Midlands State University

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Our Hands, Our Minds, Our Destiny

FACULTY OF ARTS

DEPARTMENT OF DEVELOPMENT STUDIES

RESEARCH TITLE

THE IMPACT OF CLIMATE CHANGE AND VARIABILITY ON SMALLHOLDER FARMERS. A CASE OF WARD 10, ZAKA DISTRICT. 2000 - 2014.

BY

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SUPERVISOR; Ms MUKUHLANE

A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE BACHELOR OF ARTS HONOURS DEGREE IN DEVELOPMENT STUDIES

Declaration

I, Admire Mada, hereby declare that this research is product of my own work except where sources have been acknowledged. It is being submitted in partial fulfilment of the requirements for Bachelor of Arts Honours in Development Studies in the Faculty of Arts at Midlands State University. The work has never been submitted, nor will it ever be submitted to another University for the awarding of a degree.

Signed……

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Approval form

The undersigned certify that they have read the dissertation and have approved its submission for marking after confirmation that it is in conformity with the departmental requirements.

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DEGREE TITLE: Bachelor of Arts in Development studies

YEAR DEGREE GRANTED: 2015

SIGNED

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Dedication

I dedicate this work to my parents Mr. and Mrs. Mada.

Acknowledgments

I extend my gratitude to my supervisor Ms Mukuhlani for the professional guidance and supervision throughout the process of writing this dissertation. I would also like to thank all the interviewees who participated as respondents in this research for their immense contributions. Your generous time, thoughts and perceptions shaped this research. Many thanks to my key informants from Veterinary service department, AREX department, Sustainable Agricultural Trust and CARE International Field Officers. My heartfelt thanks also go to my colleagues Andrew, Lenni, Blantina and Leon, for the discussions we had and encouragement. This study would not have been possible without the moral and financial support from my parents. I am thankful for your timely support and enthusiasm to see this work being completed. I do not know how to express deep gratitude I owe to you for always being there for me. God bless you.

Abstract

As the debate on the impact of global climate change goes on at global and regional scale, climate change impacts are already being felt at local level. This research aims at exploring impacts of climate change on smallholder farmers' livelihood in ward 10 of Zaka District of Zimbabwe. Specifically the study seeks to: determine climate change manifestations; evaluate household-level impacts of climate change on smallholder farmers' livelihoods and lastly; to investigate the extent of household-level coping and adaptation strategies to climate change in Zaka rural community in Zimbabwe, especially farmers in ward 10. The research is highly qualitative, the instruments used include; key informant interviews, structured observations and a household questionnaire survey. Climate change has contributed to significant local environmental stresses affecting local resources such as forests, fauna, water, pastures and soil among other natural assets. The local livelihoods show high levels of vulnerability to climate change due to notable low adaptive capacity. The high level of vulnerability to changing climate is exposing the study population to increased prevalence of poverty, crop and livestock failures, food insecurity, malnutrition, disease and rural urban migration among other impacts. The study concludes that the factors creating barriers to climate change adaptation are related to those contributing to poverty and holding back sustainable local development.

List of Acronyms

AGRETEX Agriculture Technical Extension

AREX Agricultural Research and Extension Services

GDP Gross Domestic Product

GHG Green House Gases

GIS Geographical Information Systems

GMB Grain Marketing Board

IPCC Intergovernmental Panel on Climate Change

MDGs Millennium Development Goals

NGOs Nongovernmental Organisations

REA Rural Electrification Agency

SAT Sustainable Agricultural Trust

SPSS Statistical Package for Social Sciences

UNFCCC United Nations Framework Convention on Climate Change

USAID United States Agency for International development

WFP World Food Programme

ZANU PF Zimbabwe African National Union Patriotic Front

ZDMS Zimbabwe Department of Meteorological Services (Met Office)

ZimVAC Zimbabwe Vulnerability Assessment Committee

ZNNP+ Zimbabwe National Network for People

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Introduction

Climate variability has become the greatest challenge caused by climate change and it has led to a number of developmental challenges being experienced in various sectors such as food security, agricultural environment, health and water resources being affected. As a result, climate variability has become a main challenge for development in Zimbabwe for it has posed significant threats to sustainable development and poverty reduction and as such this has affected the capacity for Zimbabwe in particular to meet its Millennium Development Goals (MDGs). Smallholder farmers have been under great threat to the effects of climate variability especially with this rain fed agriculture, those who are so dependent on that is heavily exposed to the vagaries of climate change and variability. Most importantly, small holder farmers constitute the largest percentage of the world's poorest people they are thus affected by climate variability because they lack adequate resources to help them cope with effects that are brought about by climate variability (Lefton, 2013) Smallholder farmers lacks resources or entitlements they can use to cope with the impacts of climate change. This extends the degree of vulnerable to climate change. This is why most Sub Saharan African states face various impacts of climate change; unlike in western countries they have entitlements and resources which gave them the ability to cope and adapt to climate change by diversifying their source of revenue.

Background to the study

Climate change is a global challenge that has posed major threats to sustainable developments at micro and macro levels but at a lesser pace in developed countries than in developing countries because developed countries have adequate resources to help them managethe challenges that come along with climate variability. Europe has experienced different climatic conditions but almost the entire continent has insignificant weather and it has seen some highly unusual weather patterns. In a report titled Climate Change Impacts and Vulnerability, the European Environmental Agency claims that climate change is affecting all regions of Europe across the continent (E.E.A 2012). Climate variability in Europe has seen a decline in the artic sea ice by 40% since the 1960s (NASA), an rise in temperature in regions within the Artic such as Alaska and Canada along with a decline in rainfall in countries such as Spain and an increase in rainfall in the Northern region of Europe. The continent has also

experienced a shift in rainfall patterns, the environmentalists have observed a decrease in precipitation in the southern regions and an increase in precipitation in the Northern parts of Europe (Skynews 2013). This has also evidenced by an increase in river flooding a case in point is the Danube River in Budapest and Elbe River in Germany whose river discharge has reached 8,91 metres in 2013 compared to the 2006 as a result of higher temperatures which have intensified the water cycle (Sky News 2013).

Climate change is not only affecting Europe alone but Africa is also at risk of climate variability. Projections by Intergovernmental Panel on Climate Change (IPCC), on Sub - Saharan Africa suggest that increased water stress, increased food insecurity, malnutrition, decreased yields from rain fed agriculture and the land is becoming arid and semi –arid. Sub-Saharan African region has been and is being affected by climate variability and change, Zimbabwe is not an exceptional to the vulnerability due to over reliance on rain fed agriculture. Meteorological records have validated that Zimbabwe is now experiencing climate changes, more recurrent and extreme weather events including droughts, floods and tropical storms (Newsday Zimbabwe Jan 2013).

As climate varies or changes, several direct influences alter precipitation amount, intensity, frequency and type (Mendelsohn and Dinar, 1999; Ravindranath and Sathaye, 2002; Winkler, 2005; Aklilu and Alebachew, 2009). Although there are many impacts expected from climate change, one of the largest impacts is expected to be on agriculture (Nordhaus, 1991; Pearce, 1996). majority of the rural people in developing countries depends heavily on rain fed subsistence agriculture and the daily exploitation of natural resources (Alebachew, 2011). Droughts and floods are very common occurrences with significant events every 3 – 5 years (World Bank, 2006). Because of changes in the patterns of the climate, in Africa is exposed to chronic food shortages, degradation of natural resources, unstable livelihoods and distress migration (Markos, 1997; Alebachew, 2000; Alebachew, 2011).

Zimbabwe has an agricultural based economy with the sector contributing about 15 per cent each year to the GDP. Agriculture provides about 66 per cent of the total employment and also supplies raw materials to industry. Zimbabwe's agricultural sector is divided into four major sub-sectors namely; large scale commercial farms, small scale commercial farms, communal and resettlement areas. The agrarian structure has changed with the recent land reform in Zimbabwe with 99 per cent of the farmers now being smallholder farmers. Of these 81 per cent are communal farmers, 18.7 per cent resettled farmers and 0.1 per cent large scale

farmers. (Zimbabwe national climate change response strategy 2013) The country is divided into five natural regions on the basis of soil type, rainfall, temperature and other climatic factors. Zaka district is under region five, this region receives the least rainfall and experience highest temperatures in the country.

Ward 10 is under Zaka north constituency which was created by the 2008 delimitation exercise from parts of what was then Zaka West. The constituency is actually one of the most impoverished in the province with a poverty incident of 76% in 2003 (A profile of constituencies: (parliament research department, 2011). The major source of economic activity in the constituency is subsistence farming and in the drier parts of the constituency people grow drought resistant crops such as sorghum and rapoko.

Statement of the problem

In most parts of Africa particularly in the Sub-Saharan region, climate change has exerted enormous pressure on rural livelihoods particularly smallholder farming which is the mainstay of rural livelihoods (UNDP Human Development Report, 2006). This scenario has arguably plunged populations into food insecurity, hunger, ill-health, limited access to income and ultimately poverty in a continent already burdened by HIV and AIDS (Madzwamuse, 2010). Smallholder farming is important for food production and income generation for many in most parts of rural Africa. A study by FAO (2006) found that about 75% of rural populations in Sub-Saharan Africa rely on smallholder farming as a source of livelihood. In Zimbabwe 70% of the population derives the bulk of food requirements and income from farming in rural areas (Levina*et al*, 2006). The heightening of climate change has had substantial negative effects on agriculture (IPCC, 2007) and this has raised the food and livelihood insecurity alarm in Zimbabwe and the entire world. Smallholder farmers in Zaka are particularly vulnerable to climate change and have been mostly affected because of their geographic exposure in an area of high climate variability and due other variables that include poverty, lack of access to resources and information. The experience of the changing climate has brought about varied perceptions amongst smallholder farmers regarding the nature, causes and effects of climate change

Theoretical framework

Sustainable Rural Livelihoods Approach

According to Scoones (1998), a livelihood comprises the capabilities, assets and activities required for a means of living. A livelihood becomes sustainable when it can cope with and recover from stresses and shocks; maintain and enhance its capabilities and assets, while not undermining the resource base. Rural households are not necessarily focused exclusively on increasing crop or livestock production and incomes (let alone on resource conservation), but undertake a range of activities, both on- and off-farm, depending on the resources to which they have access and the livelihood strategies they are able to pursue at any given time Chambers& Conway, (1991).

Within the livelihoods approach, 'a livelihood comprises the assets (natural, physical, human, financial, and social capital), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household'. This emphasis on assets, activities, and access provides a convenient framework within which to develop an understanding of the complex and dynamic realities of rural households. Different people clearly have different access to different livelihood resources depending on institutional arrangements, organisational issues, power and politics Scoones, (1998). Scoones (1998: 3) outlines the essential components of livelihoods analysis as follows: 'The key question to be asked in the analysis of sustainable livelihoods is – Given a particular context (of policy setting, politics, history, agro-ecology and socio-economic conditions), what combination of livelihood resources (different types of 'capital') result in the ability to follow what combination of livelihood strategies (agricultural intensification [or] intensification, livelihood diversification, migration) with what outcomes?' Diversification includes on-farm diversification (as measured by the range of crop, livestock and other natural resource based activities undertaken) as well as diversification away from own-account farming to include off-farm and non-farm activities in the household's portfolio Scoones, (1998); Chambers and Conway, (1991). Therefore, this research attempted to highlight the context (geographical and demographic) within which smallholders farmers in Zaka operate and different forms of capital or resources available to them and how these have influenced their ability to follow various combinations of livelihood strategies(adaptation strategies) and then evaluate whether this has enabled food security to be achieved or not.

The mediation role of institutions is considered through analysis of households' access to credit, information and extension services.

The livelihoods framework has the advantage of being applicable at a wide range of scale from individual to national scale. It enables a socially differentiated view of analysing livelihoods at household level through analysis of individual households and their relationships in relation to a range of relevant dimensions of difference (wealth, gender, age, and level of education) and the distribution of control over resources in rural communities. Understanding institutional processes allows the identification of barriers and opportunities to effective adaptation in the context of food security, Scoones, (1998). It was within this framework that the current study.

Conceptual framework

Conceptualisation is the process through which researchers specify what they mean when they use particular terms (Babbie 2004:118). The researcher would like to give an exposition of the major concepts. The aim is to clarify their conceptual meaning as well as their operational meaning in the study.

Climate change

Climate change means a significant change in the measures of climate such as temperature, wind and rainfall lasting for a long period of time which could be years or decades. It is something that develops over longer periods of decades to centuries. Climate change refers to long term trends in climate averages such as global warming that has been observed over the past century and long term changes in variability (Grains Research & Development Corporation 2008-2013). The term is often used to denote changes of climatic statistics over a given period of time. Climate change is mainly as a result of both natural and human causes.

In most parts of Africa; climate change will result in increased temperature (Tadross*et al*, 2005), erratic rainfall, sea level rise, increased intensity and frequency of extreme weather events such as floods and droughts (Mushita and Thompson, 2013). This is expected to result in environmental degradation, increased water stress and decrease in agricultural production which will result in livelihood insecurity and food insecurity. Africa will be affected by climate change far more than other regions because of its heavy dependence on rain-fed agriculture, lack of technology (Sokona and Denton, 2001) and due to widespread poverty,

limited coping and adaptive capacity and a highly variable climate; factors which are understood to exacerbate vulnerability (Madzwamuse, 2010a).

Climate variability

Variability is the state or degree of being variable or changeable (H.Mifflin p.200). Climate variability refers to shorter term (daily, seasonal, annual, inter-annual several years) variations in climate (Grains Research & Development Corporation 2008-2013). It affects almost all the human activities such as fishing and agriculture as well as natural systems. The direct impact of climate variability includes a decrease in water quantity, agriculture, human health and eco-systems. Climate variability denotes the natural characteristics of climate that manifest itself within the changes of climate with regard to time. The degree of climate variability is often described by the dissimilarity between long term statistics of the meteorological elements that are calculated for different periods (Nicholson 1987).The measure of climate variability is however the same as that of climate change.

Smallholderfamers

Small holder farmers are defined as those marginal and sub-marginal households that own or cultivate less than 2.0 hectares of land and constitute 78% of the country's farmers (WIEGO 2013). Small holder farmers define those farmers that produce on a very small piece of land and mainly practising subsistence farming rather than commercial farming. The term small holder refers to their limited resources endowments relative to other famers in the sector. Thus the definition of small holder famers differs between countries and between agro-ecological zones. In favourable areas with high population densities they often cultivate less than one ha of land, where areas they may cultivate 10 ha or more in semi-arid or manage 10 head of livestock. Often no sharp distinction between small holder famers and other large farms is necessary. Evidence from the world census of agriculture for a small number of selected countries in Africa shows that between 1980 and 1990, the percentage of agricultural holdings of less than one hectare had increased from 50 per cent to 78 per cent (FAO 1997). Small holder farmers are rural producers predominantly in developing countries who farm using mainly family labour and for whom the farm provides the principal source of income (J. Morton 2007).

Research aims

The specific objectives of the study are to:

1. Examine the effects of climate change and variability on small holder farmers in Zaka District.

2. Assess the strategies used by small holder farmers to acclimatise to the effects of climate change variability.

3. To identify challenges faced by farmers in adapting to climate change.

Research questions

The research questions are as follows:

1. What are the impacts of climate change and variability on small holder farmers?

2. What are the coping strategies employed by small holder farmers?

3. What are the challenges faced by small holder farmers in trying to adapt to the vagary of climate change and variability?

Significance of the study

Climate change has adverse impacts on crop production as rainfall patterns change and temperatures rise. The changing climatic patterns have resulted in food insecurity in some areas due to the reduction of land under the staple maize crops (Munhenga 2010). Rural folk across Zimbabwe are beginning to experience the effects of climate change with crop yields declining as prolonged drought and erratic rains take their toll yet little has been done in terms of research to establish the impacts of climate change on crop production in Zimbabwe especially from a sociological point of view as the phenomenon is regarded as foreign to the discipline. In contrast, climate change is a social issue in many respects. The study will inform educators, communities, nongovernmental organisations and the government on the needs of rural households on climate change. The adoption of the recommendations of this study as policy possibly will enhance the adaptation of small holder farmers in the area of study and Zimbabwe as a whole.

Literature review

Over the past decades, as the evidence of climate change became clearer and better understood, a strong international movement for action has emerged. In 1992 at Rio de

Janeiro, more than 180 countries signed the United Nations Framework Convention on Climate Change, which outlined the need to reduce greenhouse gas emissions as a global response to climate change. The UNFCCC came into effect in March, 1994, but despite this establishment, very little action was taken around the world. The Kyoto Protocol; which was agreed upon on December 11, 1997, at a meeting of the UNFCCC in Kyoto, Japan; was created as an effort to force action on the international community (Bond 2003)

Global climate change is viewed as a serious issue by the Government of Zimbabwe. The Government signed the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 at the Rio Earth Summit and ratified it in November of the same year.

The driving forces behind this concern stem not so much from problems of reducing Zimbabwe's emission of greenhouse gases (GHG), but rather the potentially serious impacts that global climate change might have on the country. By including climate change issues in the 1996 review of environmental legislation, Zimbabwe intends to incorporate climate change policies in its national development plans. Zimbabwe, like the rest of Africa, is constrained by its inability to put appropriate measures in place in order to respond to climate change requirements because of the lack of human, institutional and financial resources

The subject on climate change and variability has received a fair share of scholarly and academic attention. Information ranges from the unequal distribution of land among small holder farmers as well as adaptation strategies by these farmers from the impacts of climate variability. However, a knowledge gap exists of the comprehensive analysis of the effects of climate variability on small holder farmers in Zaka district as shall be evidenced in this study.

The IIED has focused on the adverse effects on a variety of socio-economic sectors that are closely linked to the Millennium Development Goals (MDGs). It postulates that climate-induced water stress threatens to decrease the quantity and quality of drinking water in rural and urban areas, reduce the run-off necessary to sustain the country's hydro-electric power supply, and contribute to declining agricultural productivity. It assumes that increasing frequency and intensity of extreme weather events are likely to intensify the existing natural hazard burdens for at-risk populations (especially in cities) and damage and destroy infrastructure. It also states that increasing geographic range of infectious disease vectors (e.g. malaria) will also affect public health, especially among people living with HIV/ Aids (PLHIV) groups.

Simba, Chikodzi, Mapurisa, Munthall and Seyitini (2012) assessed environmental changes and their effect on farm productivity in Masvingo Province. A questionnaire survey was carried out. This was assisted by focus group discussions, interviews with key informants and a study of both climatic data and yields records. Monthly rainfall and temperature data for the past 30 years was obtained from Zimbabwe Metrological Services Department (ZMSD) for the 5 weather stations namely, Masvingo Airport, Zaka, Buffalo Range, Chisumbanje and Makoholi for interpolation. Records on crop yields were obtained from AREX for the period 1995/96-present. Studies revealed that increased frequency of droughts and changes in farming seasons are some of the symptoms of climate change. People's perception of climate change point out that the crop growing season is becoming shorter, temperatures are increasing and rainfall amounts decreasing, mid-season droughts are also occurring more frequently. It also revealed that climate change is a reality in Masvingo Province. However, the study was only limited to climate change scenarios, farm productivity and the community's perception about climate change with little/ no focus on adaptation challenges concerns which are important in the current study.

Bryan et. al. (2009) used a probity model to examine the factors that influence farmers' decision to adapt to perceived climate change impacts. Factors influencing farmers' decision to adapt include wealth and access to extension, credit and climate information in Ethiopia and wealth, government farm support, and access to fertile land and credit in South Africa. Barriers to adaptation cited by farmers were lack of access to credit in South Africa and lack of access to land, information and credit in Ethiopia. Their findings revealed that, common adaptation strategies include, use of different crops or crop varieties, planting trees, soil conservation, changing planting dates and irrigation. Other coping strategies used were reducing consumption, seeking off-farm employment, migration (to urban areas), participating in food for work programmes, receiving food aid, borrowing from relatives and banks, selling livestock, changing farming type, using new technology, water conservation and crop diversification.

Chang-Gil Kim (2009) in his study he emphasise on how Climate change affects the hydrology including underground water level, water temperature, river flow, and water quality of lakes and marshes, by impacting precipitation, evaporation, and soil moisture content. To him the increase of precipitation by climate change leads to an increase of

outflow while the temperature rise increases evaporation, resulting in the reduction of outflow. He gave emphasis on the quantitative impacts of climate change on water resources and on the rural economy including agricultural productivity, revenues of the farm household and asset values, and it also affects the agricultural infrastructure through the change in water sources available for agriculture. He was silent on the coping strategies of farmers especially small holders farmers.

Chikodzi, Simba and Murwendo (2012) assessed the perceptions, vulnerability and adaptation options to climate change and variability in Masvingo Province. They administered a quantitative coded questionnaire. Validation was done using focus group discussions, key informant interviews, literature review and climatic data analysis. Places chosen for study were randomly selected in a GIS. A total of 53 villages were visited and a total of 200 samples studied, which gave the best trade- off between time and sample representativeness. Climatic data over 60 years was used to derive temperature and rainfall trends and for dry spell analysis. The current study used a sample of 100 respondents due to financial and monetary constraints. Climatic data is not very essential for the current study. Questionnaire data was entered and analysed using SPSS (Statistical Package for Social Scientist). Data was entered into tables with a Likert scale with 1 for strongly agree and 4 for strongly disagree. Results show that the province is increasingly vulnerable to climate change and vulnerability as seen in the increase in the severity and length of dry spells, increase in temperature and a late start of the rain season. Farmers need to utilise the water bodies in the province, plant indigenous crop species and adopt drought resistant and short season variety seeds. However, the study bunched all districts in the same bracket as if they experience similar climatic conditions yet some districts such as Chivi, Chiredzi and Mwenezi are much drier than the rest in the province. Resource endowments also significantly vary and as such, adaptation strategies and adaptive capacity are bound to differ from one district to another. Additionally, the study was not sector specific in its assessment of adaptation. Therefore, the current study focuses on adaptation to ensure food security, in one district, Zaka.

Methodology

The research was designed under qualitative paradigm. The nature of the study informed the research methodology chosen. According to Leedy(1993) research methodology is a plan for executing research in a systematic way. A research study must be conducted in a systematic manner so that the data collected will be authentic and reliable.

Research

In this research qualitative methodology was used to get in-depth knowledge about the study. The researcher used interviews, questionnaires, observation as well as sampling techniques as research tools. Interviews were chosen because they give instant feedback compared to other techniques and that they tell a lot from non-verbal communication. Also, questionnaires were employed during the course of research as they are the best when gathering information from many people in a short period of time. They are also a non-threatening way of conducting a research and it has minimum disruption to busy scheduled workers. Another research tool used by the researcher is the observation technique because it gives access to situations and people where questionnaires and interviews are impossible or inappropriate to use.

Sampling

Sampling is the use of a small group of people or things drawn from the larger group to represent the larger group. Under sampling, purposive and convenience sampling was used in the selection of respondents for interviews and questionnaires. Purposive sampling was used in the selection of 4 people for interviews and questionnaires. It was mainly targeting organisations, agricultural extension officers as well as educated people from the village who had rich information needed for the study. Purposive sampling will allow the researcher to reach a targeted sample quickly and the subjects were selected based on the knowledge or certain characteristics of the respondents. Also, random sampling was used in the selection of 50 small holder farmers for interviews and in the administering of questionnaires. The convenience technique was used because it made it easier for the researcher to obtain basic information and trends patterning the study. It was also used in the selection of small holder farmers because they are the ones that best understand how climate variability has affected them.

Limitations

Ethical considerations

Conducting a research implies some ethical considerations. Below are some of the ethical considerations that the researcher adhered to during the course of the research.

Permission seeking

Every society is governed by its own rules and principles directs their behaviour and that are to be adhered to by anyone be it a stranger or who is already a member of the society. Just like in the case of ward 10 in Zaka district, every visitor who wishes to gather people has to go through the chief. Henceforth in order to carry out the research, the researcher has to first seek permission from the chief before meeting members of the community.

Consent

There is need for the participants to know that the researcher is carrying out a research on them, the challenge comes in conceptualising the purpose of gathering them, they should first understand the purpose of your research, and therefore it is always important that there is an agreement between the researcher and the respondent before the beginning interviews.

Privacy and confidentiality

The researcher should ensure confidentiality and the participants' anonymity. Some participants do not want to be exposed and would want their identity to be anonymous therefore it is the researchers' duty to protect the privacy of participants who agree to provide you with data for your research.

CHAPTER 1: An overview of climate change

Introduction

Over the past decade, as the evidence of climate change became clearer and better understood that it is not a new phenomenon since the centuries in memory; changes in climatic conditions were always experienced. It is probably the most urgent problem facing the society and a strong international movement for action has emerged. In 1992 in Brazil, Rio de Janeiro, more than 180 countries signed the United Nations Framework Convention on Climate Change, which outlined the need to reduce greenhouse gas emissions as a global response to climate change. During the 20th century and until the present moment the whole Globe has experienced great climatic changes as evidently from the study of past climates like pollen in deep ice caves, geological features, documents on floods, yields and drought, oxygen isotope analysis, dune formation, glaciological evidence, and geomorphological observations show that climate is changing. Evidence has shown that, Climate change increased disaster risks to sustainable development in Africa, as well as a threat and impediment to achieving the Millennium Development Goals.

Climate change is a significant time variation in weather patterns occurring over periods ranging from decades to millions of years. Climate change may refer to a change in average weather conditions, or in the time variation of weather around longer-term average conditions that is more or fewer extreme weather events. Unganai (1996) defined it as a shift of climatic conditions in a directional incremental mode, with values of climatic elements changing significantly. The term sometimes is used to refer specifically to climate change caused by human activity through the emission of greenhouse gases (GHGs), as opposed to changes in climate that may have resulted as part of Earth's natural processes.

Climate change and Europe

According to the European Environmental Agents (2004) noted that climate change in Europe had been witnessed through natural disaster caused by potential changes of the weather. There are more frequent or severe simple extremes (like higher temperatures), secondly, changes in complex extremes (like Storms including windstorms and hurricanes), which rely on a confluence of forces to come about, and third the possibility of major

disastrous climate events such as the lack of precipitation, and associated drought. To show that European countries are being affected by climate change is the adoption of some action plan like EU flood Action Program. This program came in place due to the wake of the 2002 floods. The purpose of the program was to enhancing research and information, targeting EU funding tools on flooding, and a legal instrument of a Floods Directive. This initiative is based on a Communication on preventing damage from flooding.

As noted by the IPCC (2007), that the windstorms at the end of 1999 were among the most dramatic in European history. It was a natural disaster that affects a number of European countries by destroying buildings and human lives. The windstorm affected Scandinavia, France, Germany and neighboring countries. These storms killed almost 150 people and caused massive losses (€6.7 billion in insured losses from Lothar and Martin, €500 million in economic losses from Anatol). This windstorm affected economic of these European countries and in France the storms threw an amount of timber equal to three times the annual harvest and this destroyed the ecosystem.

European Environmental Agency (EEA) suggested that the period from 2004-2013 was the warmest decade on record in Europe. This was due to the extreme changing of temperature. However some regions are receiving reduced temperatures than before due to climate change resulting in the melting of glaciers, ice caps and the polar ice sheets. IPCC (2007) noted that there have been decreases in the snow and ice coverage in Europe. The report gave the example of the Arctic sea ice which has shrunk by 2.7% and further decrease in summer by 7.4% since 1978. Also mountain glaciers and snow cover have decreased as a result of the temperature rises. CORDIS (2012) pointed out the melting of the Greenland ice sheet has been accelerating since the 1990s with the highest melting point recorded in 2012. CORDIS also noted that the extent and volume of the ice in the Arctic sea is decreasing at alarming rate and much faster than previously forecasted. The record low sea ice cover was recorded in 2007, 2011 and 2012 and that level is not even half of the minimum coverage that was recorded in 1980s hence in line with that it is clearly shows that the phenomenon that climate is changing remain unchallengeable.

The rise of water sea levels is also one of the circumstances that can evidently support the occurrence climate change. As a result of the increase of temperature in the atmosphere, the glaciers and snow in European countries have begun to slowly melt down thus leading to an increase of sea water. N. Zinyengere 2013 Suggest that the ocean has been absorbing more than 80% of the heat added to the climate system which causes seawater to expand, contributing to sea level rise. For instance the Average sea level rose at an average rate of 1.8 mm per year over 1961 to 2003. The total 20th century rise was estimated to be 0.17 m. global sea level rose about 17 centimetres (6.7 inches) in the last century. The rate in the last decade, however, is nearly double that of the last century.

In Europe an increased number of floods have been experienced and characterised by mud slides thus costing thousands of lives. For instance in Africa, Southern Region countries have witnessed a decrease of annual rainfall whilst other European countries like the United Kingdom are now receiving higher rainfall levels than they used to receive According to A. Mardal 2013 between 2000 and 2010 in the whole of European region 19 floods were experienced with 475 deaths recorded as compared to 4 recorded between 1990 and 1999 with 223 deaths.The major floods event of the last few years, and the most economically destructive disaster in Europe's history, occurred in 2002. Floods took place along the Danube and Elbe rivers, affecting much of Central Europe; there was also significant flooding in the UK and France. 600,000 people were affected and 80 killed in 11 countries. Economic losses were at least €15 billion. Furthermore, Netherlands is already experiencing floods and that can be traced to effects of climate change in the region. The intensity of drought in Southern parts and the increase of floods in the northern parts of Europe over the past years are alarming. These extreme conditions are a result of climate change as argued by climatologists.

Climate change, impacts and vulnerability in Europe 2012 (EEA Report, 2012) claims that climate change is affecting all regions in Europe with a wide range of impacts on society and the environment. In vain of the above arguments there is also the issue of desertification occurring in various parts of the world which resulted to poverty and this supports the reality of climate. Princeton University Dictionary defines it as the process of fertile land transforming into desert typically as a result of deforestation, drought or

improper/inappropriate agriculture. Much of Southern Europe has been in the grip of severe drought for at least a year, the worst ever recorded. In addition, another evidence of climate change can be drawn from the case of Portugal where in the summer of 2005, 97 experienced severe drought conditions, France considered closing nuclear power plants, and across the European Union cereal production fell by at least 28 million tones and around 10% of the total. The heat wave in the summer of 2003 caused massive loss of life and the deaths of at least 22,146 people have been attributed to the heat. Countries affected by the heat wave include France with about 14,802 human lost, Spain 59, Italy 3,134, Portugal 2,106 and England and Wales losing about 2,045. This clearly shows that climate change is occurring around Europe.

While climate change is immensely complex and uncertainties inevitable, there is convincing evidence that changes in the earth's climate comprise of natural variability and anthropogenic activities. It cannot be explained without taking into account human influence through the emission of greenhouse gases (GHGs). It is clear that the climate is changing but whether the changes are temporary or most will be known as time goes on. Although identifying trends in extreme events is difficult, largely because they are inherently episodic and rare , our theoretical understanding of the physical processes behind the influence of climate change on various extreme weather events indicates that more extreme events would in general be an expected outcome.

Climate change in Africa

Peterson (2009) reported that no continent will be struck as severely affected by the impacts of climate change as Africa. Given its geographical position the continent will be particularly vulnerable due to the considerably limited adaptive capacity exacerbated by widespread poverty and the existing low levels of development. In Africa and other developing regions of the world, climate change is a threat to economic growth due to changes in natural systems and resources, long-term prosperity as well as the survival of already vulnerable populations.

Change in rainfall pattern has also resulted in reduced water availability especially on the African continent. There is already evidence of reduced water availability in countries such as Egypt. According to Boko et al (2012) the cause of this can be traced to low rainfall as well

and the high demand for the irrigation water. This clearly shows that climate change is hitting the whole globe destroying economies.

The occurrence of desertification shows that the climate is changing thus precipitation levels have decreased and also the temperature in the atmosphere has increased. The instances of desertification can be drawn from Chad, due to persistence of droughts Lake Chad has shrunk by 94% leaving the other area unusable even for agriculture. As a result of low precipitation levels of an average annual rainfall less than 600mm In the Sahel, (the semi-arid area south of the Sahara Desert for example, the desert moved 100 km southwards between 1950 and 1975. There with the above evidence it that climatic change is being manifested through desertification.

Climate change has also seen through an increase in the temperature levels. Due to a combination of reasons including deforestation and mass emission of greenhouse gases into the atmosphere through industrialisation leading to the destruction of the ozone layer, global temperatures have turned to increase in each and every decade. For instance the total global temperature increase from 1850 – 1899 to 2001 – 2005 period was 0.76˚C. An example can be drawn from the white cap of Kilimanjaro varies in size by the annual season and may grow and shrink at intervals depending on solar influx, precipitation and other factors. According to the the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (2007) there has been significant loss of the permanent ice fields of the Kenya's Mount Kilimanjaro. IPCC further pointed out that the mountain had lost over 80% of its ice fields since 1912 and that most of the snow is now seasonal. This has been the result of rising temperatures in the region over the years. Such incidents threaten the tourism sector of the continent thereby increasing vulnerability of the populace. IPCC has also noted that the period 1995-2006 ranks among the warmest years in the instrumental record of global surface temperature since 1850.The temperatures in the southern African region have risen by 0.4 0C over the past 100 years and are further expected to increase at a rate of 0.05˚C per decade. ZMS outline that Zimbabwe has experienced a warming trend towards the end of the twentieth century compared to the beginning, with the annual-mean temperature increasing by about 0.4˚C since 1900. For instance South Africa in 2013 in towns like Johannesburg temperatures has reduced to the point of snow.

In addition, as in support that climate change is not a new phenomenon since the centuries, it is evidently through natural disasters occurred mainly in African countries due to change of rainfall patterns that have also seen to the increase of extreme weather conditions. Tradross et al (2005) supported the notion that extreme weather patterns are now prevailing in Africa. One such example is the persistence of floods in Mozambique over the last two decades. Cyclone Eline and cyclone Japhet among other floods have hit Mozambique in the last two decades as compared to fewer floods recorded in the country prior to the 1990s. According to Mozambique National Disaster Management Institute (2005) in 2000 torrential rainfall led to the worst flooding in 50 years, directly affecting 2 million people and with 650,000 forced to abandon their homes. For instance in Africa, southern region countries have witnessed a decrease of annual rainfall whilst east African countries are now receiving higher rainfall levels than they used to receive for areas along the sea coasts such like Sudan, Somalia, Mozambique and Tanzania are now experiencing frequent floods. According to Zimbabwe Meteorological Services (ZMS) between 1960 and 1998 West African countries including Mali, Sierra Leone and Nigeria have witnessed an average of 4% decline of annual precipitation whilst north Congo experienced 3% and 2% for south Congo. In line with that, the assertion that climate is changing is unchallengeable.

Climate change has also affected two villages in Botswana namely Seronga and Okavango. According to Albert G. (2009) The Okavango river basin, it has rich biodiversity, rich ethnic diversity and is located in a wetland system that is of national and international importance, located in the north-western part of Botswana. Over the years, there has been a steady increase in temperature, particularly during the summer season. The rains have also been less frequent and more sporadic, and since climate status is the single most important determining factor for arable rain-fed agriculture, reduced rains have led to reduced rain-fed agricultural yield for the farmers. The rainy season has also changed causing confusion to the farmers regarding first rains and planting times. In the case of Seronga, the elderly have experienced a receding flood plain over the years and extreme drought in some years. All these changes, perceived or real, have led to reduced agricultural yield, particularly in Seronga where the majority of its people are engaged in agricultural activities. Ecosystem resources from the

Okavango River and Delta play an important role in shaping the livelihood activities of the people living along the river through the direct use of natural resources from therein. The impact of climate change on these ecosystem goods and services could not be established; however, noted changes to these ecosystems certainly impact on people's livelihood given the current challenges of climate change and climate variability. These are seen as additional stressors that impact on people's livelihood options. Malaria, HIV and AIDS and cholera are the existing health challenges faced in Botswana. It is because most women will engage their selves in prostitution to get a living. It is also noted that with increased temperatures due to climate change, the prevalence of Malaria carrying mosquitoes increased, not only affecting the most vulnerable group being women and children, but also increasing the burden of women caring for the sick.

Climate change in Zimbabwe

According to Chagutah (2012) Zimbabwe is now experiencing about three droughts every ten years mainly due to the changes in the phases of the El Nino-Southern Oscillation (ENSO) as well as the changes in the sea surface temperatures. He also further pointed out that there has been over 5% decrease in the 1960 to 1990 rainfall average in Zimbabwe. A case can be drawn from smallholder farmers in Chiredzi District that are exposed to one of the harshest climates of Zimbabwe as a result of its location in Natural Region five. In this region, rainfall is too low (generally below 450mmper season) and erratic for meaningful production of any crop under rain-fed condition. During the 1991/92 rainfall season, Chiredzi District received a seasonal rainfall total of only 127mm. According to AFDB (2011) noted that most crops were a complete failure and livestock perished in their thousands. Even drought tolerant crops such as sorghum and millet provide only marginal yields under existing climatic conditions. The region's meager rainfall levels are also highly variable, which presents challenges for developing appropriate adaptation strategies by farmers. Temperatures in the district have warmed by up to 0,6 degrees between 1966 and 2005, worsening water balance challenges associated with enhancing evaporative water loss. Farmers there face challenges like marketing risks due to unanticipated forces, such as inclement weather, drought conditions, crop failure or bumper harvest, pest or disease outbreak leading to dramatic changes in crop and livestock prices leading to human vulnerability hence climate change is affecting the economies of a number of countries especially developing countries.

Changes in rainfall in terms of annual and seasonal trends and extreme events of flood and drought occurred years ago in Zimbabwe have greatly affected livelihoods of many up to date. The Zimbabwe National Climate Change Response Strategy (ZNCCRS) (2013) noted that the Chirume community in Shurugwi District is still experiencing its impacts due to Cyclone Japhet. Heavy rainfall during the cyclone destroyed a nearby dam, which served as the community's central water source. The dam also provided water for a one hectare communal garden plot, which supported the majority of the community's income and protected its food security. With dam gone, the garden's alternative water source became a small seasonal stream that dried in August during peak crop demand. During the 2008 and 2010 season, the village experienced a prolonged mid-season drought in January that destroyed many crops in the absence of an accessible and reliable water source. This increased the burden among women to maintain agricultural productivity and food security. This case demonstrated how an extreme weather event can have lasting repercussions for vulnerable farming communities who live in drought prone areas without irrigation systems. The cyclone exposed the community sensitivity to drought, resulting in women and children bearing the additional responsibility of water collection.

Climate change in Zaka

Climate variability is one of the greatest challenges that Zimbabwe is facing especially rural communities of which Zaka district is not an exceptional. There has been a shift in the start of the rains, the increased frequency of heavy rainfall events, tropical cyclones and prolonged dry weather (Katz 1992). Climate variability is estimated to have intense impacts on Zimbabwe including heightened water stress just like in ward 10 Zaka district where the water level in Siya dam has plummeted and streams have dried out good example is Turwani River which used to flow year round now flows seasonally. There are also increased incidences of droughts, declines in crop and livestock productivity and an increase in possible expansion of malaria zones to mention a few. Zimbabwe has five ecological regions that are based on the quality of rainfall and type of agricultural production they can support. The rainfall distribution ranges from 710mm in region one to less than 450mm in region five Vincent & Thomas (1960) with small holder farmers in regions four and five where rainfall is unpredictable.

Agricultural production is carried out through the selection of crops suitable for the climate of specific region and application of proper farming methods. Therefore, agriculture is a climate

dependent bio-industry with notable regional characteristics. Regional characteristics refer to the ecosystem characteristics determined by the climate of the region. Climate change disturbs the agricultural ecosystem, resulting in the change in agricultural climatic elements such as temperature, precipitation, and sunlight, while further influencing the arable, livestock, and hydrology sectors. First of all, the impacts of climate change on the arable and livestock sector are made known by biological changes including the change of flowering and harvesting seasons, quality change, and shift of areas suitable for cultivation. Climate change affects the agricultural ecosystem, giving rise to blights and pests and causing population movement and change in biodiversity. In the livestock sector, climate change brings about biological changes in areas such as fertilization and breeding and also affects the growing pattern of pastures.

Conclusion

Climate change affects the hydrology including underground water level, water temperature, river flow, and water quality of lakes and marshes, by impacting precipitation, evaporation, and soil moisture content. In particular, the increase of precipitation by climate change leads to an increase of outflow while the temperature rise increases evaporation, resulting in the reduction of outflow. As illustrated above, climate change has a wide range of impact on the rural economy including agricultural productivity, revenues of the farm household and asset values, and it also affects the agricultural infrastructure through the change in water sources available for agriculture.

CHAPTER 2: Impact of climate change on small holder farmers

Introduction

This chapter is going to focus on the ways in which small holder farmers are affected by climate change and variability. Climate variability affects everyone but on the actual basis, those in the agricultural sector are the ones that suffer a great deal from the effects of climate variability. Small holder farmers constitute 70% of the entire population (FAO 1998) and this indicates that the majority in the agricultural sector. Smallholder farmers tend to suffer from the effects of climate variability because of their dependency on rain fed agriculture. Among the effects faced by small holder farmers,

Agricultural production both crop and livestock are a source of household income and food especially for small holder farmers. Money that comes from both crop and livestock production is used for educational and medical bills for their families. It is also used to meet other household necessities as well. In the case of Zimbabwe, climate variability impacts have led to an increased food insecurity and poverty in rural Zimbabwe. In most African countries including Zimbabwe, it is the rural communities that tend to suffer from the vagaries of climate change most of whom are rural small holder farmers who are dependent on agriculture for survival (FAO 1999).

Furthermore, apart from changes in the increase of temperature, changes in precipitation have been noted. Also, changes in climate variability combined with land degradation, poor access to technologies, infrastructure and institutions that deal with climate change has led to reductions in crop and livestock production and an increase in poverty. Zimbabwe is amongst the developing countries that are lagging behind development and therefore dealing with climate variability will be difficult and hard. There is, therefore need to make sure that necessary action is taken to make sure that water facilitates rather than constrain economic development or food security because as it is water stress has become a huge challenge in Zimbabwe. In the case of Ward 10 – Zaka women are already are already spending most of their time in search of water for domestic use, as a result of drying up of boreholes and rivers. This water stress has led to an increase in food insecurity due to decreased food productivity.

With the above, Zimbabwe really is one of the African country thatis most vulnerable to climate variability. Climate variability has led to increased land degradation and loss of soil water retention, the drying up of wells and boreholes, decreased water availability leading to poor sanitation and associated health impacts. Climate variability has also led to natural

disasters such as floods, droughts and pests infestations which have resulted in extreme food insecurities especially in rural societies.

Crop production

Information obtained from the research revealed that harvests in maize, sorghum and rapoko which are the major crops grown in Zaka received higher percentages in the late 1980s and from years earlier to that. The results shows that maize production was extremely higher than sorghum and rapoko production, this is so because farmers preferred maize than rapoko and sorghum. Fig 1 shows outcomes for the period 1985-1990 harvests before changes in rainfall patterns. The diagram below shows that maize produced in the years 1985-1986 was at 75% and it decreased to 68% in the years 1987-1988 with a slight increase to 73 in 1989-1990 probably because rainfall distribution varies year after year. Millet and sorghum had percentages extremely below that of maize ranging from 39%-55% in 1985-1990 mainly because people preferred maize production on the expense any other crops since it is the main food eaten in Zimbabwe.

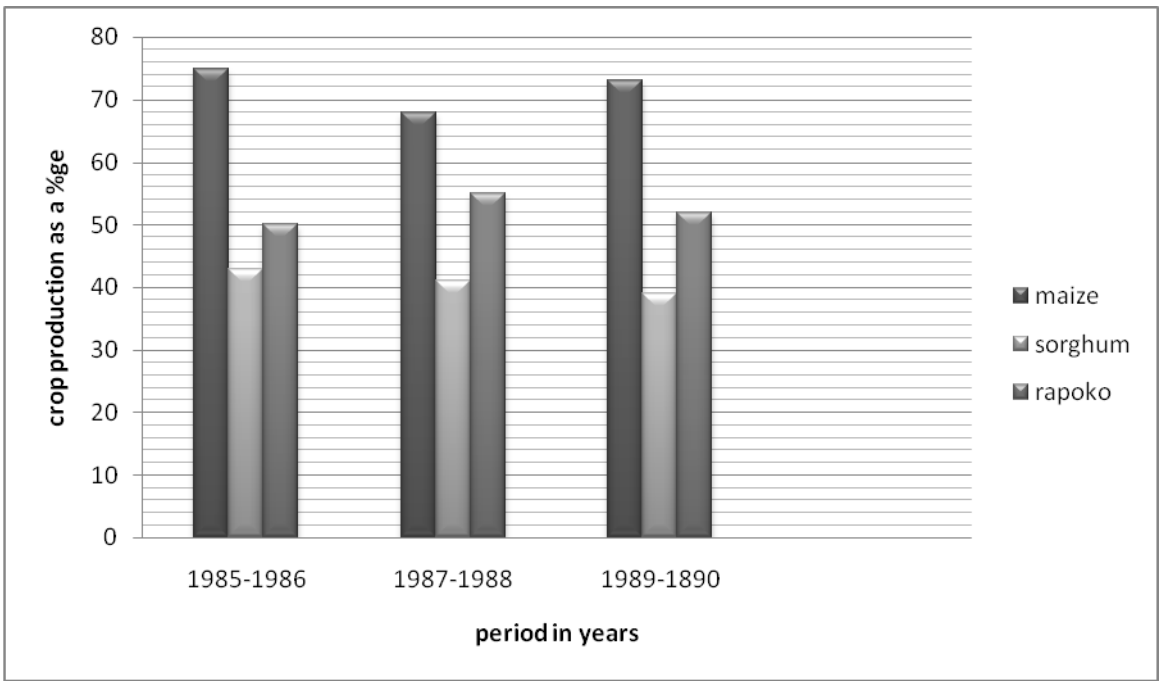

Figure 1 crop production from 1985-1990

Fig 2 now presents results for 2000-2005 crop production. From results below we now see a decline of maize production from its highest percentages which ranged from 51% to 60% in the period from 2000 to 2005. This period indicates a slight difference between maize production and sorghum and rapoko production, though maize production is still above the

production of sorghum, the 2002-2003 seasons witnessed sorghum production slightly above maize production by 3%. In the years 2002-2003 maize production was affected by dry spell, sorghum and rapoko are drought resistant that's why their production is above maize production. Due to climate variability the years 2004-2005 indicates that maize production was at 51% while sorghum and rapoko was at 42% and 35% respectively. The diagram below indicates that crop production is decreasing posing threat to food security at household level. Before the years from 2000 crop production was above 50%, but after 2000 crop production plays around 50 % and below. As a result farmers have found it difficult to afford three meals a day. One of the respondents boldly said,

"You will be very fortunate to find a household which is still taking three meals a day; we now took two meals a day as a way of saving the few that we have"

This also threatens people's health; they are now prone to malnutrition as a result to decrease in food uptake.

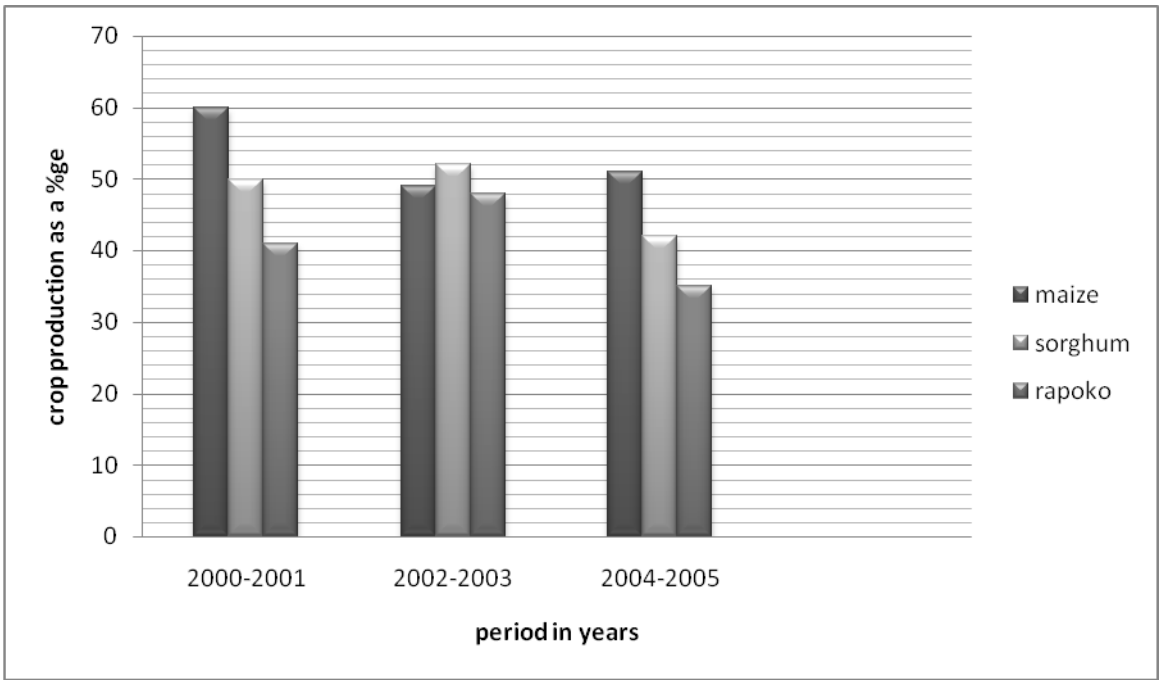

Figure 2 crop production from 2000-2005

Impact of prolonged wet weather

Prolonged wet conditions during the crop growing season leads to flooding, erosion, water logging and excessive leaching, all of these leads to crop failure, depending on the intensity of the condition. These conditions have resulted in difficulties in weeding, fertilizer and pests and diseases chemicals application. Whenever they experience these prolonged wet conditions during harvesting and post-harvesting periods, heavy crop destruction and loss are incurred as some of their crops rot in the fields, while others rot on open spaces since most small holder farmers do not afford water and/ or moisture proof storage facilities.

The impact of prolonged wet weather conditions on crop storage is also quite difficulty for the farmers. The water-damaged crops will be of poor quality and, therefore could not last them into the next farming season. The farmers were, however, points out that prolonged wet conditions that harm crops were infrequent but whenever they occur, they will be rather intensive and devastating. Farmers stress that, such conditions were last experienced in the area of study during the 2007-2008 seasons and led to serious household food insecurity among the smallholder farmers in the area.

Food insecurity

Poor maize harvests not only affects rural livelihoods but it also affects the community's ability to sustain themselves. It leads to an increment in food prices thus making it difficult for people to access food. It also leads to unavailability of food especially maize which is the staple food in Zimbabwe. Usually, when there are poor harvests there tend to be less food available in the markets and these results in the rise of prices. As a result 60% of people in rural areas will have to rely on the market to meet their food needs and according to the United Nations World Food Program monitoring in rural markets has found grain prices 15% higher in 2011 than this time in 2010 (ZimVac 2013).

Zimbabwe faces a dilemma on how to balance the short-term food needs and long term production goals of the different farmer communities because of climate-induced crop failures. Food insecurity is a major source of vulnerability for individual households and communities in the country. Food shortages have become a perennial feature resulting in a high prevalence of undernourishment estimated at 30 to 54per cent between 2006 and 2012. As a result there is an exceptionally high dependence on food handouts/aid particularly for

the rural population, often undermining efforts to build internal mechanisms towards food self-sufficiency and better livelihoods by communities in the medium to long-term. These trends imply that communities have very limited choices to satisfy their food preferences, neither do they have a say about the quality of food they eat, raising critical concerns about food safety. During periods of climate-induced disasters (e.g. droughts and floods), the basic systems that ensure access, proper handling, preparation and storage of food are often severely compromised, leading to frequent outbreaks of food borne illnesses. Increasing climate pressures will also inevitably lead to rising food prices weighing heavily on household and national budgets. Disadvantaged social groups will therefore be condemned deeper into hunger and malnutrition.

Education

Climate change has resulted in extreme poverty in the area of study, One of the respondents MrJekese a school head has illustrated that rising poverty levels has led to early marriages in the community in trying to escape poverty. He further went on to say that most people have lost their entitlements due to droughts so as a result some parent are failing to meet the academic bills as the income is directly channelled to the purchase of food. Hence climate variability has affected the livelihoods of people in rural communities especially in the area of study. The above has proven that rural communities rely greatly on agriculture and livestock production for their survival yet the two are amongst the most climate sensitive economic sectors. According to IFAD (2010) the negative effects of climate variability are highly felt by poor people in developing countries who rely heavily on the natural resource base for their livelihoods (IFAD 2010).

Crop disease

There is evidence of increased risk of crop pests and diseases of crops under climate change, although knowledge of likely impacts in the tropics and on smallholder systems is much less developed. Modelling responses of both pathogens and (where relevant) insect vectors to rising temperatures and changing precipitation is complex, but there is cause for concern over

possible spread of major diseases that attack smallholder crops in the area of study: e.g., Maize Streak Virus and in times where rainfall increases, and sorghum head smut (a fungal disease) during the time when rainfall decreases which would be compounded by farmers switching adaptively to sorghum in areas where maize becomes marginal (Kubiriba C. T 2006).

Water supply

Rivers and dams functions as sources of irrigation schemes in rural communities mainly to small holder farmers, but due to an increase in temperatures, rivers have dried up, dams declining in water levels out leaving people and livestock at risk. In ward 10-Zaka, water is scarce and there has been a steep decline in water tables due to seasonal changes in precipitation as well as evapo-transpiration. As water tables decline, water levels also decline thus affecting wells and boreholes. This is because as water levels decrease, the rate of water wells and boreholes yield also declines. In ward 10 - Zaka, rivers are now dry and wells no longer contain enough water whereas boreholes cannot yield adequate water to cater for the whole community and sometimes boreholes run out of water especially during the dry season.

Figure 3 shows current water levels on the dam wall of Siya dam

Source: field research

Figure 4 the island which was once covered by water in the 1990s in Siya Dam

Source: field research

To add to the above, the decline of water levels in Siya dam has great negative impact on smallholder famers who were practicing small scale irrigation in the ward. They are now unable to produce like what they used in the previous years. Drying of rivers such as the Turwani River which is the major river in the ward has imposed great threat to the entire community since it is used by people as a source of water for drinking and other household chores, the use of water a source of water by livestock, moulding of bricks amongst many other activities such as stream bank gardening.. Water stress in the area of study has become critical to such an extent that the water that is available no longer sustains both people and their livestock.

Changes in precipitation and rainfall patterns as well as an increase in temperatures, the world is likely to experience intense droughts and water constraints by 2050 (UNDP 2012). This is because higher temperatures affect soil moisture content, thereby changing the supply and quality of water as well as the demand for agriculture and domestic use especially in rural areas. Due to the decrease in rainfall, there is likely to be a sharp decrease in yields from rain fed agriculture. According to the Zimbabwe Medium Term Plan (ZMTP 2011-2015) reports that maize yields averaged 1-1, 4 tones (hectors) between 1980 & 1990, dropping to 0.7 tonnes during 2010-2011 partly because of annual variability in precipitation

The reduction of rainfall in Zimbabwe has affected all activities that depend on rainfall, for example crop and livestock production. Because of climate variability, there is need to

evaluate how various communities are sustaining themselves from the challenges brought about by climate variability in terms of their livelihood in the event that the agricultural production systems are affected by drought. Not only women will suffer from the vagaries of climate variability but the whole country at large will be at risk. This is because the country's economy is agro based and most industries in Zimbabwe are agriculturally based, thus the reduction of agricultural production may force them industries to shut down.

Biodiversity loss

Biodiversity refers to all living things, the different plants, animals, and micro-organisms found on earth. It is used as food, shelter, medicine, fuel, fiber, wild life trade and as an ecosystem service. Many communities in Africa are heavily dependent on biodiversity and therefore are vulnerable to the loss of biodiversity that could result from climate variability. In Africa, biodiversity is a significant resource and development is primarily dependent on natural resources as a result most Africans suffer from the loss of biodiversity caused by climate variability. The impact of climate variability will also be compounded by climate variability induced alterations of agriculture, water supply and disease.

Unavailability of water in rivers has resulted in biodiversity loss. Men used to go fishing and hunting way back in the 1960s. From the information obtained through interviews, the research revealed that the drying out of rivers has led to loss of aquatic life thus threatening the already declining food production. Not only has aquatic life been lost but also a number of wild animals such as hares, kudus, impalas and warthogs are now seen once in a blue moon in their forests. Climate variability has affected the availability of flora and fauna. Feeding livestock has become a challenge due to the unavailability of grazing pastures thus resulting in the eco-system imbalance of Zaka- ward 10. Small holder farmers are thus affected by the loss of biodiversity in the sense that they are the ones responsible for the upkeep of livestock. With unavailability of greener pastures, people are forced to drive their livestock to neighbouring villages that have not been totally affected by climate variability in search of water and pastures for their livestock. One elderly man had this to say:

“We are having the taste of our own poison; I believe this is a cursed community I tell you. We are being punished for our sinful behaviour, he alludes that the district is well known for witchcraft in the country. We used to go out fishing, swimming and hunting back in our days and everything was just good but the situation has turned upside down. One would be very

lucky to come across a hare around and our forests were used to be abundant of wild fruits, but now they are things of the past".

Climate variability has threatened food security through the loss of biodiversity as well as a reduction in agricultural production. It has also affected water availability thus causing great suffering on small holder farmers who rely on natural resources for their survival. Climate variability has also taken another turn on the health sector due to water shortages. The water situation in ward 10 will be soon beyond their control, as people are now relying on small wells drilled in the river bed culturally referred to as mufuku in order to obtain the water resource. Climate variability has led to a decrease in the quality and quantity of water. In such conditions where water is scarce, there happens to be an outbreak of diseases such as diarrhoea, cholera (like in the case of 2008), typhoid, and bilharzia. There tends to be an outbreak of such diseases because of poor hygiene and sanitation due to water scarcity. Normally availability of clean water and hygiene are inseparable. Hence the unavailability of water results in unhealthy conditions. All in all a decreased availability of water leads to poor sanitation and often is associated with poor health.

Loss of livestock

Loss of livestock has been a consequence of drought and it also leads to food insecurity and the erosion of sources of income to sustain production systems and household welfare. Zimbabwe has been facing a number of natural related disasters such as droughts, floods and pest infestations. In addition to high crop failures, chronic dry spells are resulting in the death of livestock which is detrimental to longer term agricultural development as a key livelihood activity in Zimbabwe's communal areas and animals are expensive to replace (FAO 2008).In the area of study, most farmers are facing their greatest challenge of livestock death. This is because of water shortages and grass for cattle to graze. Livestock production is important because it is a source of food in the form of meat and milk. Livestock are also a source of income and most farmers are at risk of the consequences of loss livestock.

Furthermore livestock diseases were on the increase during droughts as indicated by the results of the interviews. They also indicated that their livestock especially cattle are usually attacked by diseases that includes black leg, foot and mouth, anthrax and lumpy skin. As a

result, a number of livestock deaths were said to have occurred. In the same respect, livestock had to survive on dirty stagnant water. This fact was considered to have given a rise in the cases of livestock diseases and deaths. Drought cases are also believed to have caused a reduction in wildlife through deaths in the past due to a reduction in water flows.

Human and livestock health

Growing evidence suggests that climate change will affect human health through increases in floods, storms, fires and droughts; changes to the range of infectious disease vectors, including the geographical range of malaria and other mosquito-borne diseases, such as dengue; increases in the burden of diarrhoeal diseases, and of water-borne pathogens such as cholera; and an increase in cardio-respiratory morbidity and mortality associated with ground level ozone. Climate change is also expected to exacerbate the effects of human-induced ozone depletion in the Southern hemisphere, further worsening this situation (Karoly, 2003).

The erratic water supply situation in Zimbabwe has already contributed to an increase in water-borne diseases. A nationwide cholera epidemic in 2008, one of the largest out breaks in recorded history, affected over 100,000 people, killing over 4,000 (GoZ, 2010). Moreover, the potential for cross-contamination of water and sanitation systems make recurrent outbreaks of cholera during the rainy season a major risk factor during flood events, as experienced in Malawi (UNICEF, 2008). Zimbabwe is also vulnerable to having perennially high cases of malaria (Chigwada, 2009).According to the IPCC (2007), by 2100; changes in temperature and precipitation are likely to alter the geographic distribution of malaria in Zimbabwe, with previous unsuitable areas of dense human population becoming suitable for transmission. Disease epidemics in addition to food insecurity, chronic malnutrition and HIV/AIDS are eroding the resilience of households, rendering them less resilient and more vulnerable to hazard shocks. The Zimbabwe National Network of People Living with HIV and AIDS (ZNNP+) is particularly concerned with how health crisis will affect the vulnerability of PLHIV groups. It is estimated that approximately 14.3 per cent of those aged

15 years and above were infected with HIV/AIDS as of 2010 (GoZ, 2009). PLHIV groups face multiple vulnerabilities, which climate change will intensity, particularly within low lying, food insecure areas. Cases of diarrhoea in some instances can be severe to the extent of weakening immune systems among infected people. Adequate water supply and sanitary

facilities are of the utmost importance in reducing diarrhoea and other infectious diseases, but are severely lacking in both rural and urban areas. Despite growing health concerns, government authorities and civil society are increasingly concerned with Zimbabwe's capacity to respond to humanitarian emergencies. In 2010,the then Ministry of Agriculture, Mechanisation and Irrigation Development indicated that six provinces in Zimbabwe will become food insecure, and that recurrent malaria out breaks and cholera epidemics will become more prevalent. These threats demonstrate Zimbabwe's fragility, calling into question its ability to cope with minor emergencies, which can easily

Climate variability has effects on the health of people as well as livestock, changes in rainfall affects the presence and absence of vector and water borne pathogens (IPCC 2001). Due to water stress there is a higher record of poor hygiene and sanitation which results in an increase in diseases cholera, bilharzias, diarrhea and typhoid, for example in Zimbabwe 2008 when the country was hit by a cholera outbreak. Zimbabwe is amongst the countries that are vulnerable to climate driven health impacts from vector-bone diseases such as malaria worsened by HIV-AIDS. An estimate predicts that over one hundred and eighty million people in Sub Saharan Africa could die of diseases that are linked to climate variability by the end of the century. Also climate variability is likely to affect the distribution of tsetse flies which cause sleeping sickness and the cattle disease nagana and the tick bone livestock disease called east coast fever or corridor disease (Hulm and Sheard 1999).This shows that climate variability has serious health implications on both humans and livestock thus putting farmers at risk as they are more dependent on their health, livestock, and agriculture.

Environmental and physical processes

Another class of impacts is felt at the level of communities, landscapes, and watersheds, and has been less considered in literature on climate change and agriculture, although there is some overlap with consideration given to extreme events. One such impact is the effects of decreasing snow-cap on major irrigation systems involving hundreds of millions of smallholders, particularly in the Indo-Genetic plain. As a result of warming, less precipitation falling as snow, and earlier spring melting, there will be a shift in peak water supply to winter and early spring and away from the summer months when irrigation is most needed, with likely severe effects in areas where storage capacity cannot be expanded (Barnett et al 2005). Combined with increased water demand, and pre-existing vulnerability of many poorer irrigated farmers, such an impact could be catastrophic.

Also to be included here are effects of climate change on soil fertility and water-holding properties. Global warming and accompanying hydrological changes are likely to affect all soil processes in complex ways, including by accelerated decomposition of organic matter and depression of nitrogen-fixing activity (Rosenzwery et al 2000). Kundzewicz et al (2007) note the projected increased erosivity of rainfall, and several factors likely to increase the erodibility of soils worldwide.

Prolonged hot and dry weather during the rainy season

The damage caused by this weather condition depends on the part of the crop growing season it would have occurred. If such conditions are experienced during the early stages of the rain season, they mainly affect the farmers' ability to meet the planting deadlines and cause poor crop germination. Mid-season, prolonged dry spells, stress crops through wilting and may promote the occurrence of insect pests, such as armyworms. The area of study is already a drought-prone area but the farmers indicated that dry spells have become more frequent and devastating in recent years. Overall, agricultural productivity hinges on whether there has not been a prolonged dry condition in the area during the crop growing season, since farming is mainly rain fed. The fall in crop production leads to household food insecurity that is associated with a sharp rise in food prices until the next good harvests. This happens at a time that most households would have failed to raise household incomes through selling agricultural products and poverty levels increase dramatically. A poor rainfall season results in very poor pastures during the dry season, affecting the condition of their livestock, particularly cattle. The main impact is the existence of very weak draught animals at the onset of the rain season. The overall livelihood impacts of extreme weather conditions on smallholder farmers, therefore, include sale of assets, indebtedness, out migration, and dependency on food relief.

Land use changes

Land-use and land-cover have a direct bearing on climate change and weather patterns in diverse and complex ways. These links include the exchange of GHGs (such as water vapour, carbon dioxide, methane, and nitrous oxide) between the land surface and the atmosphere; the radiation balance of the land surface; the exchange of heat between the land surface and the atmosphere, and the roughness of the land surface and its uptake of momentum from the

atmosphere. The main land-use categories in Zimbabwe are agricultural land, rangelands, protected areas (mainly national parks, safari areas, sanctuaries and reserved forests), conservancies and settlements (including mining and urban areas). Land-use change is a driver of environmental and climate change in Zimbabwe especially through the expansion of agriculture; and economic and technological development. Increasing population pressure in the communal areas has led to the fragmentation and degradation of forests as a result of their clearance for agriculture and harvesting for firewood, poles and other forest products. In Zimbabwe, the agriculture sector is quite vulnerable with marginally productive areas probably shifting to non-agricultural use. For areas where crop production becomes non-viable, livestock and dairy production may be developed as major agricultural activities. Some farmers could switch to different crops or change to more drought tolerant and disease resistant crops.

Conclusion

Smallholder and subsistence farmers will suffer impacts of climate change that will be locally specific and hard to predict. The variety of crop and livestock species produced by any one household and their interactions, and the importance of nonmarket relations in production and marketing, will increase the complexity both of the impacts and of subsequent adaptations, relative to commercial farms with more restricted ranges of crops. Small farm sizes, low technology, low capitalization, and diverse non-climate stressors will tend to increase vulnerability, but the resilience factors—family labour, existing patterns of diversification away from agriculture, and possession of a store of indigenous knowledge—should not be underestimated.

Social-scientific study of the future impacts of climate change on poor rural people in developing countries has tended to be concerned with the increased frequency of extreme events with generalized impacts. This is understandable given the short to medium term importance of extreme events, and the difficulties of predicting any trends, climate-related or otherwise, in the longer term. However, there now must also be a genuinely interdisciplinary attempt to apply the rapidly growing scientific knowledge of the effects of climate change on crops and livestock to the “complex, diverse and risk-prone” farming systems of developing

countries. This will not only improve knowledge of impacts, but just as important, aid in building adaptive capacity at all levels including that of farmers themselves.

CHAPTER 3: Ways to enhance agricultural production

Introduction

This chapter is going to look on the efforts made by the government and other organisation in trying to improve agricultural production in erratic climatic conditions. It will also look on the efforts made by the small holders themselves in trying to enhance agricultural production. Challenges by small holder farmers in trying to adapt and cope with climate variability will be also examined in this chapter.

As already indicated in this research agricultural production is frequently linked to sustainable development and because of climate change and variability related issues, it is important to note that agricultural practices cause higher demands on resources therefore all efforts made to increase productivity on farms should not compromise the need for the future generations and ensure that they also have adequate resource base that they need to live and flourish. In order to safeguard future agricultural production there is need for the present generation to conserve the environment, water supplies and other natural resources as well as to adapt to the adverse climatic conditions.

Climate change adaptation is of great importance to Zimbabwe and other countries that are experiencing the effects of this phenomenon. Zimbabwe's contribution to GHG emissions is very insignificant compared to the industrialized countries that are supposed to reduce their share of GHG emissions under the Kyoto Protocol, yet the country has suffered the impact of climate change in recent years especially through the increased frequency of droughts, floods and epidemics. These make climate change adaptation a necessity for Zimbabweans. Smallholder, subsistence, and pastoral systems, especially those located in marginal environments, areas of high variability of rainfall or high risks of natural hazards, are often characterized by livelihood strategies that that have been evolved to reduce overall vulnerability to climate shocks and to manage their impacts ex-post. The dissimilarity between these two categories is however often unclear (Davies 1996). What start as coping strategies in exceptional years can become adaptations for households or whole community.

Government's efforts to enhance agricultural production

The government of Zimbabwe has embarked on a series of approaches so as to improve agricultural yields among small holder farmers. Among the efforts taken by the government to improve the agricultural production is to strengthen its research institutions, provide loans through the GMB to small holder farmers in form of inputs such as seeds and fertiliser. The government also tried to improve agricultural production through capacity building to mention only a few. The government best understands the contribution of agriculture in the gross domestic product of the country that is why its efforts to improve the sector are constant. To the government of Zimbabwe (1995), agricultural production contributes to 15-19% to annual gross domestic product depending on the rainfall patterns (Government of Zimbabwe 1995).

Land reform policy

In the period of 2000-2002 the government has managed to implement the fast land reform programme in an attempt to address the issue of land imbalances that were brought about by the colonial legacy. The land reform programme sought to give land that was already occupied by the white commercial farmers to the landless people of Zimbabwe. This program was aimed at improving the agricultural sector and to increase agricultural production for the benefit of the landless small holder farmers and the nation at large. This program was however, did not turn out well since land was taken from experienced whites commercial farmers who had financial resources and adequate technology. They had the capacity to sustain agriculture despite the impacts of climate change as well as to sustain the country's food security. This is evidenced by the fact that Zimbabwe was once the bread basket in the southern Africa before the fast track land reform programme.

Research institutions

The government made the efforts in increasing agricultural growth was through restructuring of institutions that are crucial in enhancing agricultural growth. In line with this restructuring of institutions; the government has made changes in the extension services such as AGRETEX to AREX, research and marketing institutions. The benefits of these approaches

to enhance agricultural growth have been seen in the improvements in the production of small holder agricultural sector where small holder farmers have become the major producers of small grain because of its drought tolerant in nature as well producers of the country's staple food maize. The improvement of these institutions such agricultural and research institutions by the government aimed at improving agricultural sector because it is within these institutions that people get information about farming from experts.

Loans to farmers

Sinceclimate variability is affecting the income of small holder farmers through the decline in agricultural production, the government has formed the Social Dimension Fund which offers funds and grants to small holder farmers to cover up the low income at household level. These funds promote farmers' access to seeds and fertilisers as a start up to increase agricultural production. The government also provides seeds and fertiliser packages directly to small holder farmers. To add to the above efforts, the government has encouraged small holder farmers to shift from subsistence farming to commercial farming through the RBZ farm mechanisation programme of2007. It also encourages smallholder farmers to adopt towards a commercial agriculture approach.

Irrigation projects The government has taken a priority in improving water and harvesting techniques for irrigation schemes. Irrigation schemes have played a crucial role in sustaining crops during years of low rainfall thus increasing agricultural sector. All in all some measures taken by the government has faced critique since most land distributed to smallholder farmers is not suitable for farming but rather it was for animal ranching. This is evidenced by the fact that, the majority of Zimbabweans have inherited land which is normally characterised by poor rainfall, soils and are situated far from markets and transport networks. However, the government is pursuing a policy of land reallocation and resettlement to correct the matters of

land imbalances and improving social facilities such as health centres and schools. The process of land reallocation and resettlement involves investment in infrastructural development such roads for easier access to markets, water supply to help maintain irrigation schemes, electricity mainly rural electrification through REA to avoid excess deforestation as well as investment in services such as education and health facilities (WFS 1996).

Intervention of NGOs

Efforts taken towards agricultural improvement were not only done by the government but by both local and foreign NGOs as well as foreign governments by providing funds meant for long term programmes that increase agricultural growth. These organisations made efforts in creating a sustainable agricultural sector, through provision capacity building where most farmers are educated on the best methods of enhancing agricultural production, good example of these organisation is SAT (sustainable agricultural trust). It is through these organisations that people acquire requisite knowledge pertaining issues to do with climate change which has become a global challenge.

Food relief aid

Other organisations such as CARE International, USAID and WFP among others have complement government governments efforts through food assistance they offer to various communities. Food aid helps increase food security and it boosted nutrition. If there is limited food and income at household level there is likelihood of under nutrition which results to production loss caused by release of human potential which helps in increasing crop production. Food assistance also helps in farmers' grain by so doing protecting people from selling their food stocks and seeds during dry times, thus food assistance ensure better production in the next season.

Strategies and coping mechanisms employed by farmers

People living in the area of study have developed a number of coping mechanisms in order to live with climate variability and uncertainty. Farmers have employed diversification of crops and sources of income, migration, switching to non-farming activities, selling assets and reliance on remittances. Most of small holder farmers employ a combination of responses to the impacts of climate variability on their livelihoods. This suggests that actions always changes with different situations. For instance in Zaka district, in a household the following coping strategies and mechanisms are being used in different situations.

Conservation farming

Individuals are also resorting to conservation farming especially in drought prone areas such as Zaka because there are higher possibilities of producing better harvests through the use of conservation farming than conventional farming. Conservation farming helps preserve moisture and it aims at conserve soil and water by covering the surface so as to reduce erosion and improving conditions for plant growth. It's by small holder farmers' choice to resort to conservation farming in improving agricultural production

Farmers have also shifted to agricultural practices that are less threatening to the environment. By abandoning their old ways of burning crop residue they now use it as mulch and they adopt the use of organic fertilizers rather than the use of chemicals and chemical fertilizers. Excess cutting down of trees was resulting in soil erosion and increase excess carbon dioxide in the atmosphere leading to global warming. All these efforts have been made to increase agricultural production and this clearly indicates how different players in the agricultural sector have been playing their roles to improve agricultural production.

Climate change in Africa is highly characterised with low rainfall, as a way to enhance agricultural production, and ensure food security the respondents said that they exercise winter plough to retain soil moisture. They emphasised that there is visible difference between land ploughed just after harvest or during the winter and that one which will ploughed in the rain season. One elderly man said winter plough is important as it improves soil fertility since plant residue and humus is overturned during ploughing. Some respondents from use of drought tolerant crops such as rapoko and sorghum, however millet is not allowed in the area of study due cultural factors which the respondent was not comfortable to

say. Most of farmers in the ward are now switching to conservation farming. Conservation farming gives them room for mulching, since it make use of plant basins. Plant basins hold a lot of water during rain. They also make use of contour ridges, they save same purpose with plant basins.

Hire labour

The hiring of labour has been used as an adaptation strategy in many Zimbabwean districts in which Zaka district is not an exceptional, one farmer from Johane Marange sect even indicated that during good season they would even consider marrying another wife so that they can increase the labour that the household already has. These farmers have learnt that by maximising the labour at household level, they can enhance their yields regardless of a good or bad season. Farmers also indicated that they also practice work parties, what they call *nhimbe*, this practice also increase labour, hence increase in production

Drought tolerant crops

Due to continuous water stress, farmers have shifted into using indigenous drought tolerant crops. Ever decreasing rainfall and rising temperatures has great impacts on the growth and production of crops such as maize that require high rainfall. To beat this, smallholder farmers are now adapting to these changes and are shifting to more drought resistant crops such as sorghum and rapoko as a coping strategy to the vagaries of climate variability. Unpredictability of rainfall as well as high temperatures has made it difficult for small holder farmers to predict their yearly yields. Ms Nango concerning this issue said that:

"I have no huge land this will automatically affect my yield if we experience prolonged dry weather. If it rains normally with this piece of land I will get enough yield to sustain my family and i, but if I experience crop failure all household demands become a challenge since farming is my source of livelihood".

From this interview, it can be noted that changes in rainfall patterns have affected the ability of small holder farmers to make a livelihood by crippling their agricultural production. Small holder farmers are now finding it difficult to produce enough yields for household

consumption and other purposes. The introduction of drought tolerant crops in the region made things better not only for the people in ward 10, but in Zaka district as a whole. The use of drought tolerant crops has helped improve food security and income for small holder farmers in the area of study.

Indigenous weather forecasting

The researcher discovered that farmers had indigenous systems of forecasting weather and climatic conditions as shown in table 1. Farmers expressed the importance of these local indicators in assisting in preparation of farming activities. However the findings have proved that these IKS were for the past few years were no longer reliable. Good example were drawn from the appearance of the halo around the moon which in the past years signified good rains but now it had been reportedly becoming unpopular as it appears even in the driest years.

Table 1 Indigenous weather and climate forecasting.

Condition	Local indicator
Drought	When the acacia tree bears many fruits,
upcoming of rains	corona around the sun
Decent rains	Swallows fly around, cuckoo sings,
Dry spell	presence of swallows,

Cooperative gardens

In Zaka, a group of smallholder farmer have implemented the initiation by CARE INTERNINATIONAL of nutrition/cooperative gardens; CARE has provided villagers with fencing equipment as well drilling boreholes and installation of tanks in which they use for water storage. Mr Machaya who is the chairperson of the project said that, "The nutrition

garden is important as it enables us to supplement food, but however our greatest challenge is that of unavailability of market to help us sustain our project, if you look at the state of this garden is now deteriorating".

In case of crop failure for ore respondents said that they sell their livestock to buy food and to cater for other necessities. Those with relative or children outside the country or in cities rely on remittances for survival. The few without relatives abroad they survive on non-agriculture activities such as building houses, thatching huts sometimes payable by grain. Some respondents said that they reduce number of meals per day, as way of minimising consumption.

Relief aid

Over reliance of farmers on external food relief and barter trade are some of the coping strategies that farmers in Zaka district use immediately they are faced with a crisis. Major worry arises when farmers over rely on aid as relief in times of food shortages as there has always been a concern of sustainability of interventions that bring in food and aid in other forms. The question that rises is what will happen to these farmers when aid dries up? There have been concerns over the effectiveness of these interventions since they are questionable and therefore heavily depending on external interventions may not be prudent for farmers (Bhadwal 2006).

Off farm activities

Small holder farmers have put into practise the use of off farm activities such as small income generating projects like poultry and ISAL groups this help them cope with the challenges of climate variability. These small projects help them to supplement little income to help them survive during difficult times caused by climate variability. The researcher has observed that these projects are gender biased as they are carried out by women.

From the interview with Mrs Matode, these non- agricultural activities such as poultry are vital for women small holder farmers as supplement non-agricultural activities that are prone to effects of climate change. However, these women are willing to take part in non-farm activities but they lack support from their male counterparts that enable them to sustain those

projects. All in all women small holder farmers lack financial resources so as improve non-farm activities.

Challenges in adaptation

Respondents has laid blame on Poverty, they say poverty isa challenge faced by small holder farmers in adapting to climate variability. Usually poverty is directly linked to vulnerability and is therefore is a rough indicator of the ability to cope and adapt (IPCC 2001). Most small holder farmers are poor most and they constitute the world's poorest population. These small holder farmers lack strong financial base and therefore adapting to climate variability becomes a challenge. This is supported by the idea that the process of adaptation is not costless but comes along with expenses since it requires money for technologies. Also, in order for these small holder farmers to engage in off farm activities, there is need for strong financial resources, of which they lack and this has hindered their ability to adapt to climate variability. Though it occurs less frequently high rainfall leads to water logging, which will minimise crop production.Mrs Matode also went on to say that they lack innovative personalities who come with new coping ideas; she says they rely on NGOs for ideas on how to cope with the vagaries of climate variability

The increase in the cost of agricultural inputs has seen most smallholder farmers lacking the ability to adapt to climate variability. Reduction in agricultural production has affected the ability of small holder farmers to obtain income to buy agricultural inputs such as seed and fertiliser needed to boost crop yields. Small holder farmers have found it difficult to afford agricultural inputs because of exorbitant prices charged, thus affecting their efforts to adapt to the effects of climate change and variability.

Furthermore, lack adequate technology has seen by small holder farmers as a barrier to adaption to the effects of climate variability. IPCC indicated that lack of technology has the potential to extremely hinder adaptation options by limiting the range of possible responses

and interventions (IPCC 2001). Small holder farmers lack access to new technologies to help them fully adapt to the impacts of climate variability. Thus the lack of adequate technology affects the probabilities of small holder farmers to adapt to the impacts of climate change and variability. Adaptation strategies vary depending on the availability and accessibility to technologies. Adaptation strategies involve the use of technologies directly or indirectly such as crop breeding or drought proofing. Community's limited access to technology has reduced their ability to adapt, because technology is expensive small holder farmers cannot afford the use of new technologies. This has undermined their ability to adapt to climate variability effects.

Conclusion

This chapter made it clear that the process of enhancing agricultural production is a process that entails much involvement and commitment from micro and macro financial institutions in agricultural sector ranging from the government itself, foreign governments and organisations as well as individuals. These players in the agricultural sector should be fully committed to their efforts for them to return Zimbabwe's status of being a bread basket in southern Africa. This chapter has reviewed government's initiative towards contribution to an enhanced agricultural production through its provision of funds, seed and fertiliser packages. Most important done by the government is the strengthening research institutions, market structures as well as agricultural extensions. However some of these efforts been complemented by non -governmental organisations that have also helped through provision of food relief, capacity building and training in various communities as a way of enhancing agricultural production.

Despite the challenges faced by these actors in the agricultural sector, their efforts proved to be of great importance in ensuring food security in the communities. Farmers have indicated

that they are willing to partner with these actors in fighting the impacts of climate variability in their community.To complement efforts made by various players it have been realised that small holder farmers have been employing a number of adapting strategies from the effects of climate variability through the use of manure and compost, growing of drought resistance crops, rain water harvesting and changing to non-agricultural activities . During the process of adapting and coping to the impacts of climate change these farmers have encountered a number of challenges that include lack of resources, technology, skills and requisite knowledge to help them adapt to climate variability.

General conclusion

Climate change and variability is a global catastrophe distressing all parts of the world including Sub Saharan Africa. It had its effects global population but it is important to note that smallholders in Sub Saharan Africa are heavily affected due to their dependency on rain fed agriculture. Zimbabwe is amongst the countries which have agro based economy most of its industries are agro-based. . The study give the evidence of climate change and variability being experienced in the area of study, through increase in temperatures, a shift in seasons, decline in rainfall, , continuous droughts and through loss of biodiversity. These are some of the challenges being faced by small holder farmers who are dependent on rain fed agriculture for survival.

In Zaka, small holder farmers are now unable to produce enough food to sustain them like in the previous years where they used to produce with surplus. An increase in temperatures resulted in decrease of water table; it also accelerates the rate of evapo-transpiration which has resulted in the drying of rivers. Water shortages have resulted to health related issues accompanied by poor hygiene and sanitation leading to outbreak of diseases such as typhoid and cholera.

Despite the effects experienced by women in adapting to climate variability effects we have realised from the research that the government has also taken an initiative towards contributing to enhanced agricultural production through its provision of funds, seed and fertiliser packages also strengthening of research institutions, market structures but this did not improve lives of smallholder farmers, it mainly targets commercial farmers. These efforts by government was politically driven, the ones who benefited was loyal to the ruling party which is ZANU PF.Small holders benefited from the support they received from non - governmental organisations which played important role through provision of food assistance, capacity building and training in various communities to improve the livelihoods of smallholder farmers.

Most importantly, all these collective efforts by different actors in the agricultural sector have assisted small holder farmers to employ a number of coping strategies from the impacts of climate change. Adapting to climate variability was done through the use of drought resistant crops, rain water harvesting, use of manure and compost but it is important to note that all these efforts employed by small holder farmers in adapting to climate variability did not come in a silver platter, in trying to adapt and coping farmers faced a number of challenges which includes lack of resources, technology, past experiences, exposure and requisite knowledge to help them adapt to climate variability. Climate change has affected the entire nation but small holder farmers suffers most due to their over reliance on rain fed agriculture.

Appendix I

Interview guide

My name is Admire Mada, am a fourth year student at Midlands State University studying a Bachelor of Arts in Development Studies Honours Degree. I am carrying out a research on the impacts of climate change and variability on Small Holder Farmers in ward 10 of Zaka district. In partial fulfilment of the requirements of the Bachelor of Arts Honours Degree. Your opinion is highly appreciated.

1. What do you understand by climate change?
2. Do you believe that climate is changing?
3. If yes, what evidence shows that climate is changing?
4. What do you think are the main causes of climate change?
5. In what ways has climate variability affected small holder farmers?
6. What strategies have been employed by small holder farmers in adapting/ coping to the impacts of climate and variability?
7. What challenges have been faced or are being encountered by small holder farmers in adapting to the effects of climate variability?

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