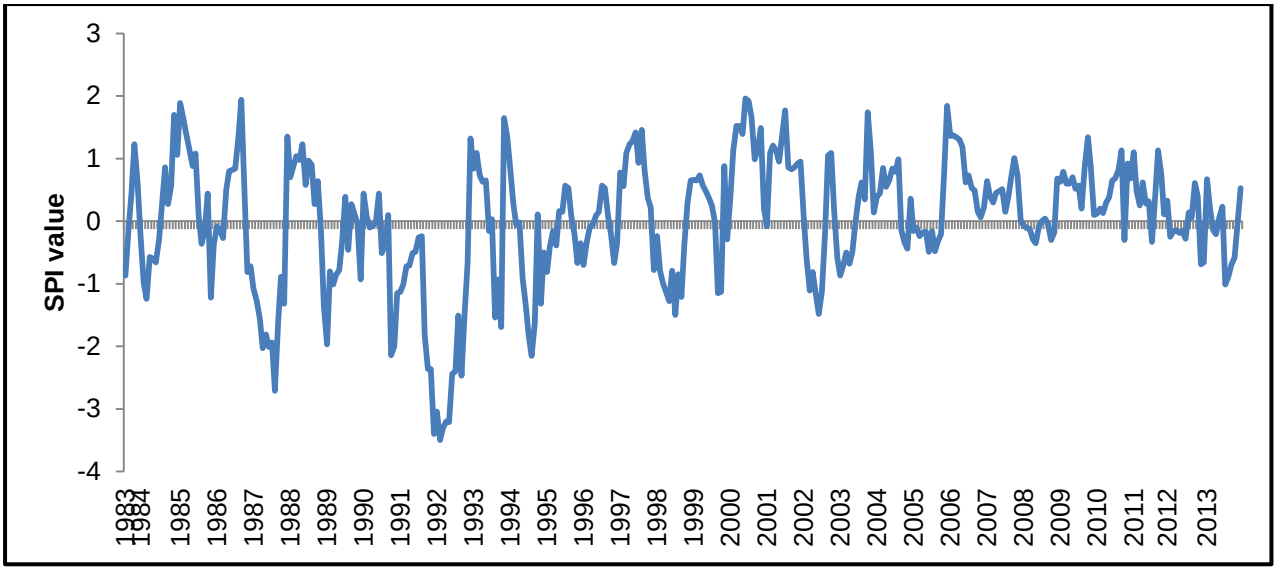


Figure 4.3 Standardized Precipitation Index: 6 month time scale (Source: Fieldwork, 2015)

The 6 month SPI showed overall alternating positive and negative values, within the October-March and April-September seasons respectively. In most years, the 6 month SPI values for June up to November show negative values, whilst the 6 month SPI values for the first 4 months of each year are positive. This coincides with the seasonal moisture variations characterising the mean climate of Chivi District. However, 1983, 1987, 1992, 1994, 1998, 2002 and 2013 show negative SPI values throughout the two seasons. This reflects a high magnitude drought which in near surface aquifer areas, such as Chivi, qualifies it as a hydrological drought.

4.1.3 Seasonal drought patterns in Chivi District

The seasonal drought patterns were plotted using the March and September 6 month SPI timescale values. This was done to show moisture conditions throughout each season for the whole period under study. Figure 4.4 presents seasonal drought patterns in Chivi, over the years since 1983.

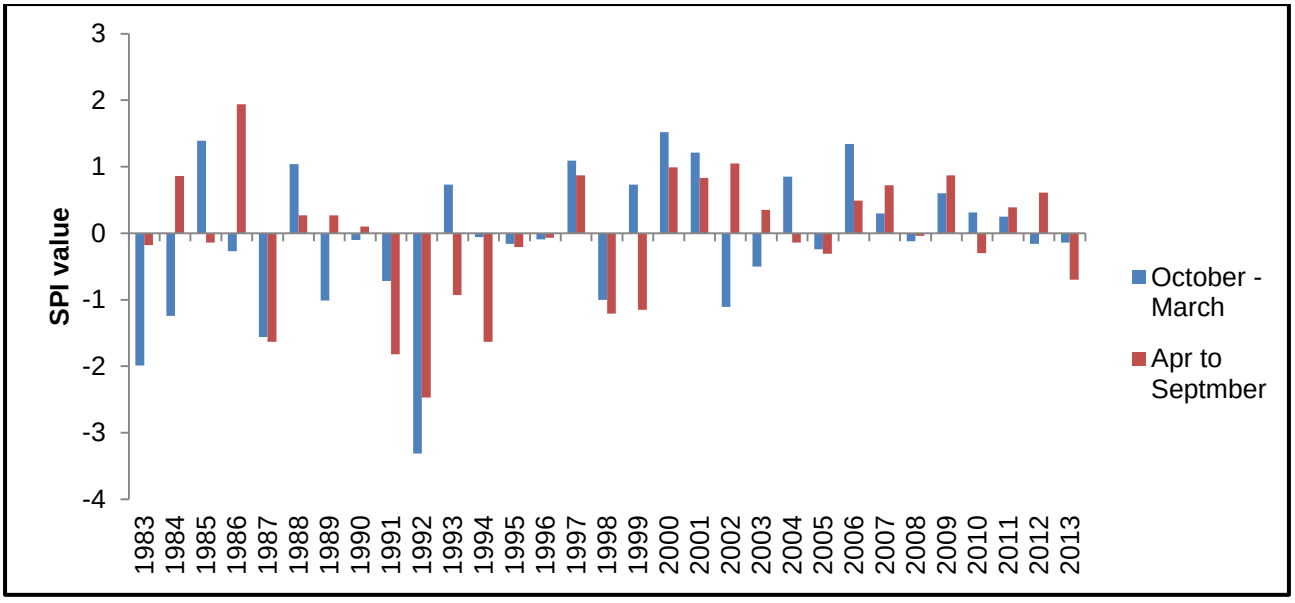


Figure 4.4: Seasonal moisture pattern Chivi (Source: Fieldwork, 2015)

The results show a 43% wet and 57% dry October to March season. Considering that the period is the rainy season, it shows Chivi has been experiencing seasonal droughts most of the time (Figure 4.5). The April to September period is normally a dry season in Zimbabwe. However the results revealed a 50% of dry and wet, April to September period. This shows a bit of climate variability. To add on the variability of this season, 60% of this wet period occurred between 2000 and 2013. This corroborates the 3 month timescale findings of the last quarter season, which showed 84% wet conditions within the same period.

4.1.4 Inter-annual drought pattern in Chivi

Drought pattern was plotted using the normal rain period (October to March), for the whole 30 year period as shown in Figure 4.5.

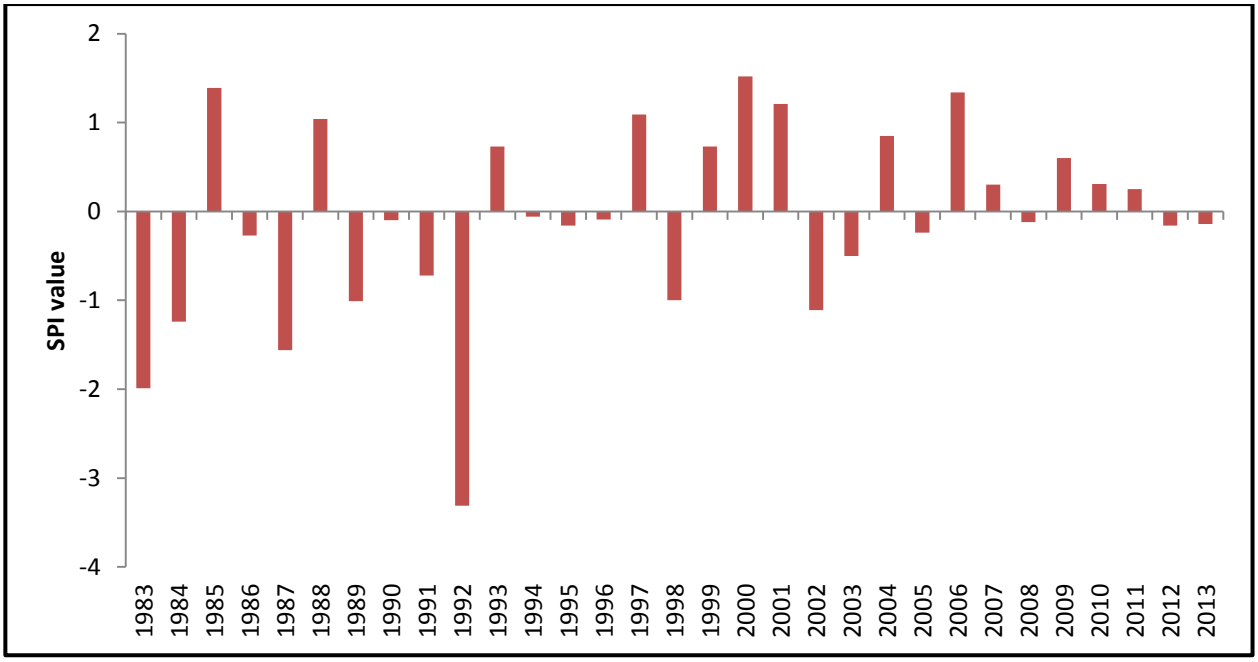


Figure 4.5: Drought pattern in Chivi District (Source: Fieldwork, 2015)

Drought was more frequent in the first half of the study period, recurring at a two year interval. Since the mid-2000s, droughts have been less frequent. The 2000 to 2013 period is generally characterised by more wet seasons than the first half of the period under study. In this study, the first half of the 30 year period showed droughts of a higher magnitude than the last part as shown in Figure 4.7. This could reflect minimal socio-economic drought in the District.

4.1.5 Drought severity in Chivi District

Drought severity was deduced by categorising the 6 month timescale values for annual rainfall seasons for the whole 30 year period. Extreme drought in Chivi occurred once since 1983. That was in 1992, 1983 and 1987 droughts fell into the severe drought category as shown in Figure 4.6. These drought periods correspond with the years mentioned by Key informants and Focus group discussion participants as years of pronounced drought that resulted in acute water shortages, very low crop production, loss of livestock and a food crisis.

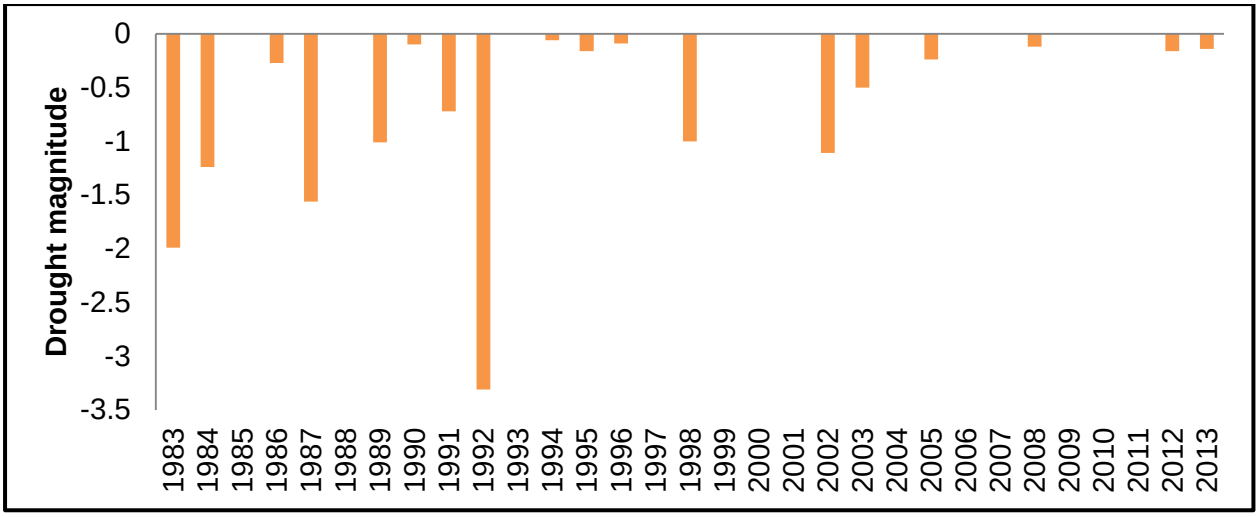


Figure 4.6: Drought severity in Chivi District (Source: Fieldwork, 2015)

The year 1985, 1989, 1999 and 2003 had moderate drought. Mild drought was experienced for 17 years of the period under study.

4.1.6 Drought frequency in Chivi District

Drought frequency was drawn up using the number of drought periods which fell in each category of the McKee *et al.* (1993) SPI drought severity table.

Table 4.0: Drought magnitude and frequency in Chivi District (Source: Fieldwork, 2015)

Level	Category	Frequency of occurrence	Probability of recurrence
2.0+	Extremely wet	0	0
1.5 to 1.99	Very wet	1	1 in 30 years
1.0 to 1.49	Moderately wet	5	1 in 6 years
-.99to .99	Near normal	17	1 in 2 years
-1.0 to -1.49	Moderately dry	4	1 in 7.5 years
-1.5 to -1.99	Severely dry	2	1 in 15 years
-2 and less	Extremely dry	1	1 in 30 years

The results show that Chivi District experienced extreme drought only once in 30 years, severe drought twice, moderate drought four times and mild drought for 17 years. Whilst droughts appear to be prevalent in the district, most of these droughts are mild. Most droughts of mild magnitude

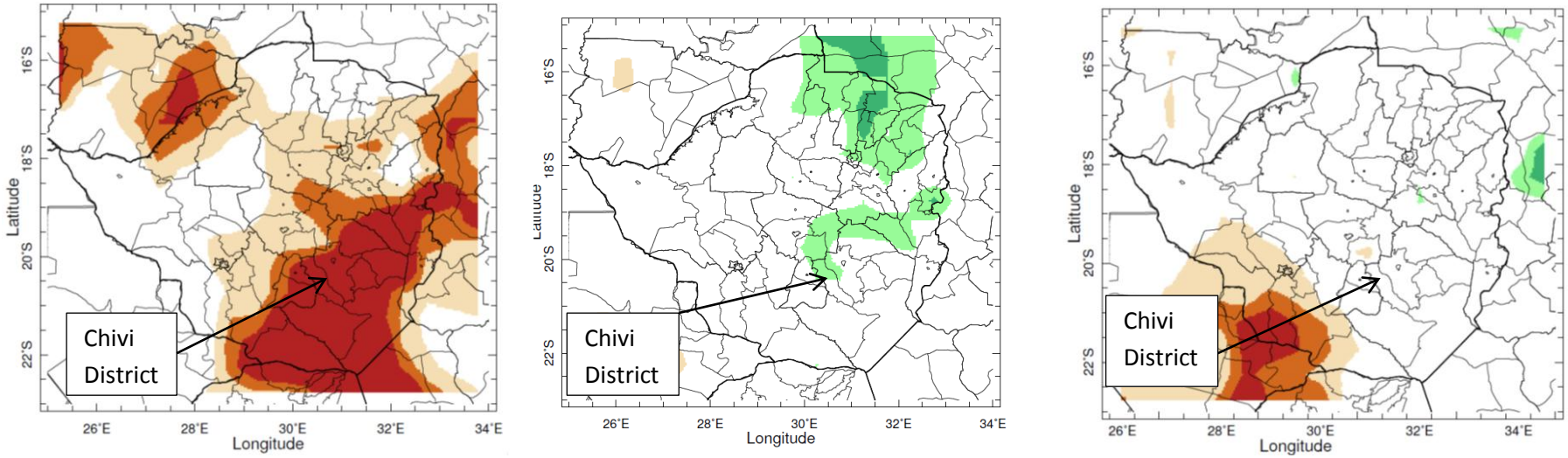
were experienced after the year 2000. A low precipitation trend was also noted during the same period see (Table 4.0).

4.1.7 Probability of drought recurrence in Chivi

Since the McKee *et al*. (1993) SPI values are standardized, this allows SPI to infer the rarity of current droughts and calculation of probability of recurrence of various drought events, World Meteorological Organization, (WMO, 2010). Probability of drought recurrence was calculated by dividing the period under study by number of drought events in each category (Table 4.0). The results show that droughts of extreme magnitude can occur in 30 years, while severe and moderate droughts can recur at an interval of 15 and 7.5 years respectively. The mild droughts recur at an interval of approximately two years. This shows that mild droughts recur more often in Chivi with an interval of two years.

4.1.8 Spatial extent of droughts occurring in Chivi

The spatial extent of droughts that occurred in the District was mapped using an online IRI-SPI model, based on a 6 month time scale of the UEA database. However, the database had limited data of up to the year 2000. Alternative databases had crude resolutions, making it impossible to clearly portray the drought spatial extent for a small area such as Chivi District. The study employed the available UEA data. To enable clear mapping of drought extent and its possible causes, drought spatial extent was mapped for the whole country. The drought spatial extent was mapped for all droughts that occurred from 1983 to 1999. Figure 4.7 (a to i) shows drought extent in and around Chivi District.

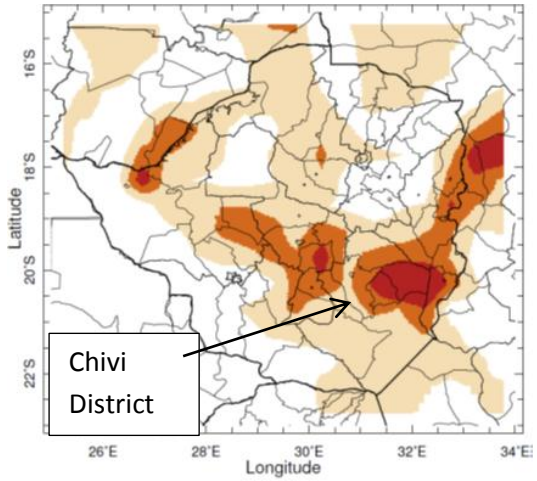


a.1983 Drought spatial extent **b.1985 Drought spatial extent** **c. 1986 Drought spatial extent**

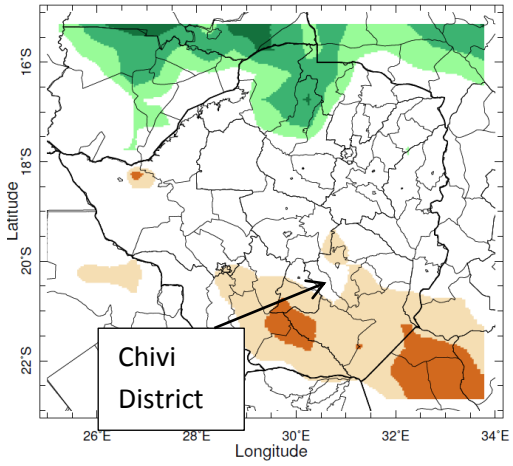
Legend

=2.0	Extremely wet
1.5 to 1.99	Very wet
1.0 to 1.49	Moderately wet
-.99 to .99	Near normal/ mild drought
-1.0 to -1.49	Moderately dry/ moderate drought
-1.5 to-1.99	Severely dry/ severe drought
=-2	Extremely dry/ extreme drought

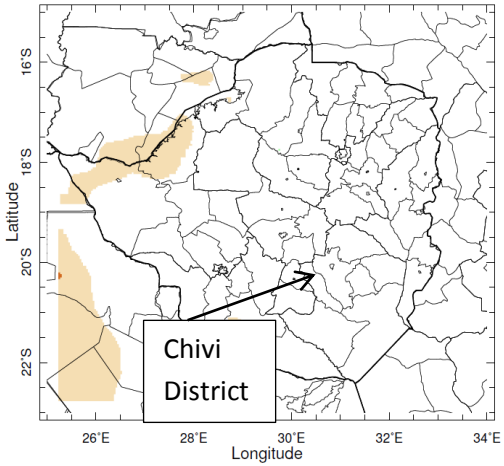
Fig 4.7a to c Drought spatial extent (Source: Fieldwork, 2015)



d. 1987 Drought spatial extent

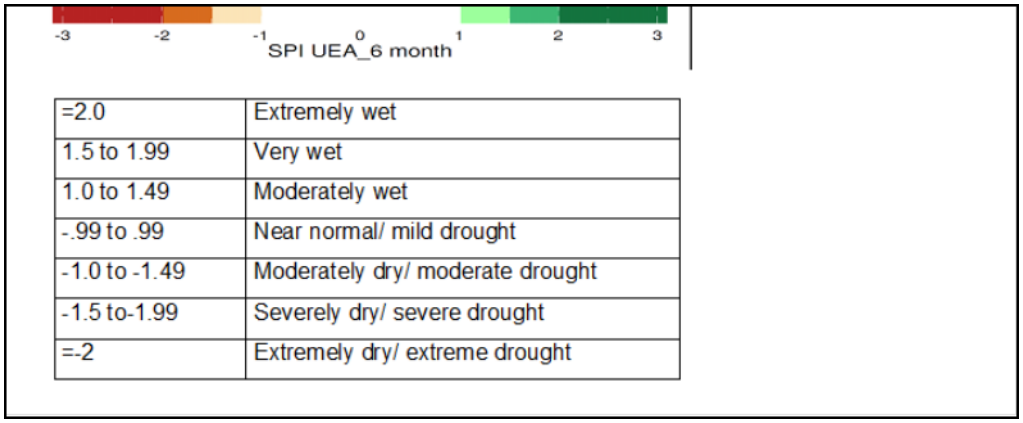


e. 1989 Drought spatial extent



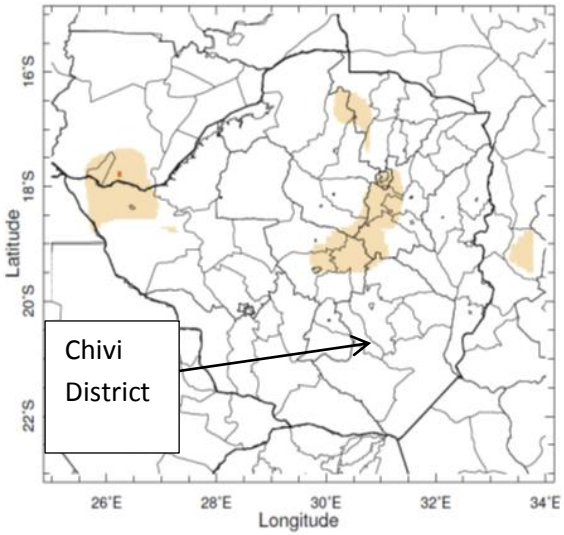
f. 1990 Drought spatial extent

Legend

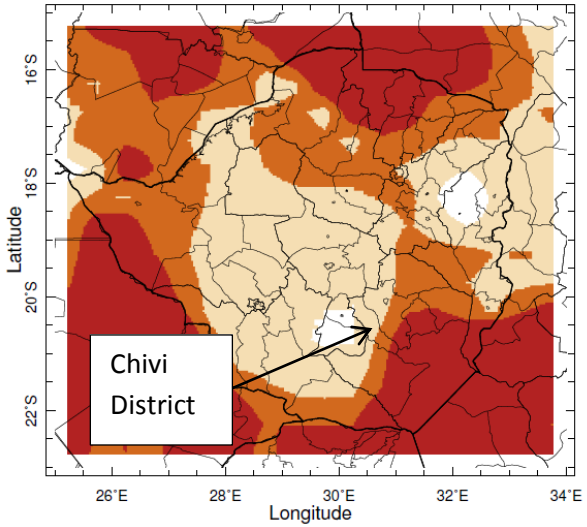


=2.0	Extremely wet
1.5 to 1.99	Very wet
1.0 to 1.49	Moderately wet
-.99 to .99	Near normal/ mild drought
-1.0 to -1.49	Moderately dry/ moderate drought
-1.5 to-1.99	Severely dry/ severe drought
=-2	Extremely dry/ extreme drought

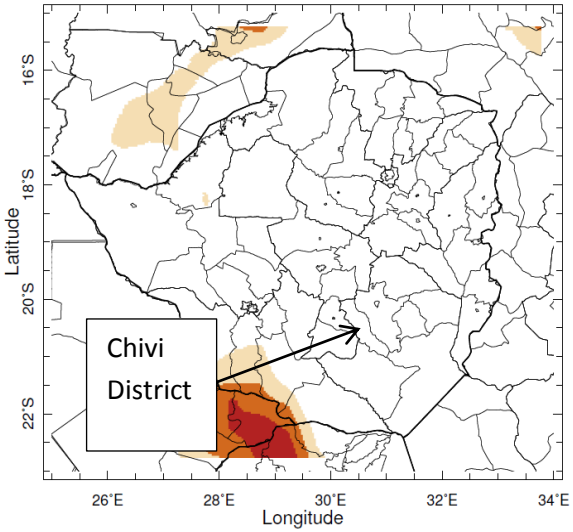
Fig 4.7d to f Drought spatial extent (Source: Fieldwork, 2015)



g. 1991 Drought spatial extent

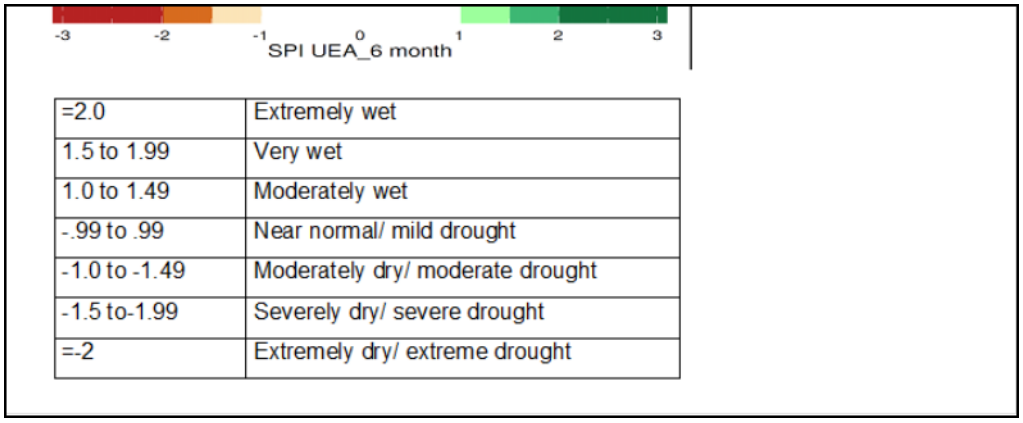


h. 1992 Drought spatial extent



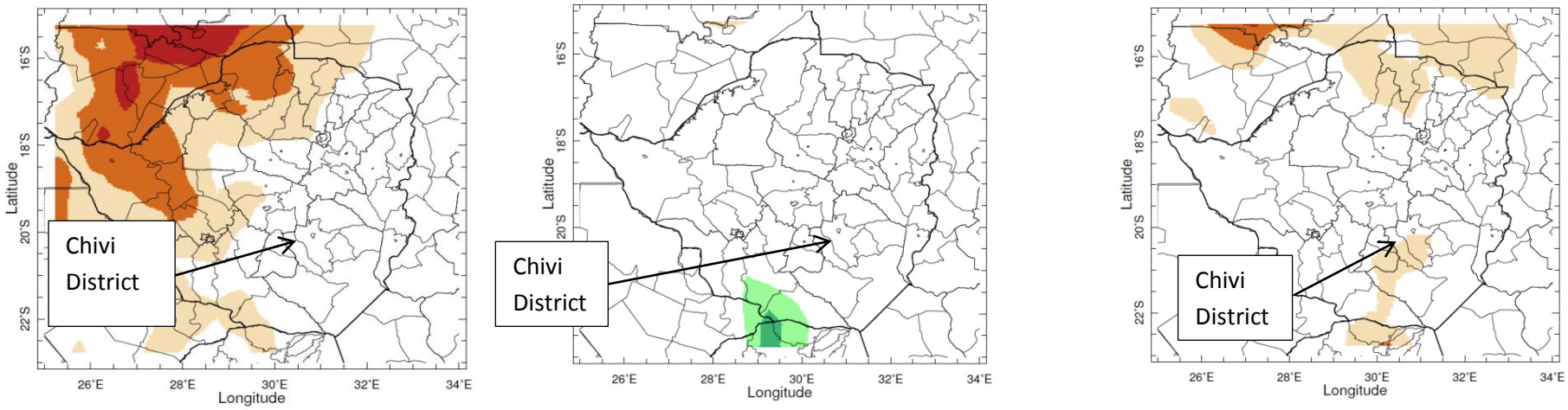
i. 1994 Drought spatial extent

Legend



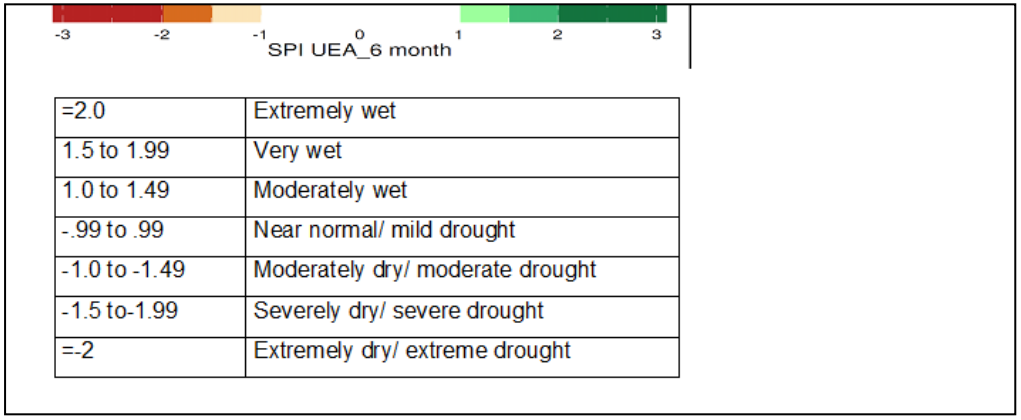
=2.0	Extremely wet
1.5 to 1.99	Very wet
1.0 to 1.49	Moderately wet
-.99 to .99	Near normal/ mild drought
-1.0 to -1.49	Moderately dry/ moderate drought
-1.5 to-1.99	Severely dry/ severe drought
=-2	Extremely dry/ extreme drought

Fig 4.7g to i Drought spatial extent (Source: Fieldwork, 2015)



j. 1995 Drought spatial extent **k. 1996 Drought spatial extent** **l. 1998 Drought spatial extent**

Legend



=2.0	Extremely wet
1.5 to 1.99	Very wet
1.0 to 1.49	Moderately wet
-.99 to .99	Near normal/ mild drought
-1.0 to -1.49	Moderately dry/ moderate drought
-1.5 to-1.99	Severely dry/ severe drought
=-2	Extremely dry/ extreme drought

Figure 4.7 j to l Drought spatial extent in Chivi (Source: Fieldwork, 2015)

Only droughts of high magnitude that occurred in Chivi (1983, 1987 and 1992) extended across the country and the neighbouring states. Most of the droughts, except for the 1983,1987 and 1992 ones, extended into the north, west and southern parts of the country, excluding the eastern parts of the country. Most of the droughts that were picked up by 6 month SPI were near normal droughts (Figure 4.7). The 1992 drought, which had the most severe index, displayed a near normal condition on most parts to the north of Chivi District and severe to extreme conditions in Chivi South. The years 1985, 1986, 1989, 1990, 1991, 1994, 1995 and 1996 showed normal conditions. The frequency and magnitude of drought in Chivi have a major impact on soil moisture content and, subsequently, food crop production.

4.2 Changes in food crop production in Chivi District

Different crops react to dry spells differently. If a community uses food crops which do not thrive in their local climate or dry spells, crop production is affected and food security is threatened. Data gathered from Focus Group discussions revealed that the main crops produced in the area range from high moisture demanding crops such as maize to drought resistant crops such as the small grain crops. Maize, groundnuts, Bambara nuts, cotton, sunflowers, millet and sorghum are some of this community's preferred crops. However the staple diet in the area being thick porridge (sadza) made from maize, sorghum or millet, means that these crops form the main food crops of the District. The discussants also showed that everyone grows maize and very few grow millet and sorghum as presented in Figure 4.8.

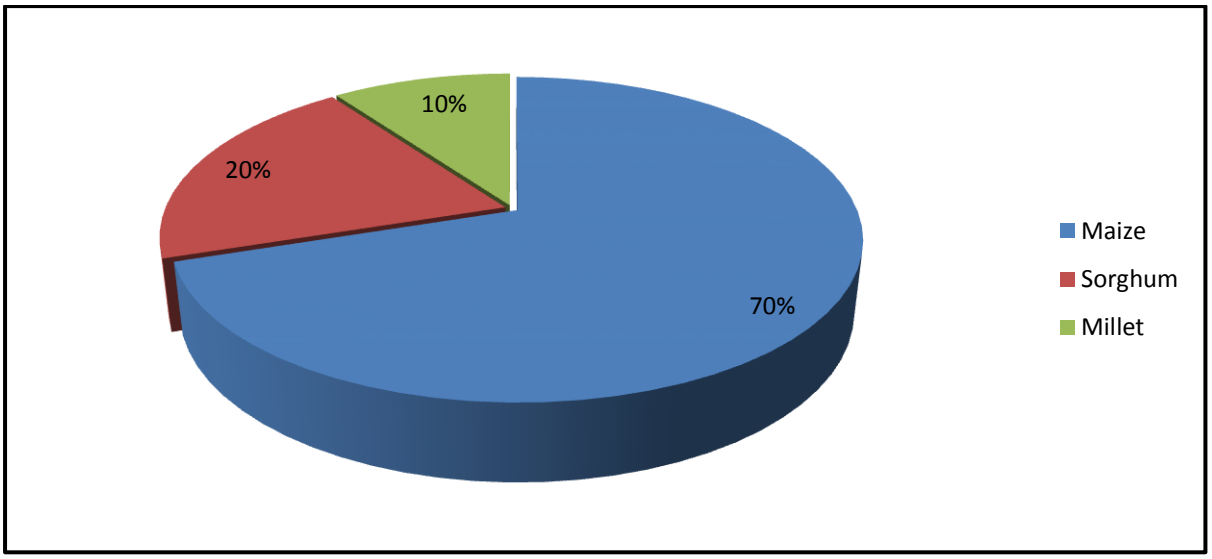


Figure 4.8 Preferred staple food crop (Source: Fieldwork, 2015)

4.2.1 Trends in food crop production changes in Chivi District

Despite maize being the most grown crop, there have been changes in its production over the years. A general fall in food crop yields over the past 30 years in Chivi was noted (Figure 4.9).

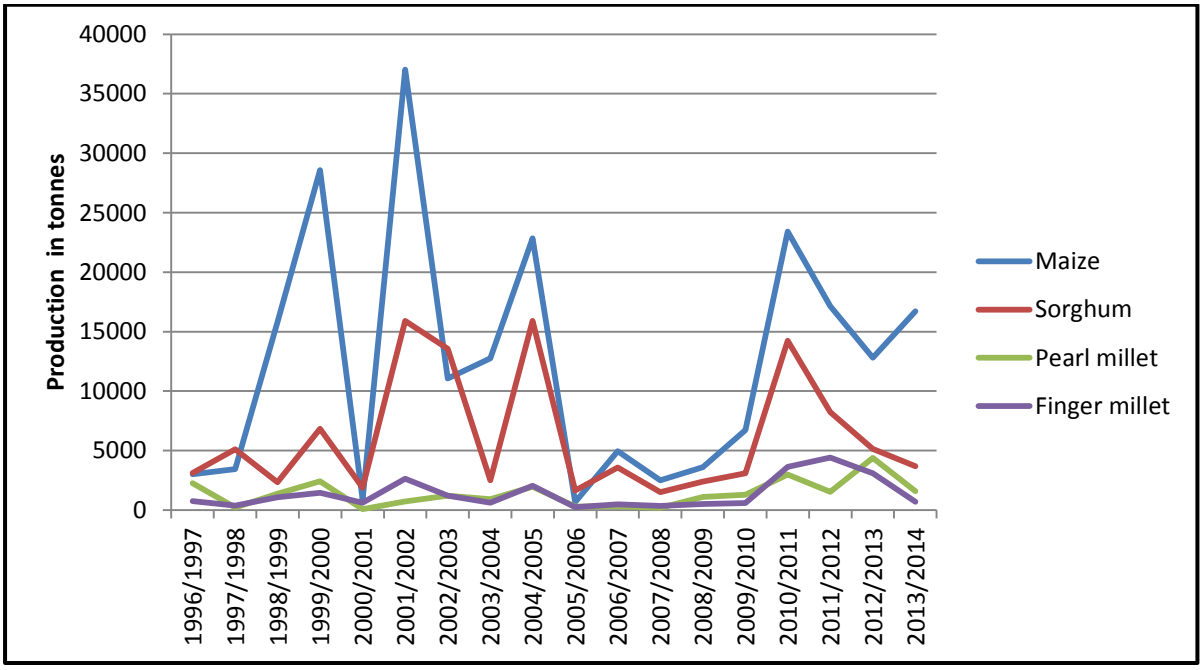


Figure 4.9 Food crop production changes (Source: Fieldwork, 2015)

Food crops were plotted using yields data from the District's Agriculture, Research and Extension Office (AGRITEX). However, the database could only provide information from year 1996 and had missing data. Therefore data for the years 2007 to 2009 were estimated using the mean yields from the wards under study. The findings show a general fall in maize production. This trend also matches the general fall in precipitation in the area as shown in Figure 4.5. The yields also fell during drought periods (Figure 4.6 and 4.7). This implies that these changes are drought related. Sorghum, like maize crop, shows a high variability over the years and has also been affected by drought. However, millet varieties show a more constant growth in production. The estimated yield results per hectare of recent seasons as presented in Figure 4.10 reveal a general low and more consistent yield/hectare in all crops, except for maize.

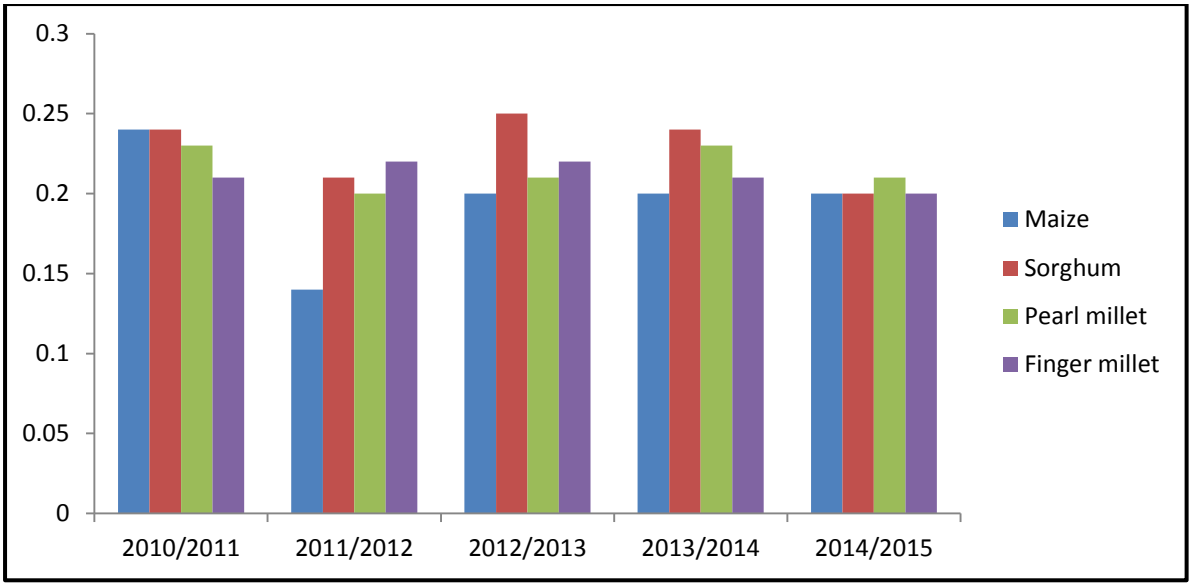


Figure 4.10 Food crop yields per hectare in Chivi (Source: Fieldwork, 2015)

Focus group discussions showed that drought affects food production every other year and recurs in three farming seasons. Whilst key informants had different views, Agriculture Extension officers showed that some community members get a good harvest in the so called drought years due to spreading the planting period and using different crop varieties. Therefore, droughts cause low food crop production, which, in turn, increase gender vulnerability.

4.3 Gender vulnerability and adaptation

4.3.1 Gender and Marital status

The study engaged 100 household heads from Ward 22, 24, 25, 31 and 32 of Chivi District to determine vulnerability and adaptation to drought. The sample consisted of 50 male and 50 female household. The survey was fairly distributed along the marital status lines as shown in Figure 4.11 below. The sample showed that most participants were married. The area has a substantial population of widows and divorcees.

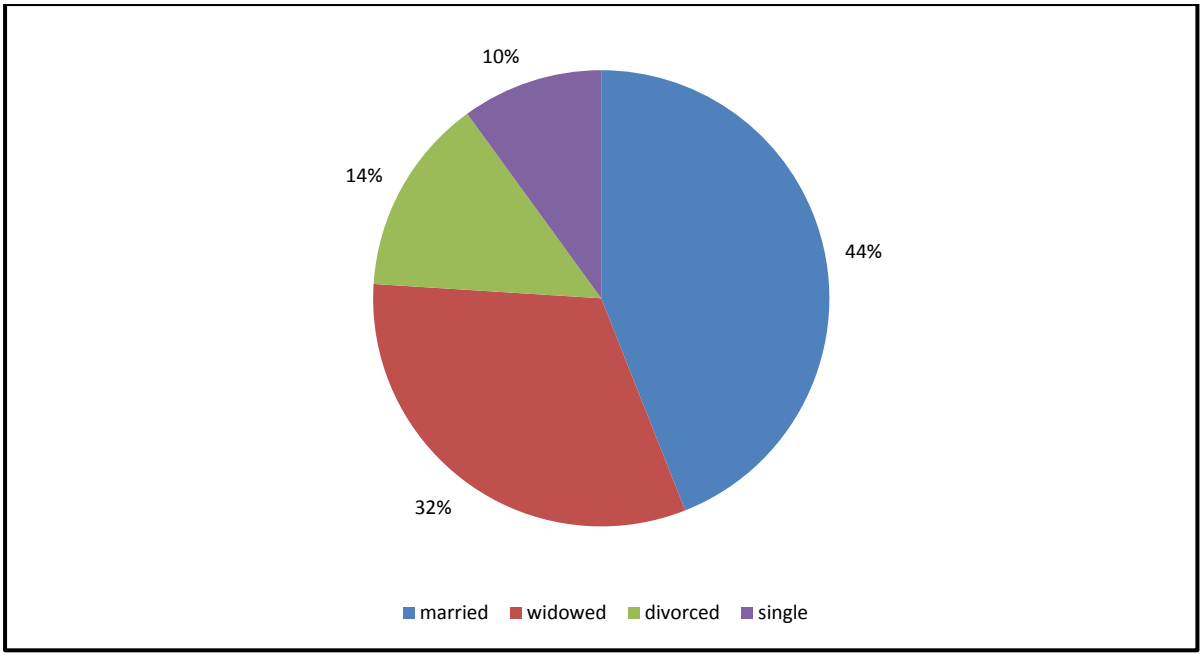


Figure 4.11 Distribution by marital status (Source: Fieldwork, 2015)

4.3.2 Age, Education and Employment status

The household survey represented age fairly across all categories. The youth, young families and middle aged were represented. The study also included the elderly, who have experienced drought in the area for a significant number of years. These are also members of the community, who are knowledgeable in indigenous knowledge.

Table 4.1: Distribution of participants by age (Source: Fieldwork, 2015)

Age	Sample size (%)
<20	0
20-30	2
31-40	21
41-54	31
55+	46 Total = 100

In this study, a minimal percentage of the participants had no formal education and the highest percentage had attended primary and secondary school education. As shown in Figure 4.12, a significant number held tertiary qualifications.

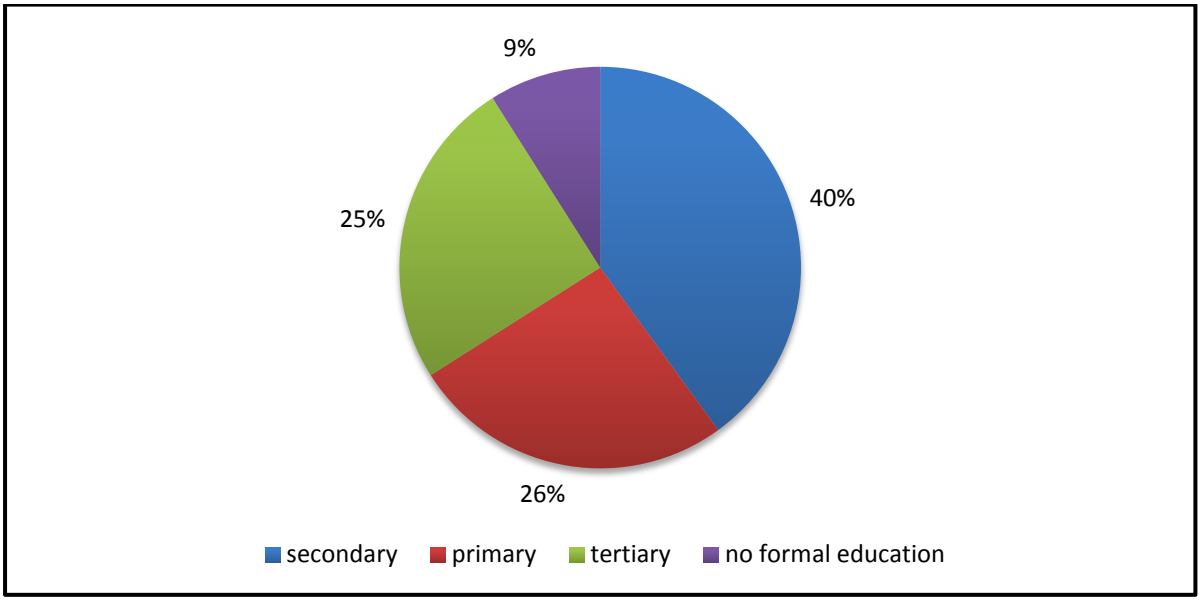


Figure 4.12 Educational qualifications of participants (Source: Fieldwork, 2015)

Despite 65% of the participants having attained at least secondary education, the majority of them are unemployed as shown in Figure 4.13. A minimal percentage has formal jobs, some are self-employed and a few are pensioners.

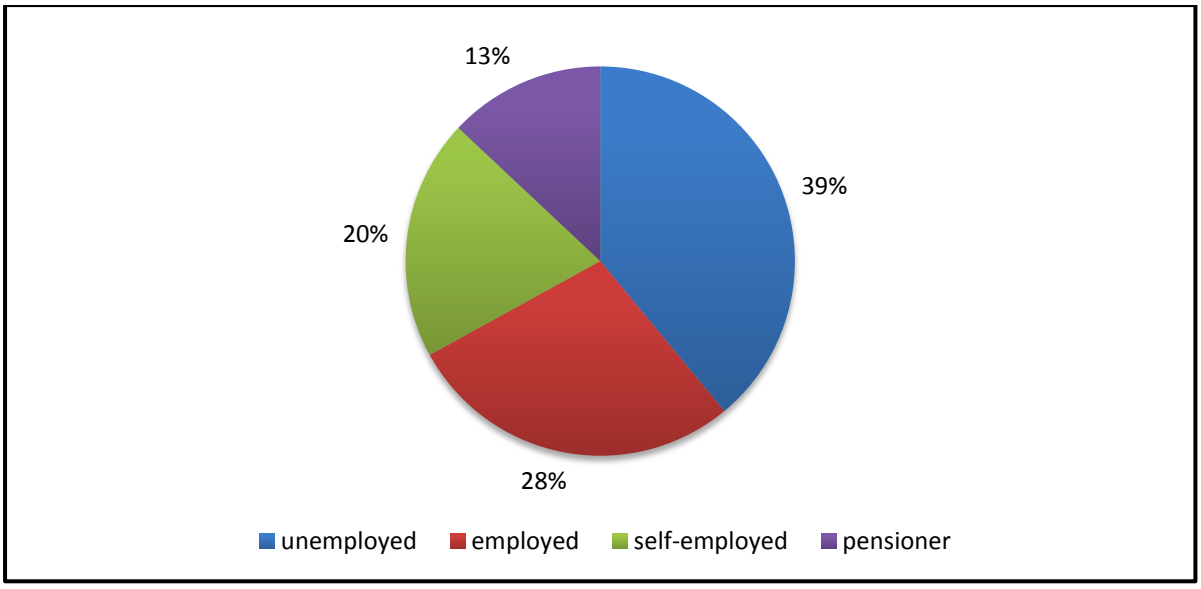


Figure 4.13 Employment statuses of the participants (Source: Fieldwork, 2015)

4.3.3 Gendered vulnerability in Chivi

Vulnerability along gender lines was assessed using HVI results of both female and male headed households. Female headed households dominated the non-vulnerable category, despite them being in a vulnerable area. A 20% of the female-headed households fell into the non-vulnerable, Level 1 (CLH) with 10% of the male-headed households falling in this category, see Table 4.2. Most male headed households are averagely vulnerable. They dominated the ALH category with a count of 84% against 72% female-headed households. Female-headed households are highly vulnerable as 8% of female-headed households were found in a critical level (ELH) against 6% male-headed households.

Table 4.2: Gender and Vulnerability (Source: Fieldwork, 2015)

			Gender		
			male	female	Total
HVI	CLH	Count	5	10	15
		% within HVI	33.3%	66.7%	100.0%
		% within Gender	10.0%	20.0%	15.0%
	ALH	Count	42	36	78
		% within HVI	53.8%	46.2%	100.0%
		% within Gender	84.0%	72.0%	78.0%
	ELH	Count	3	4	7
		% within HVI	42.9%	57.1%	100.0%
		% within Gender	6.0%	8.0%	7.0%
Total		Count	50	50	100
		% within HVI	50.0%	50.0%	100.0%
		% within Gender	100.0%	100.0%	100.0%

4.3.4 Intra gender vulnerability

Besides inter gender variations, intra gender vulnerability was also noted. Households of the same gender fell into different categories as presented in Figure 4.14.

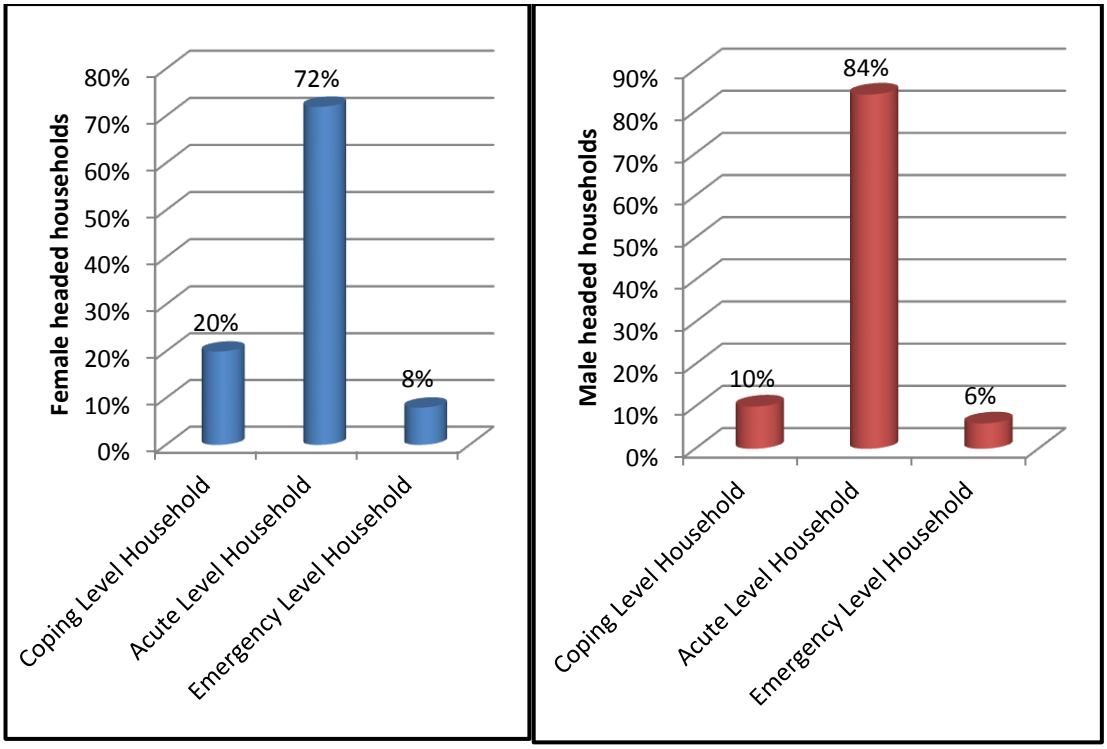


Figure 4.14 Intra-gender vulnerability (Source: Fieldwork, 2015)

A few female-headed households were not vulnerable; a high percentage of them were vulnerable and a sizable percentage was extremely vulnerable. With regards to male-headed households, only a tenth of households were not vulnerable, the majority were vulnerable, with a small percentage being highly vulnerable.

4.3.5 Gendered exposure to drought across dimensions

Cross tabulation of gender and various HVI dimensions of impact showed gendered vulnerability and adaptation in Chivi, as shown in Figure 4.15. All gender groups were highly exposed in terms of human capital. In female-headed households 54% fell into the highly vulnerable category (ELH) together with 50% male-headed households. This dimension shows a substantial full impact on variables such as household sizes, farm labour availability and chronic illnesses and disabilities in the family.

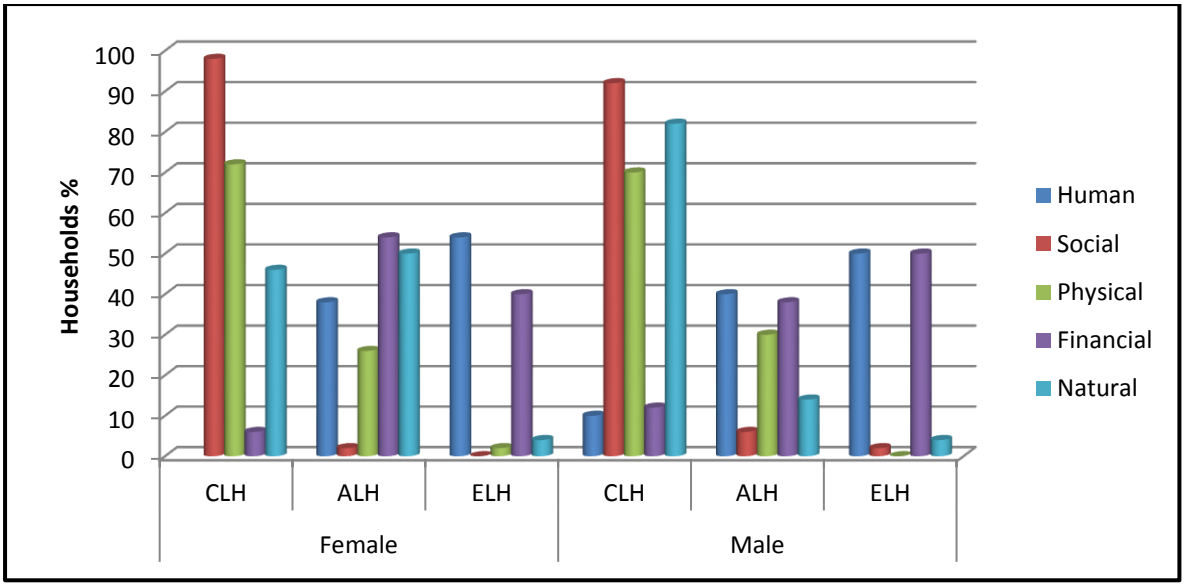


Figure 4.15 Gender and exposure to drought shock (Source: Fieldwork, 2015)

All households, irrespective of gender are not exposed to drought in terms of social assets. Only 2% of female-headed households fell in category ALH and no household was in the ELH level, against 6% of male households in ALH and 2% in ELH. The households have strong social networks. Physical assets do not expose Chivi households to drought. Both gender had access to essential farming equipment and resources. All households lack financial resources; only 6% of female-headed households had sound financial assets against 12% male-headed households. Female-led households are more exposed. Most households especially male headed are well cushioned to drought in terms of natural resources. They had access to essential resources and had sizable arable land more than female-headed households. This contradicts results from focus group discussions. In as much as the community recognises exposure of women to drought, it does not link this vulnerability to gender imbalances. Female participants supported this view. To them drought exposure is an attribute of poverty and unemployment.

The Chi-Square results of gender and household vulnerability confirmed that economic factors had a strong influence on household vulnerability. A Chi-Square test showed no dependent relationship between gender and drought vulnerability in Chivi South as presented in Table 4.3.

Table 4.3 Gender and household vulnerability relationship (Source: Fieldwork, 2015)

HVI * Gender Crosstabulation

		Gender		Total
		male	female	
CLH	Count	5	10	15
	% within HVI	33.3%	66.7%	100.0%
	% within Gender	10.0%	20.0%	15.0%
ALH	Count	42	36	78
	% within HVI	53.8%	46.2%	100.0%
	% within Gender	84.0%	72.0%	78.0%
ELH	Count	3	4	7
	% within HVI	42.9%	57.1%	100.0%
	% within Gender	6.0%	8.0%	7.0%
Total	Count	50	50	100
	% within HVI	50.0%	50.0%	100.0%
	% within Gender	100.0%	100.0%	100.0%

A Chi-Square test showed a value (X^2 = 2.271, df=2, p>0,338) on a limit of 0.050. Hence there is no real statistical significant relationship between gender and household vulnerability. This shows that there are other factors which strongly influence drought vulnerability in Chivi District.

Cross tabulations of HVI against age, marital status, education level, employment status and household size were done to establish factors influencing drought vulnerability in Chivi, as shown in Tables 4.4 to 4.8. This yielded different results. Age did not show a significant influence on household vulnerability and adaptation.

Table 4.4: Household Vulnerability and Age (Source: Fieldwork, 2015)

		Age				
		20-30years	31-40years	41-54years	55+ years	Total
HVI CLH	Count	0	3	3	9	15
	% within HVI	0.0%	20.0%	20.0%	60.0%	100.0%
	% within age	0.0%	14.3%	9.7%	19.6%	15.0%
ALH	Count	2	17	25	34	78
	% within HVI	2.6%	21.8%	32.1%	43.6%	100.0%
	% within age	100.0%	81.0%	80.6%	73.9%	78.0%
ELH	Count	0	1	3	3	7
	% within HVI	0.0%	14.3%	42.9%	42.9%	100.0%
	% within age	0.0%	4.8%	9.7%	6.5%	7.0%
Total	Count	2	21	31	46	100
	% within HVI	2.0%	21.0%	31.0%	46.0%	100.0%
	% within age	100.0%	100.0%	100.0%	100.0%	100.0%

A Chi-Square value of (X^2 = 2.428, df=6, p>0.871) was noted which shows that a household head's age is not directly related to household vulnerability. This implies that there are other factors excluding age which influence household vulnerability. Marital status in Chivi South also showed an independent relationship with household vulnerability (see Table 4.5).

Table 4.5: Household vulnerability and marital status (Source: Fieldwork, 2015)

HVI * Marital status

			Marital status				
			single	married	divorced	widowed	Total
HVI	CLH	Count	3	5	2	5	15
		% within HVI	20.0%	33.3%	13.3%	33.3%	100.0%
		% within marital status	30.0%	11.4%	14.3%	15.6%	15.0%
	ALH	Count	7	36	11	24	78
		% within HVI	9.0%	46.2%	14.1%	30.8%	100.0%
		% within marital status	70.0%	81.8%	78.6%	75.0%	78.0%
	ELH	Count	0	3	1	3	7
		% within HVI	0.0%	42.9%	14.3%	42.9%	100.0%
		% within marital status	0.0%	6.8%	7.1%	9.4%	7.0%
Total		Count	10	44	14	32	100
		% within HVI	10.0%	44.0%	14.0%	32.0%	100.0%
		% within marital status	100.0%	100.0%	100.0%	100.0%	100.0%

The hypothesis that household vulnerability and marital status are related was rejected. The Chi-square test showed the value (X^2=3.063, df=6, p>.834). This shows that households in the Chivi District are vulnerable or coping regardless of the household head's marital status. Household sizes and vulnerability Chi-square test, as presented in Table 4.6 shows that household sizes have no significant influence on vulnerability.

Table 4.6: Household vulnerability and household sizes (Source: Fieldwork, 2015)

HVI * Household size

			Household size				Total
			<4	4-5	6-9	≥10	
HVI	CLH	Count	1	3	11	0	15
		% within HVI	6.7%	20.0%	73.3%	0.0%	100.0%
		% within household size	16.7%	18.8%	14.5%	0.0%	15.0%
	ALH	Count	5	11	60	2	78
		% within HVI	6.4%	14.1%	76.9%	2.6%	100.0%
		% within household size	83.3%	68.8%	78.9%	100.0%	78.0%
	ELH	Count	0	2	5	0	7
		% within HVI	0.0%	28.6%	71.4%	0.0%	100.0%
		% within household size	0.0%	12.5%	6.6%	0.0%	7.0%
Total		Count	6	16	76	2	100
		% within HVI	6.0%	16.0%	76.0%	2.0%	100.0%
		% within household size	100.0%	100.0%	100.0%	100.0%	100.0%

The Chi-Square test revealed a value of (X^2=2.076, df=6, p>0.913). However, household vulnerability in Chivi showed a strong relationship with educational levels and employment status, as presented in Table 4.7 and 4.8.

Table 4.7: Household vulnerability and education (Source: Fieldwork, 2015)

HVI * Education level

			Education level				
			no formal education	primary	secondary	tertiary	Total
HVI	CLH	Count	1	2	4	8	15
		% within HVI	6.7%	13.3%	26.7%	53.3%	100.0%
		% within education level	11.1%	7.7%	10.0%	32.0%	15.0%
	ALH	Count	8	19	34	17	78
		% within HVI	10.3%	24.4%	43.6%	21.8%	100.0%
		% within education level	88.9%	73.1%	85.0%	68.0%	78.0%
	ELH	Count	0	5	2	0	7
		% within HVI	0.0%	71.4%	28.6%	0.0%	100.0%
		% within education level	0.0%	19.2%	5.0%	0.0%	7.0%
Total		Count	9	26	40	25	100
		% within HVI	9.0%	26.0%	40.0%	25.0%	100.0%
		% within education level	100.0%	100.0%	100.0%	100.0%	100.0%

Pearson Chi-Square test proved a statistically significant relationship between educational levels of household heads and household vulnerability with a value of (X2=15 454, df=6, p>0.017). The Chi-Square co-efficient of 0.017 gave confidence that education and household vulnerability are related. Households of less educated household heads were more susceptible to drought shock.

Table 4.8: Household Vulnerability and employment status (Source: Fieldwork, 2015)

HVI * Employment status

			Employment status				
			employed	self-employed	unemployed	pensioner	Total
HVI	CLH	Count	8	5	1	1	15
		% within HVI	53.3%	33.3%	6.7%	6.7%	100.0%
		% within employment status	28.6%	25.0%	2.6%	7.7%	15.0%
	ALH	Count	20	15	31	12	78
		% within HVI	25.6%	19.2%	39.7%	15.4%	100.0%
		% within employment status	71.4%	75.0%	79.5%	92.3%	78.0%
	ELH	Count	0	0	7	0	7
		% within HVI	0.0%	0.0%	100.0%	0.0%	100.0%
		% within employment status	0.0%	0.0%	17.9%	0.0%	7.0%
Total		Count	28	20	39	13	100
		% within HVI	28.0%	20.0%	39.0%	13.0%	100.0%
		% within employment status	100.0%	100.0%	100.0%	100.0%	100.0%

Employment showed a very strong influence on vulnerability in Chivi households with A Chi-Square value of (X^2=20.734, df=6, p>0.002). The Chi-Square co-efficient value .002 shows that this relationship is not due to chance. Households headed by unemployed people are the most vulnerable to drought in the District.

4.3.6 Gender and adaptation in Chivi

Female headed households in Chivi are coping with drought better than male headed households. Female households that fell into the coping Level Households (CLH) had a 20% count against 10% of male headed households. Most male-headed households are not coping with 84% moderately failing to adapt against 72% of female headed households. However, more female-headed households 8% are extremely not coping compared to 6% for male headed households.

Adaptation within each gender also showed variations. In female headed households, while 20% are adapting to drought shocks, 72% are moderately not coping and 8% are extremely not coping. Under male households, only 10% are adapting to drought, 84% are averagely failing to adapt and 6% are extremely not coping.

4.4 Household vulnerability and adaptation in Chivi District

Vulnerability and adaptation were calculated by adding up the five dimensions of impact, namely human, social, physical, financial and natural assets for each household. The vulnerability levels were set at three levels, using the FANRPAN (2005) Household Vulnerability Index. Level 1, which is the Coping Level Household (CLH) ranged from 0-40%, Level 2 which is the Acute Level Household (ALH) ranged from 41- 59%, while level 3, the Emergency Level Household (ELH) was set from 60-100%. Very few households were coping with drought. Only 15 % of the households adapted well to drought, as shown in Figure 4.16.

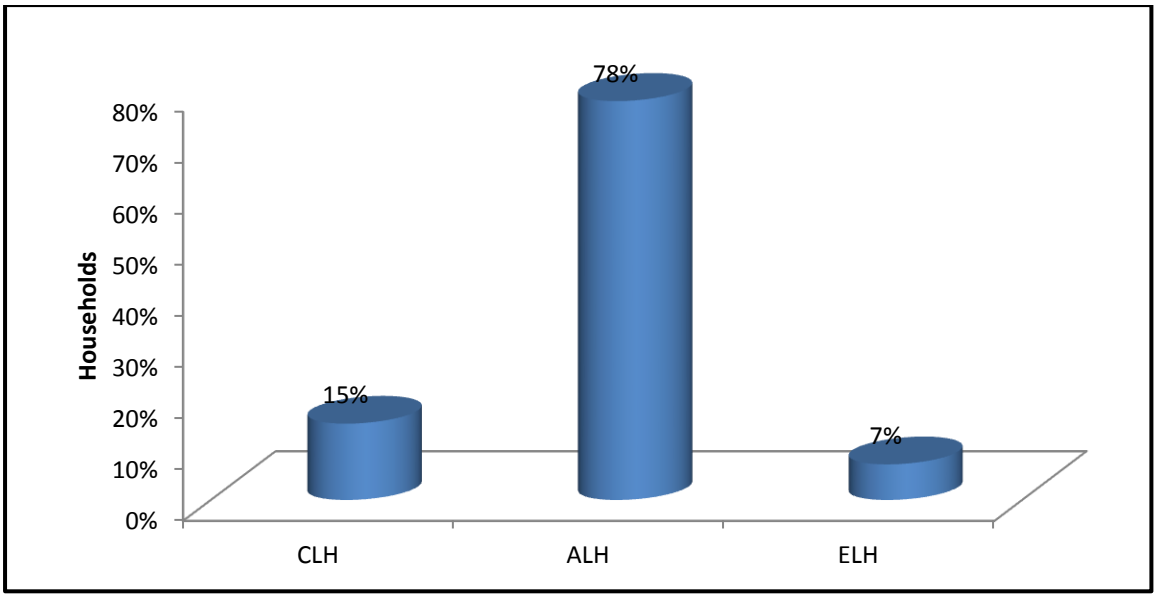


Figure 4.16 Chivi households vulnerability (Source: Fieldwork, 2015)

About 78% of the households are vulnerable to drought and are not coping. 7% are hard hit by drought, are highly vulnerable and cannot cope on their own. They are in need of emergency support.

4.4.1 Household exposure to drought shock

The levels of drought impact on households were weighed across FANRPAN's five dimensions of impact, namely human, social, physical, financial and natural assets. These dimensions were subdivided into 15 variables that are possible indicators of vulnerability, as presented in Appendix 5. Households' responses were highly variable across all dimensions. Households in Chivi are exposed to drought across human and financial assets. The households were resilient in social, physical and natural assets

4.4.1.1 Human assets

All human capital variables that were tested, that is dependants, gender ratio, farm labour availability, dependency and chronic illness or disabilities in the family revealed that many households are exposed in this respect. Households in Chivi have large family sizes. Most households had a household size of more than six members. The largest household size consisted of 25 members. Males dominated these households by a slight margin in Chivi. Most households lacked farm labour. Dependency, which was calculated by a ratio of employed family members and family size was average. A substantial number of households are exposed to drought due to chronic illnesses and disabilities in their families. In addition a substantial number of households have family members who have migrated to South Africa, a few to Botswana, Mozambique and the United Kingdom to seek for employment and other economic reasons. 40% of households recorded a full impact on this variable. Human assets showed the highest score of exposure to drought in the District.

4.4.1.2 Social assets

The social asset dimension was assessed across five variables, namely extended family, support from relatives, formal external support, internal social schemes and external information exchange. More male than female-headed households, in the District support extended families and do not get extended support in return. Almost all households get external formal support during drought from NGOs and government. There is almost a 50 to 50 ratio of households subscribing to social schemes and those which do not. Thus the District is averagely cushioned against drought. Chivi community has a sustainable external information exchange, which is helpful in early warning systems, social networking and off village employment. Most households obtained information on oncoming dry spells from media and Agricultural Extension officers. Overally with regards to social assets households are least exposed to drought.

4.4.1.3 Physical assets

The physical asset dimension was examined by tracking variables such as agricultural equipment access, availability of services, livestock ownership, and accessibility of business and agricultural markets. Households were averagely exposed on agricultural equipment. Eight pieces of essential agricultural equipment were used, that included scotch carts/car, tractor, plough, draught power, radio/television, electricity/solar/generator energy, phone and land. Most had at least two or more of these equipment. No exposure was noted on access to services, all households had essential services. However, a number of households did not have access to banks. Less exposure was noted on livestock ownership, almost all households had at least livestock.

Most female-headed households had little ownership of cattle, but most of them owned goats and poultry. This supports the observations of the community that women only get full ownership to cattle through marriages of their daughters (*N'ombe yemukadzi ndeye humai chete*). Meaning a woman only owns a cow from marrying off her daughter. A key informant from CARE noted that women in Chivi are not comfortable with owning big assets. In one project, when they were asked to fill in their names on a beneficiary register for empowering women through assets building grants women wrote their husbands' names. It is also important to note that despite women in Chivi having access to land, very few have control over it. Males control all farming operations, despite the fact that most of them did not stay in family compounds. Generally, households in Chivi have limited access to towns, which limits the chances of women getting close-by off-farm piece jobs and employment, as well as marketing their produces. Most households had access to temporal government agriculture markets. However, these are temporary markets set during harvest time. Physical assets showed that women are more exposed to drought.

4.4.1.4 Financial assets

Financial variables tracked, included incomes, remittances, agricultural returns and access to financial assets. These revealed overal limited financial resources within Chivi households, regardless of gender. Eighty nine % of households had a full shock on income. Most employed household heads, earned less than the United Nations' stipulated monthly bread basket of $600. Unemployment is also rife in the District, 39% of the respondents were unemployed, most of them women. Average impact was noted on remittances. A significant number of households benefit from remittances. However these are also not enough to cover their basic needs. The results show a 99% full impact on agricultural

returns. Agriculture being mostly done by women in this community, reveals high female exposure. Most households in Chivi are no longer producing enough to sell. Among the few who still get surplus to sell, the returns are below the UN sustainable income index. Most households are surviving on non-agricultural income generating projects such as cross border trade, piece jobs, stone and wood carving, gold panning and selling firewood. Households were less exposed on access to financial assets. A significant number of households had access to loans, credits and social schemes and a few had savings. Almost all households spend most of their finances on food, education and health. Males dominate decision-making on household finances, implying that women are vulnerable. Financial assets show the second highest percentage of households exposed to drought.

4.4.1.5 Natural assets

Access to natural resources, access to potable water, source of agricultural waters, forests, minerals and soil quality were the variables checked. Both women and men had access to natural resources such as pastures, water and forests, with a few respondents claiming access to minerals. However, it is important to note that women had access to the land but do not control it. Men, even those staying off family compounds remotely controlled daily operations on the farms. Therefore, while technically women have high access to essential resources, socially they remain vulnerable.

A number of households in Ward 22, 24 and 31 did not have access to pastures and arable land due to the construction of Tokwe-Mukosi dam. Households are averagely exposed in terms of access to potable water. Despite a number of households having access to water, a substantial number travel over two kilometres to the nearest water point, with a maximum distance travelled reaching 5 kilometres for those in Ward 32.

The source of agriculture water highly exposes every household in the District. Every household relies on rain for agriculture. Households have sizable but less fertile pieces of land. Most of it is no longer in use. However, there are isolated cases of people with no land in Chivi, especially widows and displaced families. Poor soil quality exposes households to drought shocks, a significant number of respondents confirmed soil infertility. Overal both women and men have access to natural assets. Natural resources had an average influence to drought exposure in Chivi.

4.5 Culture and gender vulnerability in Chivi District

The key informant interviews revealed that the Karanga originated from Central Africa, settled in Northern parts of Zimbabwe and pushed south due to tribal wars and moved to the

semi-arid region due to colonial land tenure systems. The main trait of Karanga culture is human respect (*hunhu*). The elderly and traditional leaders who participated in focus group discussions view culture as a defining principle to livelihoods in the District, while the youth view it as gender insensitive.

In decision-making processes at both community and household level, women have no space culturally. This is even embraced in their language discourse where it is said decision making is not for women (*mukadzi haana dare*). Vital assets such as land, livestock, main crops, household equipment and financial assets are controlled and owned by men. Women can access these resources through marriage. In case of death of their husbands, these assets are controlled by male relatives of the husbands. After divorce, women forfeit these assets. Women own less significant crops and livestock such as groundnuts, vegetables, poultry and goats. Government policies are now promoting gender sensitive development and women empowerment. Women are allowed to access land from Chiefs. Some NGOs such as CARE and World Vision have embarked on gender awareness training in the community. However, this has resulted in mixed reactions. Elderly community members are not ready for change, while the youth are ready for change. At household level, women involvement in decision-making and control over resources varies with families.

4.6 Adaptation strategies in Chivi

The coping strategies in the District range from anticipatory policy initiatives to long and short term measures at household levels. These are generally planned by the government in response to international statutory. There are also autonomous measures at a public level. These include all immediate response to the shock after a drought has been proclaimed. At household level, coping mechanisms include both long and short term strategies. Adaptation typologies in Chivi are presented. All these adaptation strategies show gender dimensions.

4.6.1 Public coping mechanisms

Community level strategies are often NGO led. Agencies active in this community include CARE, WORLD VISION, Red cross, CADEC, ACTION Contre la FAIM (ACF), Southern African Aids Trust (SAAT), Enhancing Nutrition Stepping Up Resilience (ENSURE) and Southern Alliance For Indigenous Resources (SAFIRE). These NGOs are spread in different wards across the District. They work on various projects all aimed at reducing drought vulnerability.

Table 4.9 Community coping strategies (Source: Fieldwork, 2015)

Organisation	Initiatives
CARE	Food relief, installing boreholes, food for assets, nutrition for children under 5 years, pregnant and breast feeding mothers
WORLD VISION	Food relief, seed hand-outs, water supply, financial schemes, asset building
CADEC	Food relief, seed relief, support AGRITEX projects
ENSURE	Marketing of livestock, crops and disaster risk reduction, nutritional gardens
SAFIRE	Natural resources conservation, community vegetable gardens
SAAT	Conservation agriculture, water harvesting and gully reclamation, HIV/AIDS projects

Most of the NGOs' initiatives are ex-post reactions aimed at reducing drought shock on the community. The strategies engage the communities in a holistic manner. CARE and CADEC in some projects recently noted the subtle gender lines within Chivi South, hence they now recognise the importance of gender mainstreaming in adaption strategies. New projects, such as food for assets in Ward 22 and asset building in ward 32, empower and give women an opportunity to own essential assets such as livestock. Food comes in only as an incentive to motivate them to build their assets. SAAT and ACF directly address human vulnerability through ensuring food nutrition accessibility. It reduces drought shocks through sustainable nutritional food agriculture, while SAFIRE indirectly addresses vulnerability through natural resources conservation. Most of these NGOs target specific beneficiaries regardless of gender. All NGO operations are government regulated.

4.6.2 Government led adaptation strategies in Chivi

Government operates in Chivi through various departments. Agriculture, Research and Extension (AGRITEX), Veterinary Services, Environmental Management Agency (EMA), Social Welfare and Local government are active departments in Chivi District. AGRITEX and Veterinary Services implement government policies of ensuring maximum food production in the area through various agricultural practices such as conservation agriculture and

community rotational paddocking, while EMA safeguards natural resources and sustainable development. Social welfare gives grants to disabled and elderly community members. The Local government provides food relief during drought in cases where drought has been declared a national disaster. It also heads a popular food-for-work programme in Chivi District. In this programme, communities provide in return for food labour in road or dam construction, gully reclamation and other projects in the area. However, the programme is labour intensive and only embraces the energetic group. The major government drought related project in the District is the Tokwe-Mukosi dam, which is set to benefit two thirds of the District wards. This is the project which displaced seven villages from ward 31 and affected some farming land in ward 22 and 24. All government initiatives take a top down approach and lack a gender approach.

4.6.3 Community initiatives

The communities also have their own traditional collective adaptation strategies. Various co-operatives run in the District. These include collective vegetable gardening (*mushandira pamwe*). In this community, members contribute money to buy fences and vegetable seeds and to start their own gardens. The other co-operative is group farming or harvesting *(humwe*) and work for beer *(bharoni*). The most recent initiative is marketing of individual products (*huya uhodhe*) in various wards. Marketing dates are announced throughout the wards and individuals get an opportunity to market their products.

In these co-operatives, members often choose their leader and decision making is done collectively. The profits made are often invested into community financial schemes. More women participate in these schemes than men. There are also co-operatives led by NGOs in this District. These include vegetable gardening, water reservoir building, financial and livestock schemes, as well as conservation projects. These projects usually target specific groups of the community. For example, the vegetable gardening co-operatives across all wards under study target the orphans and people living with HIV/AIDS. However some co-operatives, such as financial schemes involve willing individuals. Conservation co-operatives target affected communities, specifically those living in vulnerable environments such as those along Runde catchment. Community initiatives are mostly run by women; men lack interest in them.

4.6.4 Gendered coping strategies at a household level

Results from the Key Informant Interviews and Focus Group Discussions established that adaptation strategies at household level varied across gender lines. Female gender coping strategies include savings on household assets such as finances, food and seeds, crop and livestock diversification, vegetable gardening, craft, beer brewing and cross border trading. Diversification of crops usually involves different crops being farmed on one piece of land to ensure food security in case some crop varieties fail. This involves crops such as sweet potatoes, Bambara nuts, ground nuts, millet, sorghum, rapoko, and maize. With regards to livestock, particularly poultry, many women own ducks, traditional chickens, turkeys and guinea fowl. In some cases, crops were spread across the farming season for in case rains come early or late. Male strategies involved diversification of crops and livestock, selling of cattle, financial savings, loans, off-compound employment and piece jobs. Most male coping strategies involved big value assets. However variations in coping mechanisms at household level were not only confined to gender lines.

4.6.5 General household coping strategies

At household level, coping mechanisms varied from one household to another. The focus group discussions revealed that adaptation strategies include before drought and after drought initiatives. Households without stable incomes often engaged strategies such as barter trade, piece jobs, gold panning, selling firewood and livestock. Average income households diversify livestock and crops, take loans, stagger crops and cross border trade while the wealthier spread their financial investments and savings, as well as diversify livestock.

Table 4.10: Household adaptation strategies (Source: Fieldwork, 2015)

Pre drought exposure strategies	Post drought strategies
Staggering of crops planting, diversifying crops, small grain farming, diversifying livestock,	Piece jobs, food rationing, barter trade, cross border trade, taking loans, gold panning, fruit
Savings, investments, buying cattle, storing food stuffs, social schemes	Gathering, selling livestock, vegetable gardening, weaving, sculpturing, off compound temporary jobs, remittances

Pre drought strategies were more planned and long term focussed, while the after drought mechanisms tended to be unplanned and short term focussed. Pre-drought strategies were mostly done by women, while most men intervene only when drought strikes.

4.7 Indigenous knowledge on drought vulnerability and adaptation

The focus group discussions with the Traditional leaders and other community members revealed interesting views. Traditional leaders revealed that droughts are not new to Chivi District. They have occurred from time immemorial. However, they were rare and severe. The most vulnerable were widows, as they had no male figures to support them. Droughts were a sign that the ancestors are not appeased. A large flock of grasshoppers and abundance of (*Makwakwa*) fruits was a sign of oncoming drought. Rain making ceremonies (*Mukwerera*) would be performed first and if no rains were received, a messenger would be sent to a place of ancestors (*Matonjeni*) to ask for rain.

As an ex-ante drought coping mechanisms community members would farm food crops on a communal land (*Zunde ramambo*) and store the yields in a communal granary controlled by the Chief. However, due to individualism all this has been abandoned. The other community members blamed the untrustworthy leaders and messengers, who would often use the system to their own benefit. A discussion on indigenous knowledge also revealed gender dimensions. Most men work off-compounds, which limits manpower to work on Zunde ramambo. Also, it has become culturally wrong for the Chief to ask women to work on his farm, in the absence of their husbands.

4.8 Chapter summary

Drought was prevalent in Chivi District in 18 of the 30 years observed. Food crop production showed variations mostly in relation to drought frequency. The Household Vulnerability Index results showed that 20% of female households were adapting well to drought while 80% were vulnerable. In male households, only 10% were coping and 90% were vulnerable. Eight percent of female-headed and 6% of male-headed households was at a critical level which needs immediate intervention. Intra-gender vulnerability was also noted. Despite women having access to most resources, they lacked total control in all assets. A number of gendered coping strategies have been adopted in the area. This implies that though there is gendered vulnerability and adaptation, there are more factors influencing drought vulnerability in the District. The next chapter discusses the findings of the study and makes recommendations.

5.0 Introduction

This chapter discusses the findings of the results of drought incidence and gendered vulnerability and adaptation to drought. This study aimed at examining spatial-structural drought characteristics, food crop production changes, as well as analysing gendered vulnerability and adaptation to drought in Chivi District. The specific objectives were to establish characteristics and the extent of drought occurrences in Chivi in the past 30 years and to assess food crop production changes. Gendered vulnerability and adaptation to drought in the District were also analysed. These objectives guided the researcher in defining drought vulnerability of Chivi, food changes and gendered response as a representative of many rural communities in Zimbabwe and to propose a better adaptation strategy for this community.

5.1 Spatial structural characteristics of drought in Chivi

Characteristics and extent of drought that occurred in Chivi District between 1983 and 2013 was assessed. This was crucial to this study, as it brought out the nature and magnitude of the climatic hazard affecting livelihoods in the District. It clarified on the level of exposure the District experiences. Vulnerability being a compound effect of external and internal vulnerabilities (IPCC, 2007), spatial structural drought assessment allows the assessment of external vulnerability of the District. In this case drought gives external vulnerability of the community indirectly.

The study showed that, though Chivi is exposed to a number of shocks such as economic hardships, poverty and diseases such as HIV/AIDS, drought is the most common shock. This corroborates studies by Mudzonga, (2012); Mapfungautsi (2012); Nhodo *et al. (*2012) and Zimbabwe National Contingency Plan Committee (2013).The Zimbawe National Contingency Plan Committee noted that drought topped the natural disasters that hit the country between 1982 and 2011. The SPI results show that drought occurs frequently in the District. The 1 month SPI timescale showed drought cycles in 24 out of the 30 years assessed. The SPI capabilities of depicting moisture deficit across a different spectrum were employed to measure different types of drought occurring in Chivi. The 1, 3 and 6 month timescales showed that Chivi has been affected by several episodes of meteorological, agricultural and hydrological drought.

Drought of different magnitude affected the District. The study showed that the drought characteristics in Chivi ranged from mild to extreme events. However, mild drought occurred frequently, followed by moderate drought, while severe and extreme droughts are very infrequent. This contradicts Chifurira and Chikobvu (2010), Mudzonga (2012) and Brown *et al.* (2012)'s findings that, of late, this region is characterised by erratic rainfalls and extreme events. It is important, however, to note that, though severe drought is less frequent in Chivi, high frequency, low magnitude drought equally affects livelihoods in semi- arid areas. The District has near surface aquifers, is a low lying area characterised by high mean maximum temperatures and high evaporation rates (Davies and Burgess, 2005 and Chikodzi and Mutowo, 2013). The community relies heavily on rain fed agriculture. Hence mild droughts have the potential to affect livelihoods or even cause socio-economic drought. The study also revealed that though drought is prevalent in Chivi, drought has become mild and less frequent in the last 15 years of the study. Drought was more frequent in the first half of the study. Low magnitude, wet cycles characterised the period 2000 to 2013. Since the year 2000, drought has been less frequent. However, this could be because of differences in the study periods observed.

Another climatic variability noted, in this study is the shift of the rainy season in the District. In recent years rainfall is received late in the rainy season, that is from December to March instead of the normal October to December. The normal mean climate for Chivi shows that the area receives early rainfall between October and December from the West and South-East Tropical cyclones and is less affected by the ITCZ movement. ITCZ brings moisture to the upper and central parts of Zimbabwe and is characterised by peak rainfalls in December and January (Unganai and Mason, 2002; Dube, 2008; Chifurira and Chikobvu, 2010). The results imply that either Chivi could be now benefitting from the ITCZ movement or the tropical cyclones cycles have shifted. This opens up a grey area for further study. The shift in rainfall patterns was also noted by Simba *et al.* (2012), Brown *et al.* (2012) and Mugandani (2009). However, their studies focussed only on the extension of aridity in agro-ecological zones.

Most droughts that occurred in Chivi are localised and less spread. Only droughts of high magnitude, such as the 1983, 1987 and 1992 drought, extended across the country and beyond the borders to neighbouring countries such as South Africa, Botswana, Zambia and Mozambique. The 1992 drought was the most wide spread. The low magnitude droughts extend into the North-west and Southern parts of the country. This coincidentally forms the trough passage of the Tropical cyclones which bring rainfall to the South and western parts

of the country (Dube, 2008). This implies that the anticyclone pressure systems such as the Botswana High are the major causes of drought in Chivi. This is also supported by Unganai and Mason (2002) who account severe droughts in the area. They informed that the 1992 drought was ENSO related and the anticyclonic disturbance of the ITCZ caused the 1983 and 1987 drought. Most of the droughts picked by the 6 month SPI timescale were mild.

Chivi is a semi-arid region with very low mean annual rainfall figures. The variation between mean annual rainfall of a particular year and the average annual rainfall figure might not vary much, hence the map resolution could not pick these droughts and depict a normal condition. This also explains why the 1992 drought map shows a mild condition yet it was the most extreme drought in the region. It is also important to note that the IRI-SPI configured to the East Anglia database had limited data of up to the year 2000, and the other databases had crude resolutions which could not display a small area such as Chivi. Thus the researcher had to use the available limited data of up to the year 1998.

The Chivi community has been exposed to a number of droughts, with drought at least occurring after every other year. In Zimbabwe, the Government responds to a drought, when it is declared a national disaster at the discretion of the Civil Protection Unit. To meet the standards, drought has to be widespread and of high magnitude, leaving a marked deficit in maize production. Most of the droughts occurring in Chivi do not meet these requirements. However, it is crucial to note that, despite most droughts being mild, continuous lack of sufficient moisture depletes soil moisture, subsurface recharge, stunt vegetation growth and reduces biodiversity of the area. Dhliwayo and Mutuso (2010) point out to sparse low lying thorn shrubs characterising Chivi forests and human-animal conflict over limited natural resources. Socio-economic drought could be also experienced in the District. FAO (2011) noted that recurrent droughts have caused famine and killed thousands in Somalia. Thus, drought might be indirectly linked to some deaths and poverty in the District. However this remains a grey area for further study. Food crop production patterns speak volumes of the effects of drought in Chivi.

5.2 Changes in food crop production in Chivi

The study shows that food crop production is generally low in the District. Drought is exacerbating the already fragile food insecure community. The AGRITEX department informed that poor soil quality, scanty and erratic rainfalls influence crop production in the area. However, the study results points to more droughts. These findings are supported by

Scoones (2013) who noted dramatic fluctuations in maize production trends in Zimbabwe between 1961 and 2012. He also observed that the rainfall pattern was closely linked to the National maize production trend. The results showed a general declining maize production with every fall in rainfall. Maize is not only a staple food crop, but it is the most preferred crop, hence a fall in production means exposure of the whole community to food insecurity. Munhande *et al.* (2013) also noted a drought related maize production fall in the South of Chivi District.

The period 2005 to 2009 showed a marked consistent fall in maize production. This could be due to the drought that occurred within that time frame. However, it is important to note that this is the period when Zimbabwe had economic hardships. Anseeuw *et al.* (2012) noted that a half a million tonne fall in agricultural production between 2000 and 2008. The focus group participants also added that maize seeds were scarce and so was capital to purchase it together with other agricultural supplements. Generally, food crop production patterns in Chivi match the agricultural production patterns at national level. This might imply that the factors hindering food crop production are not exclusive to Chivi, they are felt across the country. The drought spatial extent results revealed that Chivi is unique in drought vulnerability. This might also be pointing to whole a lot of other barriers to food crop production. However, this forms a grey area for further research.

Millet is the only food crop which remained stable even during drought periods. Zishiri (2013) and Makuvaro (2014) also observed the drought resilient nature of this crop and small grains in general. However, despite it being drought resistant, it is not a popular crop in the District. Contrary to Mutekwa (2009)'s findings in Zvishavane, in which small holder farmers preferred small grain crops, Chivi community viewed the crop as a traditional and primitive small crop, which is only ideal for beer brewing.

However, communities are not homogenous. There is a gap in perception, between Chivi residents and AGRITEX and NGOs such as CARE officials. Experts view small grains as the most viable food crop option for Chivi. This begs the question whether this labour intensive crop in a human capital drained community such as Chivi is feasible. Sukume *et al.* (2000) found out that small grains are not the last option. They recommended short spun maize varieties which have the potential to boost productivity. This should however be open to further research on drought resistant maize crop varieties.

The source of agricultural water remains primarily rain, despite almost every Ward in the District having access to a dam or at least a perennial river. The dams remain underutilised,

only irrigating a few vegetable gardens funded by NGOs around. Chikodzi *et al* (2013) also noted that the high capacity of the dam to revive agriculture was not acknowledged in the area. Water, in almost all cases observed, was drawn by buckets. Vegetable gardening, despite being practised at a small scale, is one of the most popular coping strategy in the District. These vegetables are not only a source of the much required nutrition, but they are viewed by most women as a viable, source of stable income in small businesses at major business centres such as Ngundu. However, drought proved to have gender dimensions.

5.3 Gender vulnerability to drought in Chivi District

Drought exposes the Chivi South community across all gender lines. Vulnerability, in this study, is the susceptibility of a household to drought (FARPAN, 2011). The HVI estimated the level of vulnerability across physical, social, human, financial and natural assets of each household. This gave resilience or vulnerability of each household. A household head with a lot of assets would be less vulnerable to drought shock.

The results show that female-headed households are as vulnerable to drought as much as the male-headed households. A number of these households adapt better than male headed ones. This might be because they are free to make decisions and travel off their compounds. One respondent, who is into cross border trade corroborated this view,"Ini handina murume, saka handigari pasi, kuti ndiraramise mhuri yangu". (Being a single parent I travel a lot and work hard to provide for my family). Most coping households were run by either pensioners, employed or self-employed heads. However vulnerability is generally high in Chivi across all gender lines. This can be attributed to failure by Chivi residents to access town centres for possible employment opportunities. The Wards studied are served by Zvishavane, Masvingo and Chiredzi towns which are 70km, 100km and 151km away from Chivi respectively. The biggest business centre in this community is Ngundu, which does not have any industry or main supermarkets to offer employment. The District is generally rural and it offers little opportunities for employing its people.

A substantial number of self-employed-headed households fell into less and non-vulnerable category. These are mostly female headed households. Most of these people are cross border traders, who have opened up flea markets (*huya uhodhe*) in various business centres across the District and diversified their financial resources. However, the focus group discussions pointed out a number of negative effects of this trade. The rise in HIV/AIDS infected people, orphans and broken marriages were some of the issues raised. Murendo

(2012) and ZIMVAC (2013) also observed high HIV/Aids vulnerability in Chivi. However, the study noted the high prevalence of female widows.

The shocking findings were that, even working household heads, both men and women, were found in the vulnerable level (ALH). Most of the heads earn way below the UN bread basket index of $600 per month. It is also important to note that even if they are cushioned in other assets, the financial asset has ripple effects on household resilience. Households with limited financial assets struggle to meet basic expenses, fail to invest some money or save. These workers with little income are usually fulltime workers who hardly have time to do other income generating projects. This vicious cycle of poverty exposes the households to any type of shock. In a dry land area, characterised by frequent drought, sound financial resources are required to make a household cope.

Despite female-headed households adapting better than male headed households, female households dominated the most vulnerable category (ELH) These households are hard hit and cannot cope on their own anymore. The household heads are unemployed, lack almost all resources except for natural assets such as forests, water and land. This shows the importance of sound finances in less productive agricultural areas such as Chivi South. Over reliance on natural resources exposes communities to climatic risks (IPCC, 2007). Natural resources are directly affected by drought. In areas such as Chivi where drought is frequent, these households are highly exposed.

The study also revealed intra-gender vulnerability. Variations in vulnerability were observed in households despite them being of a similar gender. Female and male-headed households fell into different categories. This implies that vulnerability is not only gendered but intra-gendered as well. This also reveals that there are other factors influencing drought vulnerability besides the gender dimension. Chi-square tests revealed a strong relationship between household vulnerability and the levels of education, employment and social class. Households with educated, employed and middle to rich class people are less vulnerable to drought. The highly educated, or, at least those who reached secondary level, formed the employed population in Chivi District. Unemployment is rife in the District mainly because of few employment opportunities in the area as it is predominantly rural. Chivi has been drained of the active youthful population. The youth have migrated to either distant towns in Zimbabwe or neighbouring countries such as Botswana, South Africa and Mozambique. Very few have migrated overseas. Hence, the District lags behind in development.

The focus group discussions identified three social classes in the District. The rich, that is those who have accrued wealth through employment and businesses such as retail, livestock and transport. The second class consists of the middle class. These are employed or self-employed people who do not rely on agriculture and the resilience is financial influenced. The poor are the least educated and those with no formal education unemployed people who rely solely on agriculture for their livelihoods. This is the class which is mostly affected by drought in the District. The HVI results confirmed that not only is this class vulnerable to drought, but the middle income class is as well. This implies that their incomes are not enough to cushion them during drought periods. However, it is important to note that the so called poor are severely affected. The households which fell into the extremely vulnerable level, ELH, had all the characteristics of the poor. Adaptation to drought varied across the gender lines.

5.4 Gendered adaptation to drought in Chivi

The study revealed gendered variations in coping levels as well as mechanisms across the District. The HVI results show that more female-headed households adapted well to drought as compared to male-headed households. This implies that female households are coping well to drought than males. These coping households consisted of pensioners, employed and self-employed household heads. The same households had more than one source of income and possessed drought buffering assets such as cattle and drought impact free businesses such as transport and retail. This is in contrast to the previous research by WRI (2000); UN Women Watch (2004), IPCC (2007) and Mubaya *et al*. (2010), which noted men to adapt better to climatic risks as they are more mobile, control vital resources and stand more chances of off-compound employment. Though most men in Chivi are employed, their incomes are too low to cover their families' basic needs.

This study also noted that, while a substantial number of males were employed, very few had other income generating projects as compared to females. One male respondented revealed a reverting dilemma, "Kuinvester hapana asingadi kana kusafunga nezvazvo, asi unoiwanepi mari yacho wakatatirira muhoro wangu negurumwandira riripano". (Everyone wants to invest, but finances are limited especially with such big families). Over reliance on salaries weakens most male-headed households. Most of male-headed households, which were coping well had either an employed spouse or children or their spouses had other income generating projects. This also points to gender imbalances in decision-making at household level. The household questionnaire participants and Focus group discussants

both confirmed that decision-making on crucial issues such as finance use lay with men. Female-headed households which invested their finances in a number of income generating projects survived drought. Heifer (2010) and Ribeiro (2002) corroborate these findings. Using the Mumbwa District, Zambia and Gaza Province, Mozambique cases, they noted that women, given a platform in decision-making and if they are economically empowered, can help their communities adapt to climate change. It is also important to note that decentralisation of household financial decision-making benefit households regardless of the gender of the household head. Most coping households had their heads, or their spouses or matured children in financial use decision-making.

Male-led households had high dependency ratios than female-headed households. Dependency ratio, in this study was calculated as the number of employed family members to the family size. High dependency ratios in male-headed households might be related to the Karanga cultural values. Normally, struggling extended families and orphans are put under the custody of an employed paternal, male relative. Although many male led households struggled to cope with drought, more female headed households were found to be not coping at all and were, in dire need of external support. This confirmed UN Women Watch (2004) and Mubaya *et al*. (2010) findings that women are more prone to climatic risks. However, in this study, fewer men households were found in the coping category. This might be implying that drought vulnerability is not gender biased. It is the unemployed, poor female-headed households in Chivi who were failing to adapt. Therefore it is important to note that though gender adaptation variations are peculiar in this District due to various socio-economic issues, the drought shock is felt across the whole gender spectrum.

Intra-gender variations were also noted in drought adaptation. Some female headed households were coping well, while others were not coping at all. This was noted across all gender lines. Households fell into different vulnerability categories despite being of the same gender or Ward. The HVI findings revealed that economic issues, such as employment and incomes, have much influence on drought vulnerability across the District. The most educated people from the working class with high incomes were coping well with the drought than those that relied solely on agriculture. Mudzonga (2012) and Munhande *et al*. (2013) also noted that riches influence adaptation levels in rural communities.

The HVI results also showed that, besides financial assets, human capital has also a strong influence on drought adaptation. Most households across the District lacked farm labour, as well as off compound family support, despite the region having high household sizes. Chiripanhura (2010) investigating poverty traps in Chivi District, also noted that farm labour

was drained due to migration, especially in the southern parts of the District. The most active population had moved to nearby towns and neighbouring countries such as South Africa, Mozambique and Botswana. Though some households benefit from remittances, these are little to cover all basic needs. Most households were spending this money on food and education. Youth are critical for the development of the District, as well as innovations in coping strategies.

5.5 Adaptation across Chivi District Wards

Adaptation across the Wards also showed some variations. Ward 25 had the highest number of households which fell into the coping category, followed by Ward 22 and 32 while both 31 and 24 had the least coping households. Ward 25, which is the Ngundu area, varies from other wards in that it lies on the node of the main national transport network line. This is the busiest road which connects the country to South Africa and Mozambique to the South. It also links to many towns in Zimbabwe. This area has become the major business centre in the District. People in Ngundu, mostly women have opened up various small businesses from retail shops to flea markets and even the poor households cope by selling vegetables. The youth sell food, drinks, airtime and foreign currency. It is also important to note that Ward 22 has more services such as schools, clinics and water sources readily available. The ward has also a wetter micro climate, due to its relief. The AGRITEX officials also confirmed higher agricultural productivity in this ward. Males in the area, especially the educated showed a bit of scepticism about these small businesses, with some calling them a front for prostitution, which is rife at this centre.

Wards 22 and 32 had the second coping households. Ward 22 is along the same main road as Ward 25, however it does not have a big business centre such as Ngundu. Adaptation in the Ward is dependent on off-compound piece jobs, selling carvings and vegetables. Ward 32 is a remote area lying around Berejena Catholic mission. Services such as clinics and schools are accessible.The Ward is generally inaccessible, which lowers adaptation levels especially to unemployed female and male-headed households, who are less mobile. Chiripanhura (2010) also noted that remote Wards in Chivi struggle to cope. The CADEC, Red Cross and World Vision help households in this Ward to adapt through various projects such as basket weaving, vegetable gardening, community loan schemes and asset building. However, the area has no markets to sell their produce. Despite having two dams in the Ward, irrigation is minimal, and is characterised by vegetable gardens watered by buckets.

Ward 24 and 31 had the least coping households. These wards lie in the Zifunzi and Zunga area where most people were displaced by the construction of the Tokwe-Mukosi dam. Hence, it is important to note that these Wards had the least number households and a sizable number of households which remained where lost their land and pastures to the dam construction. Besides drought vulnerability, these households were recovering from the early 2014 Tokwe-Mukosi floods. The displacements hugely impacted on many households' social networks and family systems hugely. The focus group discussion in Ward 31 showed that, prior to displacements, many households coped by selling vegetables and mealies at business centres such as Museva and Zivuku along the Beitbridge-Masvingo road. Ward 31 is characterised by several swampy areas which allowed people to farm throughout the year. Uncertainty over further displacements also prevents people, in this area from investing in long term coping mechanisms.

At District level, the HVI results showed that Chivi is more resilient in terms of social, natural and physical assets. Households have strong social networks, good information exchange capacity and sound social schemes. Most of these social schemes have been established by NGOs. They provide relief during drought periods, as well as much needed cash for critical issues such as funerals, school and hospital fees. The sustainable schemes are the asset building schemes, which seek to empower women buy helping them to own essential assets such as livestock.

The HVI also revealed that Chivi has adequate physical and natural assets. Many households, regardless of gender, have access to land, livestock, forests and water. However it is important to note that, while resources like land and water are readily available, they are hugely underutilised. Agriculture, in the area, depends on rain. Due to frequent droughts and limited farm labour, households resort to utilise small portions of their land.

Despite households in Chivi having a wide range of livestock, a substantial number of households do not have cattle. Cattle are a symbol of wealth. They are not only a source of meat, but they are a critical drought buffering asset. Cattle are sold for money or bags of maize during drought. This accounts for minimal cattle in the area. However, cattle also do not cope well during drought, hence the prevalence of donkeys and goats in this drought stricken area.

Water resources in the District are still inaccessible. Most households travel at least two kilometres to get potable water. In areas such as Ward 32, households draw water from dams and rivers. Despite the water being unsafe for drinking, as these are open sources for

both animals and humans, its availability depends on rainfall. During drought seasons residents would not have water at all. Water is available for agriculture, as shown by the number of dams around Chivi. However, its availability is not synched with accessibility. Technology to draw water from dams to the agricultural land is lacking.

Misalignment of economic development was noted by Chameleon Research Group (2012) as one major barrier to effective adaptation. The study showed that Chivi does not have an active population, and consists of an ageing population. Hence developmental projects should match the needs of the beneficiaries. Moreover ZIMSAT (2012) noted that the District has a high female population. Women, due to their gender roles, are already overburdened with child care and household chores. Hence labour intensive bucket irrigation schemes might therefore fail to boost agricultural productivity, and ensure food security and cushion the District from drought. The study noted that agriculture is mainly dominated by females. Thus, food security is threatened as women are already overburdened.

5.6 Gender and adaption strategies in Chivi

Adaptation strategies varied across gender lines. The female gender coping strategies were more planned and long-term focussed. The female coping strategies involved savings on household assets such as finances, food and seed. Diversification of crops and livestock were also a coping mechanisms adopted by many females in Chivi. Different crops are farmed on one piece of land to ensure food security in case some crop varieties fail. In some cases crops are spread across the farming season in case the rains come early or late. Diversification is also done in livestock, especially in poultry. Many women own ducks, traditional chickens, turkeys and guinea fowl. Droughts in Chivi are often characterised by livestock diseases such as foot and mouth in cattle and Newcastle in poultry. Having more livestock means higher chances of surviving drought periods.

Market gardening and crafts are some of the coping strategies that are popular among females gender in the District. These strategies are practised on and off drought periods to boost household financial assets. Munhande (2013), assessing coping strategies of small holders farmers in Chivi, noted that irrigation farmers get higher incomes than dryland farmers especially during drought periods. However, his study's findings on gender adaptation strategies revealed that more males are into gardening. This contradicts the results of this study. Males shun gardening and refer to it as a female gender activity. Vegetable gardening is, however, affected during drought periods as irrigation water comes

from rivers and dams. It is also more lucrative around main business centres than in remote areas.

Cross border trade is also one of the popular coping strategies among women. This involves the buying and selling of household goods such as groceries, clothes and electrical equipment. However, this is usually done by middle class females with enough capital to invest. Cross border trade is most popular in Ward 25, where traders have opened up flea markets. In other Wards, it is practised but traders struggle with markets for their products.

In most Wards, selling of traditional beer is one of the commonest coping strategies women engage in. This strategy is common in poor households. Sorghum and millet crops are drought resistant. This makes these households constantly rely on this strategy. This strategy is not only practised during drought seasons, but even during wet seasons to generate cash for basics such as school fees. Though traditional beer selling generates the much needed cash, it brings social ills such as women abuse. Moreover family men spend most of their money on beer than basic household needs, this perpetuates poverty and vulnerability.

One important trait of female coping mechanisms is that every asset matters no matter how small its value is. Women in Chivi, dry wild fruits such as *hwakwa, matamba* and *nyii,* as well as vegetables and small crops such as Bambara nuts *(Nyimo)* and ground nuts for future consumption during drought periods. Food is rationed during drought and food leftovers are stored for poultry.

Males are also not passive victims of drought either. Despite Turnbull (2012)'s findings that males are the worst victims of climatic disasters in terms of their adaptation skill, this study noted a number of male coping mechanisms. Their strategies focussed mainly on big assets. The strategies included diversification of crops and livestock, selling of cattle, financial savings, loans, off-compound employment and piece jobs. Diversification of crops and livestock is normally practised by households that have finances to purchase a wide range of drought resistant varieties. Men have control over vital household assets. Thus their coping strategies are centred on high value assets.

Selling of cattle is another adaptation strategy. Cattle are usually sold for cash during emergencies and drought. However during a severe drought, they are often traded for bags of maize. In such circumstances, cattle cost as little as five bags of maize and the value of cattle decreases with the magnitude of drought. Jerie and Matanga (2011) also noted a

decline in cattle during droughts due to destocking. High losses of livestock during droughts also often compel people to sell their cattle off.

Financial savings and loans were some of the male coping mechanisms given by focus group discussants. Financial savings are generally sustainable. However, in a volatile economy like Zimbabwe which is characterised by unstable and ever changing currencies, it is difficult for households to depend on financial savings. Financial savings are not much popular in the District mainly because banks are inaccessible. As a result some employed people have access to their salaries through, fast and highly accessible cell phone wallet financial services such as Eco-cash. The application allows users to have unlimited access to their finances. This development however, promotes over spending and destroys money saving behaviour.

Loans often sustain households during emergencies and drought. However, they are only accessible to the working class people, with required collateral. Generally, male coping strategies are rather reactive in approach. This is unsustainable and costly especially when dealing with a slow onset shock such as a drought. Gukurume *et al*. (2010) also found it odd and unsustainable to sell livestock or take loans over a temporal climate variability such as drought. However, this might sound absurd in theory but in a drought recurring environment in which big assets lose value overnight, people are forced to sell their livestock.

5.7 External coping strategies in Chivi

The results showed that various NGOs and government support communities to cope with drought. The government support comes through various departments such as AGRITEX, EMA, Veterinary Services and the local government. These departments disseminate the support in the form of projects and programme. Most government-led coping strategies follow a top down approach. While Action Aid (2005); Reid (2007); Ayers (2011); Dodman and Mitlin (2011) support the authoritative power in top-down projects, they tend to treat targeted communities as beneficiaries than stakeholders. Nhodo *et al.* (2010) observed a conflict between Conservation Agriculture facilitators and the Shangani community in Chiredzi.

Popular Government coping strategies included food for work and conservation agriculture. Food for work gives communities food in return for manual labour across various economic development projects such as road construction or dam building. While the programme

helps during drought periods, it has not been reliable of late, probably due to the economic challenges facing the country as a whole. In addition, the programme is too labour intensive. This prevents the elderly from participating. In an area such as Chivi, with a high population of females, who have multiple gender roles and limited youth, the programme often leads to children abandoning school to help their families.

Conservation Agriculture (CA) is also one of the Government adaptation initiatives in Chivi. It takes various forms such as zero tillage, use of organic fertilizers, mixed agriculture and use of small grains, among others. While the practice is sustainable, environmentally, and has the potential to boost productivity, its feasibility in the Chivi community might not match its good intentions. Contrary to Murendo (2012); Mazvimavi (2010); Nhemachena and Hassam, (2007) and Mapfungautsi and Mutekwa (2009) findings, Conservation Agriculture proved to be less popular in Chivi, especially the zero tillage system. It is indisputable that the area has a high population of female farmers. However, at a household level, these females lack decision making powers pertaining to high value assets such as land, types of crops to be grown and finances. There is, thus need to align the programme with community needs without imposing a radical change on its social structure and cultural values.

5.8 Chapter summary

In this chapter attention was given to the major findings of the study. The chapter discussed on drought incidence, gender vulnerability and adaptation. Spatial and structural drought extent in Chivi was discussed. Effects of drought on food security and gender response were also discussed. In the next chapter, conclusions and recommendations are made.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.0 Introduction

In this chapter, conclusions and recommendations of the study are spelt out. The study's broad objective was to examine spatial-structural drought characteristics, food crop production changes and analyse gendered vulnerability and adaptation in Chivi South. To examine vulnerability to drought intensively, both external and internal household vulnerability was assessed across gender lines. From the findings of the study the following conclusions are made:

6.1 Conclusions

On drought vulnerability, the study concluded that Chivi District has been experiencing several severe droughts. However most of these were frequently mild to moderate drought cycles, which impacted on food production. The whole District is in an environment which is vulnerable to droughts and has noticeable rainfall variability such as delayed, scanty, erratic rainfalls.As one vital indicator of drought vulnerability, food crop production was assessed for the whole District. The study concluded that food crops in Chivi are decreasing with drought cycles. However, the general food crop production trend is decreasing proportional to the decrease in annual rainfall trends. Interestingly, not all food crops showed a decline during drought events. Small grains, such as millet, survived drought periods.

Household Vulnerability Index results showed that female households are adapting better to drought than males, despite the latter dominating the emergency level household category. Intra-gender households' variations were also noted. This implies that vulnerability is not only felt across gender lines but within the same gender as well. Generally, most Chivi households are moderately vulnerable to drought, with human and financial assets highly exposing them. A number of coping strategies have been adopted in the area, with gender connotations as well.

The study concluded that household vulnerability in Chivi and less adaptation are due to what Chameleon Research Group (2012) termed the missing means and unemployed means. The former refers to budget constraints at both government and household levels. The latter implies misaligned economic activities and complex actor relationships. It is indisputable that the economy of Zimbabwe is in turmoil, hence faces budget limitations. This in turn has hard hit semi-arid regions dependant on natural resources such Chivi. However, the few resources available are misaligned and tend to be channelled across the

country in a one size fit all format. Yet communities are not homogenous. Cultural, spatial and temporal variability characterise them. With the current climate change projections, Chivi's chances of sustaining itself are slim, hence adaptation is solely dependent on external assistance from the Government of Zimbabwe and NGOs. However, the adaptation can be facilitated in free, target focussed and well-coordinated institutional capacities. The following recommendations were proposed.

6.2 Recommendations

The drought intervention system in the country needs to define drought zones and come up with a comprehensive strategy which predicts, monitors and helps the vulnerable to cope. The Government of Zimbabwe needs to revisit its drought intervention system. While drought in Chivi might be moderate to mild, it is too frequent. This can result in its impact being severe. Thus areas such as this District, need to be declared drought disaster zones and be given immediate intervention. Chivi is a dry area, characterised by low magnitude drought of a two year frequency and occasional severe droughts. All this, coupled with an increase in climate change risks, show that rain-fed agriculture will not be sustainable. There is need for government and people in the District to invest in non-agricultural projects. However, projects, such as basket weaving, sculpturing and gold panning maybe lucrative to the local community but these have damaged the environment.

Accessible areas often attract business centres, thereby creating markets and employment. Most parts of Chivi South are remote and inaccessible. The nearest town to this District is Zvishavane, which is 65 km away, because there is no straight paved route which connects this communal area to this town, residents rely on Masvingo which is more than 70km away. Distant towns and cities limit the chances of people in Chivi South getting formal employment. Women are hugely affected by this since they are less mobile and their duties make it impossible for them to leave their households for a long period of time. Besides roads, provision of safe potable water in this area would reduce women's tasks and reduce their exposure of this community to diseases. Most households share water sources with animals on rivers and dams.

Economic development is lacking in Chivi. The District lacks markets for its produce, as well as main business centres which can have adequate financial services such as banks. Opening up of these centres would also create the much needed employment in the area and provide accessible services. Business centres, such as Ngundu Halt in Ward 25, demonstrate the positive impact, these centres have on livelihoods.

Food crop production pattern results show a close relationship with drought patterns. This communal area is generally dry hence dry, agriculture is no longer sustainable. Chivi has a strong dam capacity, but water is still inaccessible. Most vegetable gardens around dams are watered using buckets. There is need for provision of irrigation technology. The study noted that Chivi has a potential for boosting its food crop production through irrigation. Tokwe- Mukosi dam displaced a substantial number of households in the District and broke their social ties hence there is need to ensure that the communities left behind benefit substantially from this dam as part of restitution.

Financial resources expose most households in Chivi, especially male-headed households. Many households are vulnerable despite the household head being employed. Wages and salaries in the country are too low to sustain people. The government and various employers need to revise their salaries and help people to cope. Banks also need to be decentralised for remote areas such as Chivi to have access to financial savings. Men should also be encouraged to engage in other income generating projects to cushion their households.

Chivi South is a patriarchal community, which needs comprehensive gender awareness programmes. All gender development projects should be done with baseline gender training. Transformation is not an overnight achievement, hence the need to continuously educate the community. There is need to have a synergy between Government's policies, ratifications on gender and community developmental programmes. In this way, gender development will not be viewed as an external ideology imposed on the community by the NGOs.

Gender imbalance is a sensitive issue in Chivi, in which the society is very reluctant to address. There is need for a diplomatic approach to address gender disparity, an approach which is not one sided. This study noted that no gender is immune to drought vulnerability, hence the need to allow all genders an equal platform in decisive matters of economic development. Equal opportunities will yield expertise from both sides and sustainable growth. Projects such as asset building among women are a positive start. They will show case women's potential. However, other projects should also target males and address their needs.

While preservation of culture is vital, there is need to align cultural values and sustainable livelihoods development. Viral diseases have increased, hence the abandonment of the practice of passing widows to the deceased's brothers. Likewise, related values such as exclusion of women in decision-making should be revised. Chivi's widow population is growing. Women are becoming family heads thus their exclusion in decision-making compromises the adaptive capacity of their households and community as a whole.

NGOs operating in the District have well stipulated gender policies, but most of them have a pre-conceived perception that the female gender is more vulnerable. This is evidenced by a number of women empowerment initiatives. Contrary to that view, this study noted, that though males have more power over resources and decision making, they are not immune to the drought shock. Hence, there is need for a more strategic framework to implement adaptation strategies.

In response to the local community, NGOs and Government intervention noted in the study, the following adaptation framework was proposed. The framework seeks to clarify the vital steps to ensure sustainability of adaptation strategies. It spells out gender analysis as one vital component which needs to be thoroughly assessed during a community vulnerability assessment. This forms the baseline for formulation of adaptation strategies. For gender disparities to be addressed without exacerbating the inequalities, gender analysis should cover the whole gender tree from leaves to its roots. It is important to note that gender is not synonymous to women. Drought has proved that its shock is not gender biased. It is felt across the whole spectrum. Gender analysis is then followed by a needs assessment.

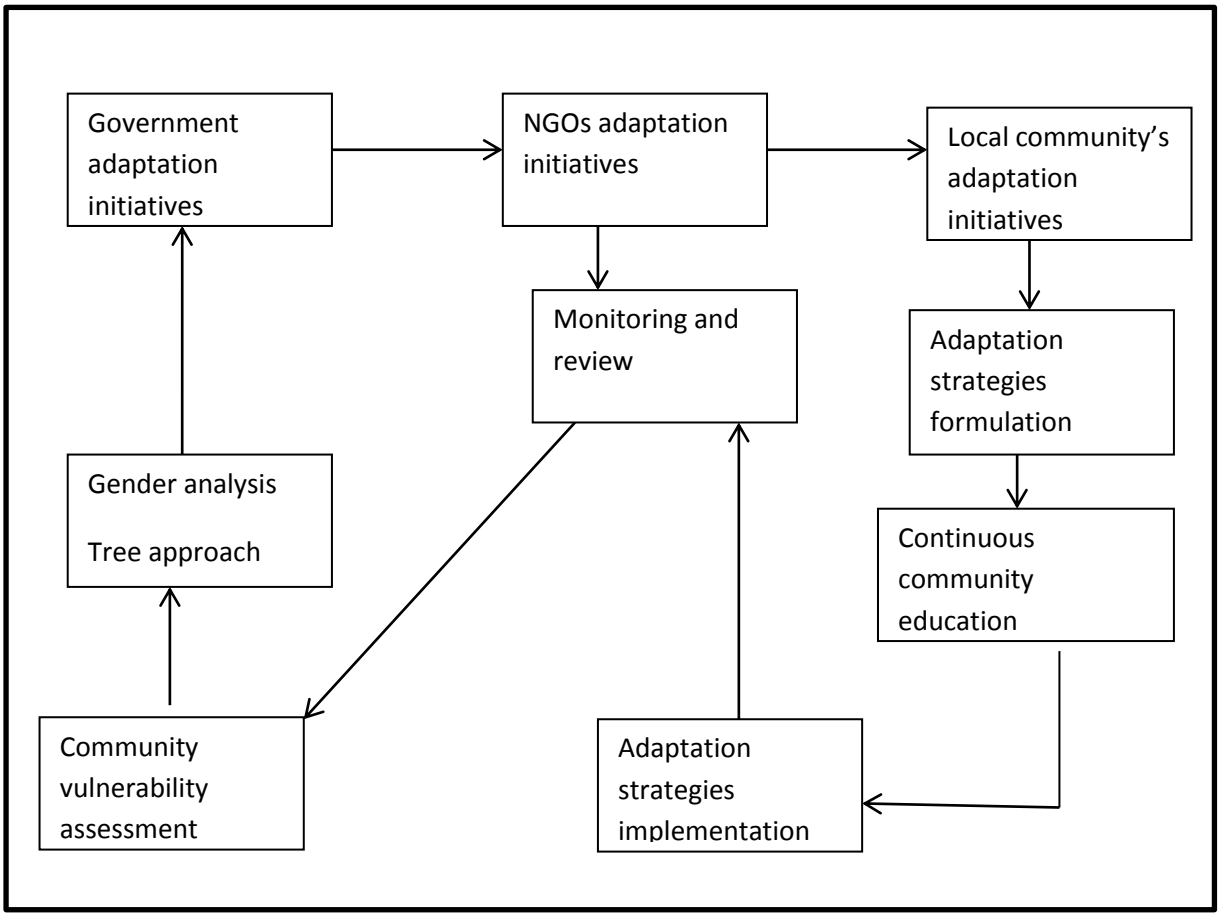


Figure 6.0 Adaptation strategy framework (Source: Author informed by UNFCCC, 2001 and Government of Kenya National Climate Change Response Strategy, 2010)

The needs screening process at community level normally comes with practical and strategic needs (UNFCC, 2001). While practical needs, which vary from one individual to another, might address the real needs of individuals, they tend to promote a donor syndrome and cover short term needs, as human livelihoods change constantly, as well as climate variability takes place. Strategic needs address community needs, transform relationships and treat individuals as agents not beneficiaries. Therefore, there is great need for NGOs and Government to do a wide assessment to come up with strategic needs of Chivi South community. The District has high drought frequency, hence strategies would have to move away from rain-fed agriculture if sustainability is to be achieved.

After a needs assessment adaptation, strategies can be formulated with the input of all stakeholders. To create an amble environment for implementing adaptation strategies, community education and transformation is vital (FAO, 2011). Coping strategies can then be implemented. However, adaptation is not a once off action; it tends to be cyclic. Hence a constant monitoring and reviewing of the whole process in order to align strategies to global changes and related needs, should be regularly done. This framework does not only give a systematic flow of the implementation of adaptation strategies but it seeks to mainstream gender into adaptation strategies without bias or without imposing gender transformation on communities.

6.3 Further research

Rainfall, in Chivi, shows some variability. In the last 15 years of the study, rainfall was received in the last half of the rain season from January to March instead of the usual October to December period. There is need to further research on the factors influencing this irregularity and verify if it is a permanent shift in the rainfall season. This is vital to enable farmers to make informed decisions. At the moment, most households spread their crops across the whole season to maximise their chances of harvesting. This results in them wasting a lot of seeds. There is also need for further studies to establish a link between frequent mild droughts in Chivi and climate change. This way, locals would be made aware of the changing climate and possible options for them.

REFERENCES

Adger, W.N. 2006. Vulnerability. *Global Environmental Change*. Vol. 16 (3) pp. 268-281.

Adger, W.N., Dessai, S., Goulden, M., Hulme, M., Lorenzoni, I., Nelson, D.R., Naess, L.O. and Wreferd J.W.A. 2009. Are the Social Limits to Adaptation to Climate Change? *Climate Change Journal*. Vol. 93 pp. 335-354.

Africa Institute of South Africa (AISA). 2014. Preliminary Report: The Development of a research framework on gender and socio-cultural inclusion in global change research, Pretoria. South Africa, Human Science Research Council.

Anseeuw, W., Kapuya, T. and Saruchera, D. 2012. Zimbabwe's Agricultural Reconstruction: Present State, On-going Projects And Prospects For Reinvestment. Development Planning Division. Working Paper Series No. 32. South Africa, Development Bank of Southern Africa.

Anyamba, A. and Eastman, J.R. 1996. Inter-annual Variability of NDVI over Africa and its relation to El Niño Southern Oscillation*. International Journal of Remote Sensing*. Vol. 17 (13) pp. 2533-2548.

Ayers, J., 2011. Resolving the Adaptation Paradox: Exploring the potential for Deliberative Adaptation Policy Making in Bangladesh, *Global Environmental Politics.* Vol. 11 pp. 62-88.

Benson, C., Clay, E. 1997. *The impact of drought on Sub-Saharan African economies.* The International Bank for Reconstruction and Development, USA: World Bank.

Bird, K., Booth, D., Pratt, N. 2003. *Food Security Crisis in Southern Africa: The Political Background to Policy Failure*, London, UK, Forum for Food security in Southern Africa.

Bohle, H.G., Downing, T.E., Watts, M.J. 1994. Climate change and social vulnerability: Toward a social and geography of food insecurity, *Global Environmental Change* Vol. 4(1) pp. 37- 48.

Brooks, N. 2003. Vulnerability, risk and adaptation: A conceptual framework. Tyndall Centre for Climate Change Research and Centre for Social and Economic Research on the Global Environment (CSERGE). Tyndall Working Paper No. 38. Norwich, University of Anglia.

Brooks, N. 2005. The determinants of vulnerability and adaptive capacity at the national level and the implications for adaptation. *Global Environmental Change,* Vol.15 (2) pp. 151-163.

Brooks, N., Adger, W.N., Kelly, P.M. 2005. The determinants of vulnerability and adaptive capacity at the national level and the implications for adaptation. *Global Environmental Change*, Vol. 15 (2) pp. 151-163.

Brown, D., Chanakira, R., Chatiza, R., Dhliwayo, K., Dodman, D., Masiiwa, M., Mugadza, D., Zvigadza, S. 2012. Climate Change impact, vulnerability and adaptation in Zimbabwe: Climate change. Working paper 3. UK. IIED.

Chaguta, T. 2010. *Climate Change Vulnerability and Preparedness in Southern Africa: Zimbabwe country report*. Cape Town: Heinrich Boll Stiftung.

Chameleon Research Group. 2012. Research workshop on barriers to adaptation to climate change, 18-21 September 2012, Berlin, Germany. www.climate-chameleon.de/htm_er . Accessed 15 April 2015.

Chaudhuri, S. 2003. Assessing in vulnerability to poverty: Concepts, Empirical methods and illustrative examples. http://econdse.org/wp-content/uploads/2012/02/vulnerability-assessment.pdf. Accessed 10 May 2015.

Chifurira, R. and Chikobvu, D. 2010. Predicting rainfall and drought using the Southern Oscillation Index in Drought prone Zimbabwe. www.ufs.ac.za/dl/userfiles/Documents/00002/1871_eng.pdf. Accessed 15 June 2015.

Chikodzi,D., Murwendo, T. and Simba, F.M. 2013. Climate Change and Variability in Southeast Zimbabwe: Scenarios and Societal Opportunities. *American Journal of Climate Change*, Vol. 2 (3A) pp. 36-46.

Chikodzi, D. and Mutowo, G. 2013. Drought Monitoring for Masvingo Province in Zimbabwe. A Remote Sensing Perspective. *Herald Journal of Geography and Regional Planning,* Vol. 2 (1) pp. 056-060.

Chikova, H. and Kangalawe, R. 2013. *Institutional Frameworks and Climate Change Adaptation: The case of Sustainable Land Management in Chivi District, Zimbabwe*. Saarbrucken. Germany. Lambert Academic Publishing.

Chiripanhura, B.M. 2010. Poverty Traps and Livelihoods Options in Rural Zimbabwe: Evidence from Three Districts, BWPI Working Paper 121, Manchester, Books World Poverty Institute.

Chiwaka, E., and Yates, R. 2005. *Participatory Vulnerability Analysis: Step by Step Guide for Field Staff*. UK, Dorset: Action Aid International.

Classic Africa, 2015. Climate of Southern Africa. www.classicafrica.com/content/weather.asp . Accessed 10 June 2015.

Clay, E., Bohn, L., Blancho de Armas, E., Kabambe, S. and Tichale, H. 2003. Malawi and Southern Africa: Climatic Variability and Economic Performance, Disaster Management Facility, Working Paper Series 7, Washington D.C, World Bank.

CARE. 2015. Key Concepts, Community Based Adaptation Toolkit.

www.careclimate.org/tk/cba/en/cba_basics/key_concepts.html.
Accessed 12 June 2015.

Cutter, S.L., Boruff, B.J. and Shirley, W.L. 2003. Social vulnerability to environmental hazards. *Social Science Quarterly.* Vol. 84 (2) pp. 242-261.

Dankelman, I. 2010. *Gender and Climate Change: An Introduction.* London. UK. Earthscan.

Davies, J. and Burgess, W.G. 2005. *Can groundwater Sustain Future Development of Rural Zimbabwe*, London.UK. University College.

Davis, C. 2011. *Climate Risk and Vulnerability: A Handbook for Southern Africa*. Pretoria. South Africa. CSIR.

Dawson, C. 2002. *Practical Research Methods: A User Friendly Guide To Mastering Research Techniques and Projects.* Oxford. U.K. How To Books.

Deressa, T.T., Hassan, R.M. and Ringler, C. 2009. Assessing household vulnerability to climate change: The case of farmers in the Nile Basin of Ethiopia. IFPRI Discussion Paper 00935. Washington, D. C. International Food Policy Research Institute.

Dinar, A., Hassan, R., Mendelsohn, R. and Benhim, J. 2008. *Climate Change and Agriculture in Africa: Impact Assessment and Adaptation Strategies*, London, Earthscan.

Dodman, D. 2010. *World Disaster Report: Focus on Urban risk,* France: Imprimerie Chirat.

Donald, A. and Taylor, P. 2014. *Ethics and Climate change: A study of National Commitments*. Gland, Switzerland: IUCN.

Downing, T.E., Butterfield, R., Cohen, S., Huq,S., Moss, R., Ramhamn, A. and Sokonay, S.L. 2001. Climate Change vulnerability: Linking impacts and adaptation. Report to the Governing Council of UN Programme. Nairobi. Kenya. UNEP.

Downing, T.E. and Patwardhan, A. 2004. Assessing vulnerability for climate adaptation. Technical paper 3. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.169.4382&rep=rep1&type=pdf. Accessed 10 May 2015.

Dube, C. 2008. The Impact of Zimbabwe's Drought Policy on Sontala Rural Community in Matebeleland South Province. Master's Dissertation, South Africa, Stellenbosch University.

Dube, L.T. 2012. Climate of Southern Africa. *Southern African Geographical Journal*. Vol. 84 (1) pp.125-138.

Eakin, H. and Bojorquez–Tapia, L.A. 2008. Insights into the composition of Household Vulnerability from Multicriteria Decision Analysis. *Global Environmental Change.* Vol.18 (1) pp.112-127.

Eakin, H. and Luer, A.L. 2006. Assessing the Vulnerability of Social-Environmental Systems: *Annual Review of Environmental and Resources*. Vol.31 (1) pp.365-394.

Eisenach, K., Stecker, R., 2012. A framework for analysing climate change adaptations as actions. *Mitigation and Adaptation strategies for Global Change*. Vol. 17 (3) pp. 243-260.

Elaine, E., 2000. *Gender and Natural Disasters, Recovery and Reconstruction Development*. Geneva: USAID.

Eriksen, S. and Naess, L.O. 2003 Pro-poor climate adaptation, Norwegian development cooperation and climate change adaptation: An assessment of issues and potential entry points Report, Oslo. Norway. CICERO.

Eriksen, S.H. and Kelly, P.M. 2006. Developing Credible Vulnerability Indicators for Climate Adaptation Policy Assessment. *Mitigation and Adaptation Strategies for Global Change*. Vol. 12 pp.495-524.

Famine Early Warning Systems Network (FEWSNET). Southern Africa Special Report 2014/105 El Niño Event. www.fews southern@fews.net. Accessed 10 July 2015.

Famine Early Warning Systems Network (FEWSNET). 2014. Zimbabwe Food Security Brief. Harare. Zimbabwe. United States Agency for International Development.

FAO. 1986. World food security:re appraisal of the concepts and approaches. Director-general's Report, Rome. http://www.fao.org/docrep/005/y4671e/y4671e06.htm. Accessed 10 May 2015.

FAO. 2001. The feminisation of Agriculture. FAO Fact Files. Italy.FAO.

FAO. 2007. Climate Change and Food Security: A Framework for Action: Report by an Interdepartmental Working Group on Climate Change. Italy. FAO.

FAO. 2011. Drought related food insecurity: A focus on the Horn of Africa. Rome. Drought Emergency Ministerial Meeting. FAO.

FAO. 2011. Policy on Gender Mainstreaming. http://www.fao.org/climatechange/en . Accessed 10 June 2014.

Field, C.B., Barros, V.R. and Mastrandrea, M.D. 2014. Climate Change 2014: Impacts, Adaptation and Vulnerability. IPCC WG11 AR5. Summary for Policy Makers.

Food Agriculture and Natural Resources Policy Analysis Network (FANRPAN). 2011. The Household Vulnerability Index (HVI). Pretoria. South Africa. FANRPAN.

Food Security Network. 2014. What is food security.
http://www.foodsecuritynews.com/What-is-food-security.htm. Accessed 10 May 2014

Fussel, H.M. 2005. Vulnerability in Climate Change Research: A Comprehensive Conceptual Framework. University of California International and Area Studies, Breslauer Symposium, Paper 6.
http://repositories.cdlib.org/ucias/breslauer/6. Accessed 10 May 2015.

Fussel, H.M. 2007. Vulnerability: A generally applicable conceptual framework for Climate Change Research. *Global Environmental Change* Vol. 17 (2) pp. 155-167.

Gaudioso, D. 2010. Adaptation to Climate Change: Key Concepts, Project Act, Adapting to Climate Change in time. Institute for Environmental Protection and Research (ISPRA) www.actlife.eu/medias/si-adaptation-to-climate-change-key-concepts.pdf. Accessed 10 June 2015.

Gitay, H., Finlayson, C.M. and Davison, N. 2011. A Framework for Assessing the Vulnerability of Wetland to Climate Change. Ramsar Technical Report Number 5.Technical Series Number 57. Gland. Switzerland. Ramsar Convention Secretariat and Secretariat of the Convention on Biological Diversity.

Government of Kenya, 2010. National Climate Change Response Strategy.
http://www.environment.go.ke/wpcontent/documents/complete%20nccrs%20executive%20brief.pdf. Accessed 10 May 2015.

Government of the Republic of Trinidad and Tobago, 2013. Vulnerability and Risk www.odpm.gov.tt/node/162. Accessed 19 June 2014.

Guha-Sapir, D.,Hoyois, P. and Below, R. 2012. Annual Disaster Statistical Review: The Numbers and Trends. http://www.cred.be/sites/default/files/ADSR-2012.pdf. Accessed11 April 2014.

Gukurume, S. 2013. Climate Change, variability and sustainable agriculture in Zimbabwe's rural communities. *Russia Journal of Agriculture and Socio-Economic Sciences*. Vol.14 (3) pp. 89-100.

Gukurume, S., Nhodo, L. and Dube, C. 2010. Conservation Farming, The Food Security-Insecurity Matrix in Zimbabwe: A case of Ward 21 Chivi Rural. *Journal of Sustainable Development in Africa*. Vol. 12 (7) pp.40-52.

Guttman, N.B. 1998. Comparing the Palmer Drought Index and the Standard Precipitation Index. *Journal of the American Water Resources Association*. Vol. 34 (1) pp.113-121.

Habtezion, S. 2012. Gender and climate change capacity development series, Africa Training Module 2, Global Gender and Climate Change Alliance. UNDP.

Hahn, M.B., Riederer, A.M. and Foster, S.O. 2009. The Livelihoods Vulnerability Index: A pragmatic approach to assessing risks from climate variability and change: A case of Mozambique. Global Environmental Change Journal. Vol. 19 (1). pp.74-88.

Hannan, C., 2002. "Statement at a round table panel and discussion: Status of women." Paper presented at Women watch. New York.

Heifer International, 2010. Women farmers building resilience through harnessing crops and livestock: Best practices and innovations initiatives. www.heifer.org. Accessed 10 December 2014.

Ibarraran, M.E., Malone, E.L.and Brenkert, A.L. 2008. Climate Change Vulnerability and Resilience: Current Status and Trends for Mexico. Batelle. USA. Department of Energy.

Intergovernmental Panel on Climate Change (IPCC), 2001. 3rd Assessment report: Climate Change Working Group 2 on Impacts, Adaptation and Vulnerability. http://www.ipcc.ch/ipccreports/index.htm/. Accessed 10 April 2014.

Intergovernmental Panel on Climate Change (IPCC). 2007. 4th Assessment report: Climate change 2007: Working Group 2 on Impacts, Adaptation and Vulnerability. http://www.ipcc-wg2.org/. Accessed 10 April 2014.

Intergovernmental Panel on Climate Change (IPCC). 2007. Climate change: Impacts, Adaptations and Vulnerability: Working Group 2 contribution to the Fourth Assessment Report of the IPCC. UK: Cambridge University press.

Intergovernmental Panel on Climate Change (IPCC), 2007. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group 11 to the Fourth Assessment Report of the IPCC. New York. USA. Cambridge University Press.

Intergovernmental Panel on Climate Change (IPCC). 2012. IPCC, 2012: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, USA.

International Federation of Red Cross and Red Crescent Societies (IFRC). 2013, www.ifrc.org/en/what-we-do/disaster-management/about-disasters/. Accessed 12 May 2015.

Jerie, S.and Matanga, E. 2011. The Effectiveness of Ethno-Science based strategies in drought mitigation in Mberengwa District. *Journal of Sustainable Development in Africa*, Vol.13 (4) pp. 395-409.

Joseph-Brown, L. and Tuiloma-Sua, D., 2012. *Intergrating Gender in Disaster Management in Small Island Developing States: A guide*, UNDP, Cuba.

Jury, M.R. 2013. Climate prediction experiences in southern Africa 1990–2005 and key outcomes. *Natural Hazards Journal* Vol. 65 pp. 1883–1894.

Kalibwani, F. 2005. Household Vulnerability Index. Paper presented at The Johannesburg Regional Multi-Stakeholder Public Policy Dialogue, 5-7 0cober 2005. South Africa.

Kalibwani, F. 2005. Quantifying vulnerability: The Household Vulnerability Index and Social Protection Policy, Johannesburg 2005 Regional Multi-stakeholder Public Policy Dialogue, FANRPAN.

Kalyanapu, P.nd. Understanding The Causes Of Malnourishment In Zimbabwe, Pinkerton Academy, New Hampshire.

Kandji, S.T., Verchot, L. and Mackensen, J. 2006. Climate Change and Variability in Southern Africa : Impacts and Adaptation strategies in the Agriculture Sector. Kenya, UNEP and ICRAF.

Kelly, P.M.and Adger, W. N., 2000. Theory and Practice in assessing vulnerability to Climate Change and facilitating adaptation. *Climate Change Journal*. Vol. 47 pp. 325-352. Kluwer Academic Publishers. Netherlands.

Kumar, R., 2005. *Research Methodology A Step-by-Step Guide for Beginners*. 2nd edition. Singapore: Pearson Education.

Kureya, T. 2013. *Household Vulnerability Index*. Harare. Zimbabwe. Development Data.

Lawson, V.A. and Staeheli, L.A., 1990. Realism and the practice of geography: *The Professional Geographer*, Vol. 42 (1) pp. 13-20.

Leedy, P.D. and Ormrod, J.E. 2010. *Practical Research: Planning and Design*. 9th edition. Boston: Pearson Education Inc.

Leichenko, R.M. and O' Brien K.L. 2002. The Dynamics of Rural Vulnerability to Global Change: The Case of Southern Africa. *Mitigation and Adaptation Strategies for Global Change*. Vol. 7 (1) pp.1-18.

Loukas, A. and Vasiliades, L. 2004. Probabilistic analysis of drought spatiotemporal characteristics in Thessaly Region, Greece. *Natural Hazards and Earth System Sciences*. Vol. 4 (5-6) pp. 719-731.

Luers, A.L., Lobell, D.B., Sklar, L.S., Adams,C.L. and Matson, P.A. 2003. A method for quantifying vulnerability, applied to the agricultural systems of the Yaqui Valley, Mexico*. Global Environmental Change*. Vol. 13 (4) pp. 255-265.

Lyddon, C., 2013. Focus On Zimbabwe, The Grain And Grain Processing Information Site. http://www.World-Grain.Com/. Accessed 11 July 2015.

Mabe, F.N., Sarpong, D.B. and Osei-Asare, Y. 2012. Adaptive capacities of farmers to climate change adaptation strategies and their effects on rice production in the Northern Ghana. *Journal of Agricultural and Socio-Economic Sciences*. Vol. 1(11) pp. 9-17.

Madhuri, T.H.R. and Bhowmick, P.K. 2014. Livelihood vulnerability Index analysis: An approach to study vulnerability in the context of Bihar. *Jamba Journal of Disaster Risk.* Vol.6 (1) pp. 1-13.

Madzvamuse, M. 2010. *Climate Governance in Africa: Adaptation strategies and Institutions*. Capetown, South Africa, Heinrich Boll Stiftung.

Mahan, B.B., Garrard, W.M., Lewis, S.E. and Newbrough, J.R. 2002. Sense of community in a university setting: Campus as a workplace, In Fisher, A.T., Sonn, C.C., Bishop, B. J. Psychological sense of community: Research application and implication. New York. Kluwer Academic Publishers.

Maiyaki, A.A. 2010. Zimbabwe's Agricultural Industry. *African Journal of Business Management*. Vol. 4 (19). pp. 4159-4166.

Makuvaro, V. 2014. Impact of Climate Change on Smallholder Farming in Zimbabwe, using a modelling approach. PhD thesis submitted to the Department of Soil, Crop and Climate Sciences. University of Free State. Bloemfontein.

Mannuci, P.J., Brown, C.L., Hess J.J. and Luber, G. 2011. Climate and Health Technical Report Series: Climate Health Program, Centres for Disease control and Prevention, Atlanta, USA, National Centre for Environmental Health.

Manyeruke, C., Hamauswa,S. and Mhandara L. 2013. The Effects of Climate Change and Variability on Food Security in Zimbabwe: A Socio-Economic and Political Analysis*. International Journal of Humanities and Social Science* Vol. 3 (6) pp 270-286.

Mapanda, F. and Mavengahama, S. 2011. Assessment of selected soil nutrients and irrigation water quality in the dryland area of Chivi District, Zimbabwe. *Scientific Research and Essays*. Vol 6 (14) pp. 2918-2927.

Mapfumo, P., Adjei-Nsiah, S., Mutambanengwe,F., Chikowo, R. and Giller,K.E. 2013. Participatory Action Research (PAR) as an entry point for supporting climate change adaptation by small holder farmers in Africa. *Environmental Development Journal* Vol. 5 (1) pp. 5-22.

Mapfungautsi, R. and Munhande , C., 2013.Climate Risk and Smallholder farmers in Zimbabwe: A case Study of Chivi District. *International Journal of Humanities and Social Science Invention.* Vol. 2 (5) pp. 31-38.

Masendeke, A. 2003. SARD Initiative Retrospective Study–Chivi, Food Security Project Masvingo, Zimbabwe. UK, ITDG.

Mason, S.J., Jury, M.R., 1997. Climatic Variability and Change over Southern Africa: A reflection on underlying processes, Progress in Physical Geography, *SAGE Journal* Vol. 21 (1) pp 23-50.

Mawere, M., Madziwa, B.F. and Mabeza, C.M. 2013. Climate Change And Adaptation in Third World Africa: A quest for Increased Food Increased Food Security in Semi-Arid Zimbabwe. The International Journal of Humanities and Social Studies. Vol.1 (2) pp.14-22.

Mazvimavi, K.., Nyathi, P. and Murendo, C. 2011. Conservation Agriculture Practices and Challenges in Zimbabwe. 5 th World Congress of Conservation Agriculture. Australia.

Mazvimavi, K., Twomlow, S., Murendo, C. and Tawedzegwa, M. 2007. Science in Agricultural Relief and Development Programs. The case of Conservation Farming in Zimbabwe. AAAE Conference Proceedings pp. 321-325.

McClendon, M.J., 2004. *Statistical Analysis in the Social Sciences*. Canada: Wadsworth.

McKee, T.B., Doesken, N.J. and Kleist, J. 1993. The relationship of drought frequency and duration to time scale, Proceedings of the 8th Conference on Applied climatology, Anaheim, California 17-22 January, American Meteorological Society, pp 179-184.

Mdoka, M.L. 2005. Climatic trends and soil moisture feedbacks over Zimbabwe. Masters Thesis , Department of Environment and Geographical Science, University of Capetown.

Microsoft, 2015. Definition of security vulnerability, Microsoft Security Response Centre (MSRC) https://msdn.microsoft.com/en-us/library/cc751383.aspx. Accessed 19 June 2015

Molden, D. 2007. Water for Food, Water for Life: A comprehensive assessment of water management in agriculture, London, U.K: Earthscan.

Moser, C. and Stein, A. 2011. Implementing appraisals urban participatory climate change adaptation: A methodological guideline. *Environment and Urbanisation Journal* Vol. 23 (2) pp. 463-488.

Mubaya, C., Njuki, J., Liwenga, E., Mutsvangwa, E. and Mugabe, F. 2010. Perceived impacts of climate related parameters on smallholders farmers in Zambia and Zimbabwe, *Journal for Sustainable Development in Africa*, Vol. 12 (5) pp170-186.

Mudavanhu, C. and Chitsika, T. 2013. Coping with and adapting to food shortages adversities in semi-arid regions of Zimbabwe: The case of Chivi district. *International Journal of Innovative Environmental Studies Research.* Vol.1 (2) pp. 23-39.

Mudimu, G. 2003. Zimbabwe Food Security Issues Paper www.odi.org.uk/food-security-forum. Accessed 10 July 2015.

Mudzonga, E. 2012. Farmers' Adaptation to Climate Change in Chivi District, Zimbabwe. Harare: Trade and Development Centre.

Mugandani R. 2009. Towards Food Sustenance: A revisit to the agro ecological zones of Zimbabwe. Paper presented at the Land use Workshop, Bindura University of Science Education, 2-4 November 2009.

Mugandani, R. Wuta, M., Makarau, A. and Chipindu, B. 2012. Re- classification of Agro-ecological Regions of Zimbabwe inconformity with climate variability and change, *African Crop Science Journal*, Vol. 20 (2) pp 361-369.

Mukarumbwa, P. and Mushunje, A. 2010. Potential Of Sorghum and Finger Millet to Enhance Household Food Security in Zimbabwe's Semi-arid Regions: A Review. 3rdAfrican Association of Agricultural Economists (AAAE), Agricultural Economics Association of South Africa (AEASA) AAAE .48th Conference. Cape Town. South Africa.

Munhande, C., Mapfungautsi, R. and Mutanga, P. 2013. Climate Risk Management, Actors, Strategies and Constraints for Smallholder farmers in Zimbabwe: A case of Chivi District. *Journal of Sustainable Development in Africa.* Vol.15 (8) pp. 57-71.

Munyanyi, W. 2013. Agricultural Infrastructure Development Imperative For Sustainable Food Production: A Zimbabwean Perspective. *Russian Journal of Agricultural and Socio-Economic Sciences.* Vol. 12 (24) pp. 13-21.

Murendo, C., Naess, L.O. and Mazvimavi, K. 2012. Gender and Youth: Decision making and participation in climate risk management in Zimbabwe. Young People, Farming and Food Conference Paper. Accra Ghana.

Musyoki, A. and Khayesi, M. 2012. *Environment and Development selected themes from Eastern and Southern Africa*. Gaborone, Bay Printing and Publishing Company. Gaborone, Botswana

Mutasa, C. 2008. Evidence of climate change in Zimbabwe. Paper presented at the Climate Change Awareness and Dialogue Workshop for Mashonaland Central and Mashonaland West Provinces Held at Caribbea Bay Hotel, Kariba, Zimbabwe, 29-30 September, 2008.

Mutasa, M. 2011. Climate Change vulnerability and adaptation in failing states: Zimbabwe's drought struggle. Initiative on Climate Adaptation Research and Understanding through Social Sciences (ICARUS-2). University of Michigan.

Mutekwa, V. 2009. Climate Change Impacts and Adaptation in the Agricultural Sector: The Case of Smallholder Farmers in Zimbabwe. *Journal of Sustainable Development in Africa*. Vol. 11(2) pp. 237-256.

Ngigi, N.S. 2009. *Water Resources Management Options for Small Holder Farming Systems in Sub-Saharan Africa: Climate Change Adaptation Strategies*. New York: Columbia University.

Nhemachena, C. and Hassan, R. 2007. Micro-led analysis of farmers' adaptation to climate change in Southern Africa. IFPRI Discussion Paper, No. 714, Washington D.C. International Food Policy Research Institute.

Nhodo, L., Gukurume, S. and Mafongoya, O. 2010. Contestations and Conflicting Lifeworlds in Conservation Farming Practices in Zimbabwe: The Experiences of Peasant Smallholder Farmers in Chivi South District in Masvingo. *Russian Journal of Agricultural and Socio-Economic Sciences*. Vol. 4 (16) pp. 19-30.

O'Brien, K., Eriksen, S., Schjolden, A. and Nygaard, L. 2004. What's in a word? Conflicting interpretations of vulnerability in climate change research, Oslo, Norway. CICERO.

Olomos, S. 2001. Vulnerability and Adaptation to Climate Change: Concepts, Issues, Assessment Methods. Climate Change Knowledge Network Foundation Paper.

Orangesenquarak. 2015. Southern African Climate.
www.orangesenqurak.com/river/climate/basin/patterns.aspx.
Accessed 10 June2015.

Overholt, C. 1985. *Women Development: A Framework for Project Analysis*. UK: Women development.

Parson, E.A., Cordl, R.W., Barron, E.J., Burkett, V., Janetos, A., Joyce, L., Karl, T.R., Maccracken, M.C., Melillo, J., Morgan, M.G., Schimel, D.S. and Wilbanks, T. 2003. Understanding Climatic Impacts, Vulnerabilities and Adaptation in the United States: Building a capacity for Assessment Climate Change Vol. 57 pp. 9-42.

Patt, A., Suaez, P. and Gwata, C. 2005. Effects of seasonal climate forecasts and participatory workshops among subsistence farmers in Zimbabwe: *Proceedings of the National Academy of Sciences,* Vol. 102 (35) pp.12623-12628.

Progressio Zimbabwe. 2009. *Seed Saving and Climate Change in Zimbabwe*. London. UK. Progressio. Zimbabwe.

Rahmat, S.N., Jayasuriya, N.and Bhuiyan, M. 2013. The challenges of drought monitoring and early warning. Melbourne, Australia, Global Cities Research Institute, RMIT University.

Roehr, U. 2007. Gender, Climate Change and Adaptation. Introduction to the gender dimensions. Background Paper prepared for the Both Ends Briefing Paper. Berlin.

Safaris. 2015. Southern Africa climate www.ultimatesafariafrica.com. Accessed 10 June 2015.

Scoones, I. 2013. Zimbabwe's Agricultural Sector Goes From 'Bread Basket To Basket case'? Or Is It (Again) A Bit More Complicated?. Zimbabwe land http://zimbabweland.wordpress.com/2013/09/23. Accessed 20 August 2015.

Shiferaw, B., Tesfaye, K., Kassie, M., Abate, T., Prasanna, B. M. and Menkir, A. 2014. Managing vulnerability to drought and enhancing livelihood resilience in Sub-Saharan Africa: Technological, institutional and policy options. *Weather and Climate Extremes Journal.* Vol 3 pp 67-79.

Smit, B., Burton, I., Klein, R.J.T. and Wandel, J. 2000. An anatomy of adaptation to climate change and variability. *Climate Change* Vol. 45 pp. 223-251, Netherlands, Kluwer Academic Publishers.

Solonki, J.K. and Parekh, F. 2014. Drought assessment using Standardized Precipitation Index. *International Journal of Science and Research*, Vol. 3 (7) pp 1073-1076.

Spearman, M. and McGray, H. 2011. Making adaptation count: Concepts and options for monitoring and evaluation of climate change adaptation, Eschborn, Germany, Deutsche Gesellschaft fur Internationale Zusammenabeit (GIZ).

Stehilik, D., Lawrence, G., Gray, I., 2000. Gender and Drought: Experience of Australian women in the drought of the 1990's. *Disasters Journal Vol. 24.* (1) pp. 38-53.

Sukume, C., Makuze, E. Mabeza-Chimedza, R. and Zitsanza, N. 2000. Comparative Economic Advantages of Crop Production in Zimbabwe. Technical Paper No. 99, Department of Agriultural Economics and Extenion. Univeity of Zimbabwe, Harare.

Tavirimirwa, B., Manzungu, E., and Ncube, S. 2012 The evaluation of dry season nutritive value of dominant and improved grasses in fallows in Chivi district, Zimbabwe. *Online Journal of Animal Feed and Research,* Vol. 2 pp. 470-474.

Taylor, A. and Butterfield, R. 2011. Vulnerability definitions. https:weadapt.org/knowledge-base/vulnerability/vulnerability-definitions. Accessed18 June 2015.

Turnbull, M., Sterrett, C.L., and Hilliboe, A., 2013. *Towards Resilience: A Guide to Disaster Risk Reduction and Climate Change*. UK: Catholic Relief Services.

UN Women Watch. 2004. Women, Gender Equality and Climate Change.

http://www.un.org/womenwatch/feature/climate_change/ Accesed 13 June 2015.

Unganai, L., 2009. Adaptation to Climate Change among Agro-Pastoral Systems: Case for Zimbabwe. IOP Conference. *Earth and Environmental Science* Vol 6 (41) 412045.

Unganai, L. 2012. Coping with Drought and Climate Change in Zimbabwe. www.arkletontrust.com/?q=node/323. Accessed 13 July 2015.

Unganai, L.S. and Kogan, F.N. 1998. Drought Monitoring and Corn Yield Estimation in Southern Africa from AVHRR Data. *Remote Sensing of Environment* Vol. 63 pp. 219–232.

Unganai, L.S. and Mason. S.J. 2002. Long-Range Predictability of Zimbabwe Summer Rainfall. *International Journal of Climatology*. Vol. 22 (9) pp. 1091-1103.

United Nations International Strategy for Disaster (UNISDR). 2012. Disaster Risk Resilience, UN System Task Team on the Post 2015. UN Development Agenda. Geneva. UN.

United Nations Development Programme (UNDP). 2010. Gender, Climate Change and Community-Based Adaptation: A Guidebook for Designing and Implementing Gender Sensitive Community Based Adaptation Programmes and Projects. New York, USA, UNDP.

United Nations Environment Programme(UNEP). 2003. Assessing Human Vulnerability to Environmental Change. Concepts, Issues, Methods and Case Studies. Nairobi, Kenya, UNEP.

United Nations Environment Programme(UNEP). 2008. Africa: African Atlas. http://www.unep.org/dewa/Africa/AfricaAtlas/PDF/en/Chapter1.pdf. Accessed 10 0ctober 2014.

United Nations Environment Programme (UNEP). 2011. Mainstreaming climate change adaptation into development planning: A guide for practitioners. Nairobi. Kenya. UNEP.

United Nations Development Programme (UNDP). 2012. Scaling up adaptation in Zimbabwe, with a focus on rural livelihoods, by strengthening integrated planning systems: Project Identification Form (PIF), http://www.thegef.org/gef/sites/thegef.org/files/. Accessed 10 June 2015.

United Nations Framework Convention on Climate Change (UNFCCC). 2001. Improving the participation of women in the representation of Parties in bodies established under the United Nations Framework Convention on Climate change, draft decision proposed by the President, Conference of the Parties, Other Matters, Seventh session, Marrakech, 29 October–9 November 2001, Agenda item 13, France, UNFCCC.

United Nations Framework Convention on Climate Change (UNFCCC). 2008. Zimbabwe's Initial National under the United Nations Framework Convention on Climate Change, Harare, UNFCCC, Harare.

United Nations International Strategy for Disaster Reduction (UNISDR). 2005. Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters, World Conference on Disaster Reduction 18-22 January 2005, Kobe, Hyogo, Japan. www.unisdr.org/wcdr. Accessed 10 April 2014.

United Nations International Strategy for Disaster (UNISDR). 2007. Terminology: Basic terms of Disaster Risk. www.unisdr.org/we/inform/terminology. Accessed 12 June 2015.

United Nations International Strategy for Disaster Reduction (UNISDR). 2008. Climate change and Disaster Risk Reduction. International Strategy for Disaster Reduction, Briefing Note 01. Geneva, Switzerland. UNISDR.

United Nations International Strategy for Disaster Reduction (UNISDR). 2014. Third World Meteorological Organisation gender conference, 05-07 November 2014, Geneva Switzerland. www.unisdr.org/we/inform/events/36560. Accessed 02 October 2015.

Vincent, K. 2007. Uncertainty in adaptive capacity and the importance of scale. *Global Environmental Change.* Vol. 17 (1) pp.12-24.

Vogel, C.H. 1994. The Impact of Extreme Drought Events. Report submitted to Human Science Research Council. Pretoria. South Africa.

Waddick, P. 2015. Building a Sound Data Collection Plan Six Stigma. http://www.isixsigma.com/tools-templates/sampling-data/building-sound-data-collection-plan/ Accessed 10 April 2015.09.15.

Wamukonya, N. 2001. Climate Change implications for Southern Africa: A gender perspective, Southern African Gender and Energy Network (SAGEN).

Webster, M. 2015. iWord dictionary. www.i.word.com/idictionary/vulnerable. Accessed 10 April 2015.

Word Food Proramme (WFP). 2015. Southern Africa: The 2014-2015 Rainfall Season. VAM food security. www.wfp.org/doc/en. Accessed 10 July 2015.

Wisner, B., Blaikie, P., Cannon, T. and Davis, I. 2004. At risk: Natural hazards, people's vulnerability and disasters. Second edition. www.preventionweb.net. Accessed 10 May 2015.

Women 2000 and Beyond. 2004. Making Risky Environments Safer. Paper presented to United Nations Department of Economic and Social Affairs. http://www.un.org/womenwatch/daw/documents/Natdis . Accessed 10 April 2014.

World Bank. 2011. Guide to Climate Change Adaptation in Cities, International Bank FOR Reconstruction and Development. World Bank. http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1318995974398/GuideClimChangeAdaptCities.pdf . Accessed 15 May 2015.

World Food Programme. 2014. Zimbabwe Food Security Outlook Jan-Mar 2014.Vam Food Security Analysis. Harare. Zimbabwe. WFP.

World Food Summit. 1996. Rome Declaration on World Food Security 13-17 November. http://www.fao.org/ag/againfo/programmes/en/lead/toolbox/Indust/romedec.pdf. Accessed 10 June 2014.

World Food Programme (WFP). 1999. Vulnerability Analysis and Mapping, www.documents.wfp.org/vam/ . Accessed 10 April 2014.

Word Heath Organisation (WHO). 1992. The concept of vulnerability. www.whqlibdoc.who.int/publications/1992/9241561467_(chapter2).pdf. Accessed 19 June 2015.

World Health Organisation (WHO). 2002. Environmental health in emergencies and disasters, A practical guide, vulnerable groups. www.who.int/environmental_health_emergencies/vulnerable_groups/en/.Accessed 19 June 2015.

World Health Organisation (WHO) 2012. Mainstreaming gender in health adaptation to climate change programmes, User Guide. Geneva, Switzerland. WHO.

World Meteorological Organisation (WMO). 2012. Standardized Precipitation Index User Guide, Geneva. Switzerland. WMO.

World Meteorological Organisation. 2014. 3rd Gender Conference, First Announcement www.wmo.org/int. Accessed 10 June 2014.

World Resources Report. 2011. Decision making in a changing climate: World Resources 2010-2011, Washington D.C, U.S.A. World Resources Institute.

Yonetani, M. 2014. Global Estimates 2014: People displaced by disasters, Internal Displacement Monitoring Centre.
www.worldbank.org/en/topic/disasterriskmgt. Accessed 10 April 2015.

Zimbabwe Conservation Agriculture Task Force. 2009, Farming for the Future A Guide to Conservation Agriculture in Zimbabwe.
http://www.foodgrainsbank.ca/uploads/Farming%20for%20the%20Future%20-20A%20Guide%20to%20Conservation%20Agriculture%20in%20Zimbabwe.pdf.
Accessed 15 August 2015.

Zimbabwe Department of Meteorological Service. 2005. Climate change in Zimbabwe: trends in temperature and rainfall.
http://weather.utande.co.zw/climate/climatechange.htm. Accessed 10 April 2015.

Zimbabwe National Contingency Committee, 2013. Zimbabwe National Contingency Plan December 2012-November 2013.
http://www.ifrc.org/docs/IDRL/Zimbabwe%20National%20Contigency%20Plan%202012-2013.pdf. Accessed 10 May 2014.

Zimbabwe National Statistics Agency. 2012. Census 2012 Preliminary Report. Harare. Zimbabwe. Central Statistics Office.

Zimmermann, M.N. 2005. The Risk Concept. World Conference on Disaster Reduction (WCDR). Kobe. Japan.

ZIMVAC. 2009. Zimbabwe Vulnerability Assessment Commission Rural Households Survey Report. Harare. Zimbabwe. ZIMVAC.

Zishiri, C. 2013. Ministry of Agriculture, Mechanisation and Irrigation Development. Report on the Small Grains Demonstration plots in Mashonaland Central: 2012/2013 season. Harare. Zimbabwe. Ministry of Agriculture.

APPENDICES

Appendix 1. Research authorisation letter

Zimbabwe

Chivi District Administrator's Office

Private Bag 527
Nyaningwe

Telephone (037) 239
Fax (037) 287

27 April 2015

The Chief Executive Officer- Chivi Rural District Council

I.O.C Chivi ZRP

AGRITEX

EMA

Council Chairman

Chief Nemauzhe and Chief Gororo

All Headmen and Village Heads

RE: APPROVAL OF MASTERS RESEARCH PROPOSAL FOR JESTINA CHINEKA (14014919)

The District Administrator's office grants Jestina Chineka, a Masters Student at University of Venda permission to carry a research entitled;

A gender analysis of the vulnerability and adaptation to drought in Chivi South District.

This letter confirms permission for the research. The research will be for academic purposes only.

Your assistance in this study will be highly appreciated.

.....

For: District Administrator

27/4/15

Appendix 2. Rainfall Data for Chivi District

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1983	28.43094	43.86924	27.45097	10.7357	15.315	1.562776	18.94749	15.94429	4.38E-02	34.95379	72.29221	75.75502
1984	48.81721	58.23733	117.7764	28.89818	2.95946	2.424139	3.829277	0.682176	17.38003	38.12975	139.9445	110.9515
1985	248.7363	118.0266	55.45427	1.596001	15.80895	3.730127	2.878203	1.076081	16.09952	21.25932	30.96486	134.8299
1986	122.6861	85.60571	52.20148	136.8117	4.810532	0.576307	0.738893	0	1.276139	54.11004	29.34678	101.7392
1987	53.62058	47.4193	10.16383	0.720392	0.636902	0.449739	0.105914	1.2958	8.138832	19.90636	40.70103	266.0376
1988	72.41788	143.5336	104.8658	17.50217	6.198889	24.98582	0.919144	4.562769	0.561547	28.50677	49.42234	67.15086
1989	26.3624	163.0889	20.99194	41.64424	0.268582	4.144197	5.63E-02	8.613087	1.120125	37.98381	63.44628	64.26822
1990	204.5454	67.38744	33.68726	42.48116	1.309528	0.683014	4.38E-02	1.519802	3.733565	4.665453	40.28432	111.5544
1991	72.9023	78.80652	81.25925	1.519199	4.217063	0.174282	6.22E-03	0.14325	3.176967	3.538906	37.02581	27.08627
1992	46.90977	4.532188	33.25104	2.494526	1.873407	0	0	0	0	18.33429	73.00156	242.3091
1993	91.43277	158.9649	14.00262	7.436489	2.50E-02	4.453326	9.489912	2.479454	0.46215	2.855049	180.6163	139.7329
1994	99.10604	42.31258	12.40678	9.250105	0.953015	0.14335	0.187439	0.218944	1.318731	49.92994	18.87473	130.0186
1995	61.92867	116.6425	85.3627	16.69883	29.17933	1.771541	0.262746	0.413091	0.761951	12.26706	76.25316	119.7016
1996	329.0125	130.8067	36.46687	12.4877	13.13692	2.820368	10.73268	1.242339	1.687323	3.564053	68.94769	91.69231
1997	208.5721	87.39075	154.179	45.92769	3.914285	0	3.425023	0.36142	26.03972	25.96383	70.89469	56.87531
1998	132.237	24.41467	46.07056	6.383444	0.487526	1.118528	2.693012	2.887959	3.570487	28.69289	88.85378	150.8212
1999	127.9438	116.3326	83.11628	9.02667	0	4.877381	1.569731	0	2.20471	17.14255	130.6948	61.44951
2000	163.8575	214.2417	147.5077	31.09028	20.84946	20.41429	4.603077	0.587465	10.46711	26.65106	127.2284	75.09251
2001	87.47995	258.4839	103.87	21.21713	17.58845	6.38993	7.630704	0.13744	27.35597	14.69448	102.6371	148.7824
2002	48.77692	13.67923	14.06886	46.09693	3.806629	22.64855	0.749763	2.731933	13.50416	36.95161	45.90375	94.04782
2003	62.53627	92.36572	86.25631	9.645946	8.20966	33.67992	1.344908	0.350084	5.769108	57.93518	69.28916	107.6258
2004	135.1756	111.8523	135.0878	12.7723	10.7517	1.950209	3.458931	2.685406	10.27939	12.49189	69.21316	160.3242
2005	66.07697	99.56272	45.00407	18.70135	4.868542	4.291833	2.274589	0	6.508865	26.35946	114.4801	230.9807
2006	109.1199	141.326	80.44523	29.59146	10.30775	5.904719	2.324121	5.097637	12.05207	18.35462	76.28054	134.3664
2007	156.9863	85.43137	58.8502	44.33148	7.62723	6.91041	2.429502	2.550694	11.08743	48.29473	79.27029	89.87491
2008	96.92557	91.02969	62.78245	22.53674	7.094334	3.887165	2.174588	3.032225	6.055152	19.98778	73.88496	175.6048
2009	122.1382	140.1438	42.70919	25.29545	16.34258	15.08416	10.55806	2.069513	12.81618	34.43054	81.31333	97.52681
2010	118.6092	110.7557	61.04884	61.84656	20.66209	5.539089	2.362022	0.575691	2.559742	8.80022	138.1232	128.2931
2011	175.6217	39.56556	29.55281	71.77257	12.13224	5.354218	0.973639	4.195036	1.137417	47.75506	61.5071	138.9242
2012	57.10334	101.6225	57.24968	41.49273	1.312528	2.930362	0	0.575045	24.19261	30.81654	31.471	102.6704
2013	214.6007	53.8257	31.56209	20.20872	0.937323	1.013211	1.224741	2.700881	0.800223	29.42843	79.07398	156.8594

Appendix 3. Standardized Precipitation Index

Year	1983	1983	1983	1983	1983	1983	1983	1983	1983	1983	1983	1983
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	-1.83	-0.87	-0.91	-0.53	0.92	-0.39	2.87	3.02	-1.30	0.67	0.05	-0.89
SPI 2	-0.99	-0.99	-1.88	-1.31	-0.79	-0.22	1.21	1.91	1.71	0.82	0.02	-0.58
SPI 3	-0.99	-0.99	-0.99	-0.99	-0.99	-1.80	-0.87	-0.18	0.45	1.23	0.62	-0.21
Year	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	-1.09	-0.52	1.26	0.37	-0.44	-0.39	0.62	-0.13	1.21	0.81	1.54	-0.09
SPI 2	-1.18	-1.49	-0.26	0.33	0.95	0.01	-0.32	-0.16	1.00	1.01	1.99	0.95
SPI 3	-0.98	-1.24	-0.57	-0.60	-0.66	-0.30	0.24	0.86	0.27	0.57	1.70	1.06
Year	1985	1985	1985	1985	1985	1985	1985	1985	1985	1985	1985	1985
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	1.98	0.52	0.01	-1.64	1.00	0.01	0.37	-0.13	1.13	-0.14	-1.44	0.36
SPI 2	1.73	1.27	1.30	0.01	-0.32	-0.47	0.63	-0.05	0.87	0.27	-1.22	-0.51
SPI 3	1.89	1.64	1.39	1.14	0.88	1.08	0.08	-0.36	-0.14	0.44	-1.12	-0.38
Year	1986	1986	1986	1986	1986	1986	1986	1986	1986	1986	1986	1986
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	0.44	0.03	-0.07	2.61	-0.11	-0.65	-0.25	-0.37	-0.86	1.48	-1.54	-0.28
SPI 2	-0.09	0.22	0.07	0.97	1.49	2.20	-0.53	-0.93	-1.23	0.97	-0.66	-0.55
SPI 3	-0.08	-0.14	-0.27	0.50	0.80	0.82	0.84	1.34	1.94	0.47	-0.81	-0.72
Year	1987	1987	1987	1987	1987	1987	1987	1987	1987	1987	1987	1987
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	-0.95	-0.79	-1.92	-2.00	-0.88	-0.99	-0.55	-0.13	0.40	-0.21	-0.99	2.17
SPI 2	-1.35	-1.23	-1.68	-1.82	-2.53	-2.33	-1.80	-1.14	-0.07	-0.18	-1.18	1.41
SPI 3	-1.08	-1.27	-1.56	-2.03	-1.81	-2.01	-1.94	-2.71	-1.63	-0.89	-1.32	1.35
Year	1988	1988	1988	1988	1988	1988	1988	1988	1988	1988	1988	1988
Month	1	2	3	4	5	6	7	8	9	10	11	12

SPI 1	-0.50	0.85	1.04	-0.11	0.02	1.97	-0.25	1.07	-0.86	0.35	-0.68	-1.13
SPI 2	0.77	1.30	0.58	0.91	0.66	0.46	1.05	1.61	-0.32	0.13	-0.83	-1.28
SPI 3	0.70	0.88	1.04	0.98	1.23	0.58	0.97	0.90	0.27	0.64	-0.16	-1.36
Year	1989	1989	1989	1989	1989	1989	1989	1989	1989	1989	1989	1989
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	-1.92	1.08	-1.19	0.79	-1.13	0.01	-0.55	1.92	-0.86	0.81	-0.22	-1.22
SPI 2	-2.02	-0.62	-0.42	0.54	-0.54	0.38	-0.96	0.44	0.04	0.71	-0.12	-0.90
SPI 3	-1.97	-0.80	-1.01	-0.86	-0.78	-0.33	0.39	-0.46	0.27	0.11	-0.04	-0.93
Year	1990	1990	1990	1990	1990	1990	1990	1990	1990	1990	1990	1990
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	1.51	-0.33	-0.63	0.79	-0.88	-0.65	-0.55	0.21	-0.15	-1.86	-1.03	-0.07
SPI 2	0.34	0.15	0.46	-0.37	-0.23	0.32	-1.41	-0.75	-0.46	-1.55	-2.02	-1.05
SPI 3	0.44	0.07	-0.10	-0.07	-0.03	0.44	-0.51	-0.38	0.10	-2.14	-2.00	-1.15
Year	1991	1991	1991	1991	1991	1991	1991	1991	1991	1991	1991	1991
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	-0.48	-0.10	0.60	-1.64	-0.27	-0.99	-0.55	-0.37	-0.34	-2.07	-1.15	-2.65
SPI 2	-0.82	-0.54	-0.19	-0.13	-0.03	-1.61	-0.96	-1.30	-0.99	-2.07	-2.26	-3.24
SPI 3	-1.13	-1.01	-0.72	-0.71	-0.51	-0.49	-0.26	-0.24	-1.82	-2.36	-2.36	-3.40
Year	1992	1992	1992	1992	1992	1992	1992	1992	1992	1992	1992	1992
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	-1.15	-2.89	-0.67	-1.64	-0.64	-0.99	-0.55	-0.37	-1.30	-0.36	0.07	1.89
SPI 2	-2.59	-3.33	-2.14	-2.32	-1.28	-1.89	-1.41	-1.30	-1.85	-0.90	-0.44	1.48
SPI 3	-3.04	-3.50	-3.31	-3.20	-3.21	-2.44	-2.40	-1.51	-2.47	-1.54	-0.67	1.32
Year	1993	1993	1993	1993	1993	1993	1993	1993	1993	1993	1993	1993
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	-0.11	1.03	-1.61	-0.87	-1.13	0.01	1.59	0.21	-1.30	-2.33	2.22	0.44
SPI 2	1.00	1.36	0.10	0.07	-1.95	-1.12	0.02	0.61	0.14	-2.43	1.78	1.37
SPI 3	0.84	1.09	0.73	0.63	0.65	-0.16	0.03	-1.54	-0.93	-1.69	1.65	1.34
Year	1994	1994	1994	1994	1994	1994	1994	1994	1994	1994	1994	1994
Month	1	2	3	4	5	6	7	8	9	10	11	12 0.27
SPI 1	0.04	-0.92	-1.75	-0.68	-0.88	-0.99	-0.55	-0.37	-0.86	1.33	-2.14	-0.32 -
SPI 2	1.11	-0.36	-1.07	-1.71	-1.90	-1.20	-1.80	-1.30	-1.54	0.82	-1.15	0.50
SPI 3	0.85	0.27	-0.06	-0.02	-0.92	-1.31	-1.83	-2.15	-1.63	0.11	-1.32	

Year	1995	1995	1995	1995	1995	1995	1995	1995	1995	1995	1995	1995
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	-0.74	0.50	0.68	-0.16	1.82	-0.39	-0.55	-0.37	-0.86	-0.89	0.15	0.08
SPI 2	-0.99	-0.09	0.10	0.47	0.69	0.43	1.01	-0.93	-1.54	-1.34	-0.51	-0.18
SPI 3	-0.81	-0.41	-0.16	-0.39	0.16	0.15	0.57	0.53	0.07	-0.21	-0.67	-0.35
Year	1996	1996	1996	1996	1996	1996	1996	1996	1996	1996	1996	1996
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	-0.74	0.50	0.68	-0.16	1.82	-0.39	-0.55	-0.37	-0.86	-0.89	0.15	0.08
SPI 2	-0.43	-0.19	0.10	0.47	0.69	0.43	1.01	-0.93	-1.54	-1.34	-0.51	-0.18
SPI 3	-0.70	-0.34	-0.09	-0.06	0.09	0.15	0.57	0.53	0.07	-0.21	-0.67	-0.35
Year	1997	1997	1997	1997	1997	1997	1997	1997	1997	1997	1997	1997
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	1.56	0.04	1.78	0.90	-0.27	-0.99	0.37	-0.37	1.78	0.18	0.02	-1.43
SPI 2	0.99	0.81	1.47	1.07	1.60	0.49	-0.53	-0.75	1.41	0.86	0.44	-1.10
SPI 3	0.78	0.56	1.09	1.23	1.28	1.42	0.93	1.46	0.81	0.37	0.22	-0.78
Year	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998	1998
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	0.58	-1.54	-0.24	-0.98	-1.13	-0.65	0.37	0.52	-0.15	0.35	0.48	0.63
SPI 2	-0.40	-1.11	-0.50	-1.43	-0.82	-1.49	-0.96	-0.16	0.04	0.18	0.42	0.69
SPI 3	-0.24	-0.79	-1.00	-1.13	-1.28	-0.79	-1.50	-0.85	-1.21	-0.39	0.29	0.65
Year	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	0.51	0.49	0.64	-0.68	-1.13	0.18	0.08	-0.37	-0.57	-0.44	1.37	-1.31
SPI 2	0.67	0.65	0.62	0.36	0.06	-0.91	-0.53	-0.16	-0.78	-0.83	1.08	-0.16
SPI 3	0.66	0.65	0.73	0.57	0.48	0.37	0.25	-0.02	-1.15	-1.13	0.88	-0.29
Year	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	1.02	1.60	1.70	0.44	1.35	1.64	0.85	-0.13	0.61	0.24	1.30	-0.91
SPI 2	0.56	0.99	1.93	1.85	1.56	1.01	1.57	1.34	0.57	0.27	1.38	0.14
SPI 3	0.39	1.13	1.52	1.52	1.39	1.96	1.92	1.66	0.99	1.15	1.49	0.19
Year	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	-0.19	2.00	1.03	0.04	1.15	0.32	1.42	-0.37	1.84	-0.61	0.81	0.59

SPI 2	-0.09	0.84	1.47	1.78	0.86	0.35	1.05	0.53	1.71	0.45	0.96	0.67
SPI 3	-0.08	1.09	1.21	1.12	0.95	1.38	1.77	0.86	0.83	0.86	0.92	0.95
Year	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	-1.09	-2.05	-1.61	0.90	-0.27	1.85	-0.25	0.52	0.98	0.76	-0.79 -	-0.45
SPI 2	0.03	-1.12	-2.30	-1.47	-0.52	1.03	0.87	1.40	0.73	0.94	0.26	-0.68
SPI 3	0.08	-0.60	-1.11	-0.81	-1.17	-1.48	-1.12	-0.16	1.05	1.09	0.18	-0.58
Year	2003	2003	2003	2003	2003	2003	2003	2003	2003	2003	2003	2003
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	-0.71	0.13	0.70	-0.60	0.27	2.48	-0.25	-0.37	0.15	1.63	-0.04	-0.15
SPI 2	-1.10	-0.70	-0.11	0.16	0.27	0.54	1.46	1.81	-0.32	1.29	0.69	0.23
SPI 3	-0.87	-0.70	-0.50	-0.68	-0.49	-0.01	0.40	0.62	0.35	1.74	1.09	0.14
Year	2004	2004	2004	2004	2004	2004	2004	2004	2004	2004	2004	2004
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	0.62	0.43	1.52	-0.39	0.58	-0.39	0.37	0.52	0.61	-0.89	-0.04	0.77
SPI 2	0.14	0.32	1.02	0.85	1.07	-0.30	0.23	-0.05	0.57	-0.42	-0.44	0.31
SPI 3	0.40	0.44	0.85	0.55	0.65	0.84	0.79	0.99	-0.14	-0.34	-0.44	0.36
Year	2005	2005	2005	2005	2005	2005	2005	2005	2005	2005	2005	2005
Month	1	2	3	4	5	6	7 0.08	8	9	10	11	12
SPI 1	-0.64	0.25	-0.27	-0.06	-0.11	0.01	-0.14	-0.37	0.28	0.18	1.04	1.76
SPI 2	-0.03	0.06	-0.41	-0.11	-0.40	-0.22	-0.16	-0.29	-0.07	0.03	1.01	1.90
SPI 3	-0.16	-0.10	-0.24	-0.18	-0.17	-0.49		-0.48	-0.31	-0.21	0.80	1.84
Year	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	0.21	0.82	0.58	0.40	0.48	0.32	0.08	1.07	0.80	-0.36	0.15	0.34
SPI 2	1.39	1.29	0.64	0.77	0.53	0.38	0.35	0.44	0.80	0.13	-0.01	0.13
SPI 3	1.36	1.37	1.34	1.30	1.18	0.62	0.73	0.53	0.49	0.15	0.06	0.22
Year	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	0.93	0.01	0.11	0.85	0.27	0.45	0.08	0.52	0.71	1.25	0.23	-0.54
SPI 2	0.66	0.49	0.42	0.16	0.38	0.72	0.29	0.36	0.57	1.22	0.80	-0.04
SPI 3	0.64	0.40	0.30	0.45	0.48	0.51	0.15	0.38	0.72	1.01	0.74	0.01
Year	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008

Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	0.00	0.11	0.21	0.13	0.15	0.01	0.08	0.52	0.15	-0.21	0.10	1.01
SPI 2	-0.34	-0.39	-0.02	0.04	0.08	0.01	0.02	0.06	0.14	-0.18	-0.18	0.71
SPI 3	-0.07	-0.11	-0.12	-0.29	-0.35	-0.08	0.00	0.04	-0.04	-0.30	-0.18	0.68
Year	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	0.42	0.80	-0.33	0.21	1.00	1.26	1.89	0.21	0.89	0.62	0.29	-0.36
SPI 2	0.71	0.98	0.45	0.36	-0.09	0.64	1.43	1.45	1.24	0.75	0.57	-0.10
SPI 3	0.63	0.79	0.60	0.60	0.70	0.52	0.57	0.20	0.87	1.34	0.86	0.10
Year	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	0.37	0.42	0.16	1.30	1.35	0.32	0.08	-0.13	-0.34	-1.23	1.50	0.23
SPI 2	0.00	0.08	0.33	0.61	0.87	1.35	0.92	0.06	-0.46	-1.34	1.08	0.77
SPI 3	0.12	0.20	0.13	0.30	0.38	0.65	0.68	0.81	1.13	-0.30	0.92	0.68
Year	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	1.17	-0.98	-0.79	1.52	0.67	0.18	-0.25	0.81	-0.86	1.25	-0.25	0.43
SPI 2	1.29	0.22	-0.06	-0.38	0.43	1.35	0.35 -	0.17	-0.46	0.90	0.13	0.42
SPI 3	1.10	0.48	0.25	0.62	0.28	0.32	0.33	0.39	1.13	0.76	0.11	0.33
Year	2012	2012	2012	2012	2012	2012	2012	2012	2012	2012	2012	2012
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	-0.87	0.28	0.06	0.76	-0.88	-0.17	-0.55	-0.13	1.67	0.46	-1.44	-0.26
SPI 2	-0.43	-0.20	-0.35	0.28	0.18	0.35	-0.96	-0.58	1.18	1.01	-0.60	-0.90
SPI 3	-0.25	-0.16	-0.14	-0.19	-0.15	-0.28	0.14	0.05	0.61	0.40	-0.69	-0.66
Year	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013
Month	1	2	3	4	5	6	7	8	9	10	11	12
SPI 1	1.62	-0.61	-0.71	-0.01	-0.88	-0.65	-0.25	0.52	-0.86	0.35	0.23	0.72
SPI 2	0.50	0.46	0.42	-0.89	-0.79	-0.47	-1.16	-0.43	-0.61	0.03	0.08	0.64
SPI 3	0.67	0.22	-0.14	-0.21	0.05	0.23	-1.01	-0.88	-0.70	-0.58	-0.06	0.53

Appendix 4. Household Questionnaire

The aim of this survey is to establish the extent of vulnerability and adaptation to drought among Chivi South community members. It is meant for academic purposes only and participation is voluntarily, respondents can withdraw at any time. Respondents will not be exposed to any form of harm either physically or psychologically. Privacy and identity of the respondents will be safeguarded. This implies that the information will be kept confidential.

Please, Provide answers using a cross(x) in the appropriate box next to the question.

Name of Village | | **Questionnaire ID** | | **Date……..**

SECTION A: Demographic information

1. Sex

Male	1	
Female	2	

2. Age

Under 20	1	
20-30	2	
31-40	3	
41-54	4	
55 and above	5	

3. Marital status

Single	1	
Married	2	
Divorced	3	
Widowed	4	

4. What is your level of education?

No formal education	1	
Primary	2	
Secondary	3	
Tertiary	4	

5. What is your employment status?

Employed	1	
Self employed	2	
Unemployed	3	
Pensioner	4	

Section B: Household human capital

1. What is the size of your household?

<4	1	
4-5	2	
6-9	3	
≥10	4	

2. Are your female family members more than males?

No	1	
Yes	2	

3. In your opinion, do you have enough farm labour?

No	1	
Yes	2	

4. What is the ratio of employed family members to your household size?

0	1	
1:4	2	
1:3	3	
1:2 and less	4	

5. Do you have a family member who has long term illness or disability?

No	1	
Yes	2	

6. Do you have family members who have migrated from the family compound in the last 30 years? Explain the causes of these movements.

_____

Section C: Social assets

1. Do you support any extended family members economically?

No	1	
Yes	2	

2. Do you get support from extended family members?

No	1	
Yes	2	

3. During drought where do you get most support from?

Social scheme	1	
Family members off- compound	2	
Government	3	
Private organization	4	
None	5	

4. Are you a member of any social scheme?

No	1	
Yes	2	

5. Do you communicate with or visit relatives and friends in town?

No	1	
Yes	2	

6. Where do you get information about an oncoming drought?

_____

Section D. Physical assets information

1. Which assets do you have?

Car/scotch cart	Tractor	Plough	Animal draught power	Radio/television	Electricity /Generator/Solar	Phone	Land
1	2	3	4	5	6	7	8

2**.** Which resources and services do you have access to?

Health facilities	Schools	Agricultural markets	Banks	Public transport	Agricultural extension services
1	2	3	4	5	6

3. How big is your livestock herd?

		Cattle	Goats	Donkeys	Poultry
1-5	1				
6-10	2				
11+	3				

4. The nearest town

>10 km away	1	
11-79km away	2	
80km+ away	3	

5. The nearest agricultural market

>10 km away	1	
11-79km away	2	
80km+ away	3	

6. Who own livestock in your family? Explain

E. Household Financial Status

1. How much on average do you earn per month

< $600	1	
$600-$ 1000	2	
>$1000	3	

2. How many family members support your household financially?

0	1	
1	2	
2	3	
3+	4	

3. How much money on average do you get from agricultural sales every year?

0	1	
$7 200	2	
$ 8000- 24 000	3	
$25 000+	4	

4. Other non-agricultural income generating projects

Gold panning	1	
Selling carvings	2	
Selling firewood	3	
Cross border trading	4	
Others	5	

5. Which financial assets do you have access to?

Savings	1	
Credit	2	
Loans	3	
Social schemes	4	
None	5	

6. Explain on financial use in your family?

Section F. Natural assets

1. Which of the following resources do you have access to?

Pastures	1	
Arable land	2	
Water	3	
Forests	4	
Minerals	5	

2. How much distance do you travel to fetch household water?

<2km	1	
2 – 4 km	2	
≥5km	3	

3. What is your main source of agricultural water?

Source		
Dam	1	
Tap	2	
River	3	
Borehole	4	
Rain	5	

4. How big is your arable land?

Football pitch size	Twice football pitch size	Bigger	No land
1	2	3	4

5. How would you describe your soil quality?

Satisfactory quality	1	
Good	2	
Poor	3	
Don't know	4	

6. Which drought coping strategies does your family use?

Section G. Community Based Asset Weighting

Household asset		**Weight**
Financial	1	
Human	2	
Natural	3	
Physical	4	
Social	5	

Appendix 5. Household vulnerability variables

Dimension And weight	Variable	Theory	Description of variable	Weight given to variable	Transformation
Human assets (17)	Dependants	Big household sizes increase vulnerability	Number of household members	4	1 = households sizes > 6; 4-5=0.5;X<4=0
	Sex ratios	Female dominated households are more exposed to drought	Number of female family members to males	1	1= households with female family members more than male, zero otherwise
	Farm labour	Households lacking farm labour are more likely to be affected by drought	Family members available for farm labour	4	1= households without enough farm labour, zero otherwise
	Dependency	Households with more family members having a consistent salary are less affected	Family members working in relation to household size	4	1= households without anyone employed; 0.5 with a 1:4+ ratio; 0.25 for 1:3 and 0 for 1:2 and less
	Chronic illness/ disability in the family	Other vulnerabilities makes a household more exposed to drought	Family members with long-term illness or disability	4	1= households with disabled and chronic ill family members and zero otherwise
Social assets (18)	Extended Dependants	Households supporting extended family are more exposed	Extended family members supported	4	1= households which support extended families and zero otherwise

	Extended family support	Households getting support from extended family are less vulnerable	Support from extended family members	1	1= households which do not get support from extended family and zero otherwise
	External support during drought	Households with high external support systems are less exposed to drought	Drought related external support	5	0= households which get support from >2 institutions, 0.5= households getting support from 1 or 2 institutions and 0= with no support
	Social support	Households under social schemes are less vulnerable than those not	Membership to social schemes	4	1= households who do not have any social scheme and zero otherwise
	Information exchange	Households communicating with or visiting off compound members and relatives are less vulnerable	External communication	4	1= households which do not communicate with relatives in towns and zero otherwise
Physical assets (19)	Agricultural equipment	Households with essential farming equipment are less vulnerable	Access to equipment	4	score 0 is X = 4+ total number of equipment, 0.5= <4 X>1, 1= X<2
	Services	Households lacking basic services are more exposed to drought	Access to services	4	0= households with>3 services listed and 1 otherwise
	Livestock	Households with more livestock adapt to drought better	livestock Ownership	5	Productive livestock index, 0 is X=1cattle and any other livestock, 0.5= households with no cattle but other livestock and 1with no livestock at all
	Access to towns	Households with access to towns are more likely to find employment or market their products	Nearest town accessibility	4	1= households with nearest town X>100km away; 0.5= households with nearest town of 11 to100 km and 0= households of X<11km

		and cope with drought better than those far off			
	Agricultural markets	Households with high agricultural markets accessibility are less vulnerable	agricultural market accessibility	5	2= households with nearest agricultural market X>100km away; 1= households with nearest agricultural market of> 11X<100 km and 0= households of X<11km
Financial assets (23)	Household head Income	Households with a head having a consistent salary are less exposed to drought	Monthly income	5	1= households with heads earning <$600 per month and zero otherwise
	Remittances	Households getting income from family members off the compound are less vulnerable to drought	Number of family members who send money home	4	1= households which do not receive remittance, 0.5 with at least one source of remittance and 0= more than 1 source
	Agricultural returns	Households getting high annual agricultural returns are less vulnerable	Average annual agricultural sales	5	1= households with no agricultural sales 0.5 with returns <$7200 and zero otherwise
	Non-agricultural income generating projects	Households with alternative income sources are less affected	Other non-agricultural income generating projects	5	1= households with no any other income generating project; 0.5 for those selling firewood and zero otherwise
	Access to financial assets	Households with access to financial assets and schemes are less vulnerable	Access to financial assets	4	1= households with no financial assets; 0.5 =households with at least 1 financial asset and zero otherwise
Natural assets (23)	Access to natural resources	Households with high access to natural resources are less vulnerable	Access to natural resources	5	1= households without access to resources and 0.5 households <2 resources and 0= with 2 and more resources

	Access to potable water	Household with access to water are less vulnerable	Access to potable water	5	0= households which get water <2 km away; 0.5 =>2X<5 and 1= X=5+km
	Agriculture Water source	Households relying on rain for agriculture are more vulnerable to drought	Source of agricultural water	5	1= households with rain as the source of water; 0.5 for river source and zero otherwise
	Arable land size	Households with small to no land are more vulnerable to drought	Size of arable land	5	0 is X= land size double football pitch size and bigger , 0.5= less than double football pitch size and 1=households with no land
	Soil quality	Households with declining soil fertility are more vulnerable	Soil quality	3	1= households with poor soil quality; 0.5= who don't know and zero otherwise