



**THE ROLE OF INDIGENOUS KNOWLEDGE SYSTEMS IN SEASONAL
PREDICTION AND ADAPTATION TO CLIMATE CHANGE AND VARIABILITY
AMONGST SMALLHOLDER FARMERS IN BIKITA, ZIMBABWE**

by

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PREFACE

The research contained in this thesis was completed housed in the discipline of Rural Development and Resource Management, School of Agricultural, Earth and Environmental Sciences of the College of Agriculture, Engineering and Science, University of KwaZulu Natal, Pietermaritzburg Campus, South Africa.

The content of this work has not been submitted in any form to any other university and, except where the work of others is acknowledged in the text, the results reported are due to investigations by the candidate.

DECLARATION

I, Owen Mafongoya, declare that:

- The research reported in this thesis, except where otherwise indicated or acknowledged, is my original work;
- The thesis has not been submitted in full or in part for any degree for examination at any other university;
- This dissertation does not contain other peoples' data, pictures, graphs or other information unless specifically acknowledged as being sourced from other persons;
- This dissertation does not contain other persons' writing unless specifically acknowledged as being sourced from other researchers. Where other written sources have been quoted, then
- their words have been re-written but the general information attributed to them has been referenced;
- where their exact words have been used, their words have been placed inside quotation marks, and referenced;
- Where I have used materials for which publications followed, I have indicated in detail, my role in the work;
- This dissertation is primarily a collection of materials prepared by myself, published as journal articles or presented as a poster and oral presentation at conferences. In some cases, additional information has been included;
- This dissertation does not contain text, graphics or tables copied and pasted from the internet, unless specifically acknowledged, and the sources being detailed in the dissertation and in reference sections.

Owen Mafongoya... 

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As research supervisor, I agree to submission of this thesis for examination.

Prof P. L Mafongoya (Main supervisor).....

Date.....

Dr Maxwell Mudhara (co-supervisor).....

Date.....

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ABSTRACT

Climate change and variability have serious threats on rainfed agriculture in Zimbabwe. Poor and vulnerable smallholder farmers are facing serious food insecurity. Vulnerability to droughts is worsened by poverty, limited financial capital and access to technology. These factors limit their ability to cope, adapt and build resilience to climate change shocks and stresses. Local farmers' adaptive potential, planning and preparedness are affected because of absence of adequate seasonal forecasting information. Smallholder farmers usually get forecasting information from indigenous knowledge indicators and scientific forecasts. Due to limited technology, they rely more on indigenous indicators. This study scrutinized local farmer vulnerability and the subsequent indigenous adaptation strategies used in coping with climate change risks and hazards. In using indigenous knowledge in coping and adaptation, the study interrogated the role of social capital and local institutions in reducing their vulnerability to disasters. The role of social capital and local institutions was scrutinized in the context local farmer indigenous knowledge and adaptation.

Data in this study was collected using Focus Group Discussions, key informant interviews and structured questionnaires. The collected data was discussed based on the Sustainable Livelihoods Framework. Results revealed majority of smallholder farmers, particularly women, are vulnerable to droughts and diseases. Their adaptive potential is constrained by their limited access weather and seasonal information. Seasonal forecasting information helps them in planning and making decisions which reduces vulnerability to climate change risks and hazards. Despite the presence of multiple indigenous indicators for seasonal forecasting, seasonal information still remains problematic for local farmers. Unreliability of some of the indigenous indicators and other factors such as modern science, christianity, western education and scientific seasonal forecasting are negatively affecting the use indigenous indicators in seasonal forecasting.

On another level of adaptation, using social capital and local institutions is critical. Some farmers' failure in reviving indigenous based social capital is crippling their potential of self-help adaptation strategies. Furthermore, some intervening local institutions are not premising their adaptation strategies much on indigenous strategies. In areas where local farmers invest in social capital and local institutions include indigenous knowledge systems, vulnerability is reduced. It can be concluded that use of indigenous knowledge systems is critical for sustainable adaptation of rural poor and vulnerable smallholder farmers. It can be recommended that the government needs to encourage and incorporate indigenous knowledge into adaptation plans and actions, and integrate indigenous knowledge into scientific seasonal forecasting and adaptation strategies. Integrating local knowledge and scientific strategies would reduce vulnerability and increase local farmer resilience and adaptive capacity against climate change shocks and stresses.

Key words: Indigenous knowledge, vulnerability, adaptation, resilience climate change, forecasting

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CHAPTER 1

INTRODUCTION

1.1 Thesis introduction

Impacts of climate change are severe and are creating serious humanitarian crisis, particularly for developing countries (IPCC, 2007). Serious humanitarian challenges are experienced from disasters such as droughts, disease outbreaks, floods, high temperatures inter, among others. Climate change disasters have devastating impacts on resource-poor smallholder farmers who rely on climate sensitive rain fed agriculture (Hulme, 2005). Increasing disasters expose majority of local farmers with low adaptive capacity to increased vulnerability. Low adaptive capacity is worsened by the absence of important livelihood assets, modern technologies and climate information (Porter et al, 2014; AGRA, 2014). Smallholder farmers with assets and climate change information have increased capacity to deal with climate change risks and hazards.

Adapting to negative impacts of climate change is important for smallholder farmers (Porter et al, 2014). Ability to adapt ensures sustainable livelihoods amongst farmers. Devising robust resilient strategies is achievable at grassroots level (DFID, 2000). This can be in part achieved through maximum utilization of social capital, indigenous knowledge and natural assets (Roncoli et al, 2002; Chang'a et al, 2010; DFID, 2000). Grassroots based adaptation is critical in building self-help resilience against slow onset and rapid onset disasters (Porter et al, 2014). Successful use of indigenous knowledge and social capital in adaptation can be possible with support from vibrant local institutions (Agrawal, 2008; Ellis, 2000; Putman, 2000). Local institutions act as catalysts which facilitate interaction between local farmers and their resources which enhance their livelihoods.

1.2 Rationale of the study

Various studies revealed that, at local, regional and international levels, climate is drastically changing and weather variability increasing (Hulme, 2005). The effects of climate change are severe and exposing majority of rainfall dependent poor smallholder farmers into increased vulnerability. The most vulnerable groups are those found in the global south particularly in sub-Saharan Africa (AGRA, 2014; Porter et al, 2014). The most vulnerable smallholder

farmers are the resource poor who have few or no assets which limit their adaptive capacity and resilience potential.

In sub-Saharan Africa, the deteriorating livelihoods standards are worsened by over reliance on climate sensitive agriculture and livelihoods (AGRA, 2014). Studies revealed that approximately 80% of cultivated land in Africa relies on rain fed agriculture (Bhattacharya, 2008). On a downscaled level, it is estimated that 90% of the food consumed in Zimbabwe comes from rain fed agriculture (Chagutah, 2010). The common disasters affecting smallholder farmers in sub-Saharan Africa are droughts and intermittent floods which lead to loss of crops and livestock (Chagutah, 2010; Manjengwa et al, 2014). Vulnerable local farmers are prone to serious food insecurity.

Dry spells have negative impacts on crop and livestock production and this reduces smallholder farmers' adaptive capacity (IPCC, 2007; AGRA, 2014). Adaptive capacity can be improved by drawing insights from the bio-physical approaches and indigenous knowledge sources (Porter et al, 2014). Technical approaches of adaptation as prescribed by bio-physical scientists maybe more suitable for commercial farmers who have resources to implement robust adaptation strategies. On the other hand, indigenous knowledge is more suitable and readily available for resource constrained smallholder farmers (Kolawole et al, 2014; Chang'a, et al, 2010).

Indigenous knowledge strategies provide sustainable adaptive capacity of local farmers (Roncoli et al, 2002). Studies revealed that indigenous knowledge provide forecasting information and adaptive options amongst smallholder farmers (Chang'a et al, 2010). Indigenous knowledge reduces vulnerability of local farmers by their ability to provide timely weather and seasonal information. Timely information instructs local farmers to devise locally appropriate adaptation options (Kolawole et al, 2014). Dependence on the bio-physical scientists does not adequately address challenges faced at the local level (AGRA, 2014; Porter et al, 2014).

Most outside intervention strategies which are put in place by technocrats and local institutions do not consider smallholder farmers as critical players in climate change adaptation (Alexander, 2011). The majority of smallholder farmers in remote rural areas are regarded as illiterate and poor. Excluding local farmers and their coping and adaptive

strategies reduce the potential reducing their vulnerability to climate change disasters (Porter et al, 2014). Furthermore, excluding local farmers and their local initiatives increases rejection new intervention strategies. Limited use of indigenous knowledge in adaptation is among the causes of vulnerability and low adaptive capacity of local farmers. Furthermore, non-usage of indigenous knowledge in smallholder farming is causing its subsequent disappearance (Kolawole et al, 2014; Alexander, 2011).

Preservation of indigenous knowledge is supposed to government and local institutions' priority (Gutsa, 2014; Manjengwa et al, 2014). Institutional support on indigenous knowledge increases local farmers' adaptive capacity. Calls emphasizing use of indigenous knowledge in seasonal prediction and adaptation is increased by smallholder farmers' limited access technology and scientific seasonal forecasts (Porter et al, 2014). Use of indigenous indicators remains a top priority in smallholder farming decision making for agricultural and livelihood adaptation to climate change and variability. Indigenous knowledge indicators are praised for providing direct solutions to context specific problems affecting local farmers (Kijazi et al, 2013; Kolawole et al, 2014).

This study examined the role of indigenous knowledge systems in seasonal forecasting and adaptation. It scrutinizes various indicators and strategies drawn from indigenous knowledge which are critical in building adaptive capacity and resilience. It also examines roles played by social capital and local institutions increasing local farmers' adaptive capacity. The role of local institutions and social capital are scrutinized in the context of indigenous knowledge. The aim is to ascertain the possibility of attaining sustainable grassroots solutions to climate change disasters amongst smallholder farmers.

1.3 Aim of the study

The study aims to identify various indigenous indicators which are used by smallholder farmers in seasonal prediction and adapting to extreme seasonal conditions. The study also aims at examining the indicators that are reliable in prediction as well as their influence in adaptation. The research will explore the possibility of integrating indigenous knowledge systems in planning and decision-making drawing more insights from the forecasting information. The possibility of incorporating social capital, local institutions and indigenous knowledge for more robust adaptation is also explored.

1.4 Conceptual framework - Sustainable Livelihoods Framework

This study is grounded on the Sustainable Livelihoods Framework (SLF). SLF is also known as Sustainable Rural Livelihoods (SRL) or Sustainable Livelihoods Approach (SLA). SLF was popularized by the DFID (2000) (Figure 1.1). SLF is an important framework in understanding poverty, vulnerability and adaptation. SLF gained prominence in climate change debates in recent years (Scoones, 2009). Usefulness of SLF in climate change discourses was facilitated by its flexibility in bridging the relationship between livelihoods assets and adaptation (Scoones, 2009; Chambers and Conway, 1992).

Central to SLF is various capitals (herein referred to as assets) which are pillars for sustainable resilience and adaptation to disasters (DFID, 2000). Presence of capitals or their absence determines vulnerable groups' ability or inability to cope and adapt climate change and non-climate change shocks and stresses (Scoones, 2009). The main pillars of SLF are social capital, human capital, physical capital, natural capital and financial capital. The importance of various capitals in reducing vulnerability is determined by some external forces. The main factors which facilitate the success of capitals are good policies, vibrant local institutions and various processes (DFID, 2000). Availability of enabling policies and vibrant and local institutions ensure sustainable adaptation. Cooperation between farmers, government and local institutions is critical in building resilience and adaptive capacity.

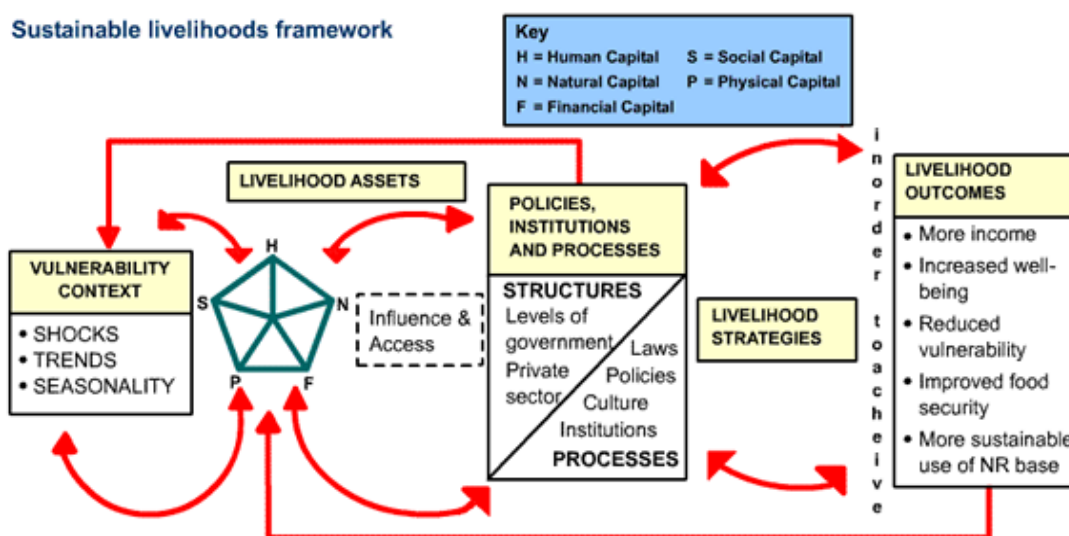


Figure 1.1: SLF's capitals and structures for adaptation. Adopted from DFID, 2000

In this study, SLF is used in explaining local farmers' ownership and use of various capitals in coping and adapting to climate change shocks and stresses. Human capital comprises human beings, knowledge, ideas, labor inter alia, which are possessed by local farmers in farming livelihoods (DFID, 2000). Connected to human capital are indigenous knowledge systems. Indigenous knowledge is an important asset possessed by local farmers (Kolawole et al, 2014; Roncoli et al, 2002). Indigenous knowledge provides forecasting information and advises adaptive strategies. Availability of human capital (knowledgeable elders) eases the complex processes of interpreting weather and seasonal events as they unfold. Seasonal forecasting information empowers farmers in planning and decision making which improves food security among other adaptation options.

Knowledgeable elders as human assets are also important in execution of traditional rain making ceremonies (*mukweverera*) (Roncoli et al, 2002). Rain making ceremonies are important in reducing outbreak of disasters such droughts and diseases. They are also important in replacing misfortunes with favorable conditions like bumper harvests in agriculture (Ngara et al, 2014; Kijazi et al, 2013). Prevalence of disasters affect both crop and livestock production which are critical livelihood assets for smallholder farmers (AGRA, 2014).

On the other hand, the presence of human capital in the form technical experts from non-governmental organisations (NGOs) and extension services facilitate adaptation through devising pragmatic farming methods in both good and uncertain conditions (DFID, 2000; Scoones, 2009). Technical agricultural experts provide vast resources and ideas to vulnerable farmers. They provide help such as farming knowledge, technology, financing agriculture and critical seasonal information (Chambers and Conway, 1992). The help is critical in reducing vulnerability through strengthening adaptive capacity.

Social capital is an integral asset in building adaptive capacity and resilience of vulnerable smallholder farmers (DFID, 2000). Social capital is divided into three broad categories (Putman, 2000). The categories are linking, bonding and bridging capitals. Bonding capital is a grassroots based collective relationship which is used community members in reacting to disasters (Putman, 2000). Smallholder farmers' sharing of climate change information, pooling resources and implementation of risk management strategies help them in adapting.

In this study, bonding capital is critical in examining the influence of smallholder farmers' horizontal relations on adaptation and building resilience. Scrutiny on bonding capital is extended to the impact of social, political and economic relationships amongst local farmers. Presence of strong social bonding allows vulnerable groups to collectively deal with disasters (Coleman, 1990). Smallholder farmers with strong bonding capital are able to reciprocate and share ideas and strategies when responding to disasters such as droughts. Collectivism, trust and sharing also allow smallholder farmers to maximize gains in favorable seasonal conditions.

Equally important is bridging capital in reducing vulnerability and adapting to negative impacts of climate change and variability (Pretty, 2003). Bridging capital is defined as an extended relationship based on sharing of natural resources by different social groups, villages and communities (Coleman, 1990). Common resources which are shared by local farmers are farm lands, pastures, water resources, among others. These resources are of paramount importance in sustaining crop and livestock production. In this study, bridging is examined on smallholders sharing scarce resources such as grazing land, water and mountains. Mountains are important as sites and shrines which host sacred rain making rituals. Sacred rain making rituals are critical in influencing the favourable weather and seasonal outlook (Roncoli et al, 2002).

Lastly on social capital, linking capital is defined as a vertical relationship which between vulnerable groups and local institutions (Coleman, 1990; Pretty, 2003). Vibrant local institutions inject important missing assets such as technical expertise, financial resources, new technologies and climate change information (Ellis, 2000). In this study, linking capital is examined on the pretext of local farmers' relationship with local institutions. It scrutinizes the role played by interrelationships in coping, building resilience and adapting to climate change shocks and stresses.

The importance of social and human capital can be realized in the absence of natural capitals (DFID, 2000; Pretty, 2003). Communities with natural assets such as vast lands, water, rivers, livestock, and biodiversity have a better adaptive potential than those without assets. In this research, smallholder farmers' adaptive capacity is premised on availability of assets such as trees, birds, animals and insects. Ownership of vast tree species, animals and insects increases local farmers' base of indigenous seasonal indicators (Kolawole et al, 2014; Chang'a et al,

2010). Availability of seasonal information from indigenous indicators is examined in the context of local farmers' planning, decision making and modeling adaptive strategies. Presence of water sources shall be examined in supporting livelihoods diversity. Some important livelihoods diversification strategies include livestock production. For areas with innovation and technological resources, large sources of water supplement rain fed agriculture. Irrigation becomes an important factor in improving farming production.

Physical capital is an important asset to be examined in relation to local farmers' resilience and adaptation. Physical assets such as roads, dams, irrigation, boreholes and clinics are critical in supporting farming and other diverse livelihoods activities (DFID, 2000; Scoones, 2009). The study examines the presence of dams and irrigation infrastructure and how they improve food security.

The last asset in the SLF is the financial capital. The researcher interrogates the importance of financial capital in boosting diverse adaptation options in cases of uncertainty. The study examines the presence of credit schemes and financial resources in funding agricultural activities as well as coping with droughts. The study unravels various practitioners and local institutions which offer credit facilities to farmers. The study examined how smallholder farmers use financial capital in maximizing crop and livestock production.

Availability of credit schemes and loans from local institutions is fundamental in supporting the role played by other capitals in agricultural livelihoods (DFID, 2000). Also, the importance of financial capital is evaluated in the acquisition of modern technologies and accessories such as radios, televisions inter alia. Presence of such technologies is analyzed in the provision of seasonal forecast information as an addition to available indigenous indicators. In overall, the role of financial resources is evaluated in empowering farmers with decision making and planning capacities in coping with disasters or maximizing productivity in farming enterprise.

1.5 Importance of the study

Climate change and variability are serious threats to human security in the 21st century (IPCC, 2007). The impact and effects of disasters are undoing achievements achieved over long periods of time (UNEP, 2007). Most affected are poor smallholder farmers who live in

precarious ecological conditions (IPCC, 2007). Poverty and increasing extreme climate change impacts are causing serious food insecurity. Most smallholder farmers vulnerable to food insecurity have limited or no adaptive capacity (AGRA, 2014).

Vulnerability to droughts and food insecurity amongst smallholder farmers is caused by over dependence on rain fed agriculture (AGRA, 2014). 80% of the total cultivated land in Africa depends on rain fed agriculture (FAOSTART, 2005; Bhattacharya, 2008). Rain fed farming is practiced by 80 % of the total population in the continent. Research revealed that the rain fed dependent farmers produces more than 80% of the total food consumed (AGRA, 2014). With impacts and effects of climate change disasters increasing, food production is expected to drop by 8% exposing majority to vulnerability (Porter et al, 2014).

Sub-Saharan Africa is more vulnerable to droughts and food insecurity compared to other agro-ecological regions (IPCC, 2007). Central to vulnerability is the capacity to build resilience to disasters. Poverty, multiple socio-economic and political problems are among the impediments hindering smallholder farmers' adaptive capacity (Reid et al, 2012). In many cases, the governments are blamed for failing to support smallholder farmers in coping and adapting to disasters (Reid et al, 2012). Malawi, Zimbabwe and Namibia are among countries with minimum governmental intervention which facilitate smallholder farmers' adaptation to negative climate change impacts (Mapfumo et al, 2014; Gutsa, 2014).

Governments should facilitate local farmers' access to seasonal and weather information (AGRA, 2014). Access to seasonal information facilitates decision making and planning in agricultural activities. Correct decisions improve food production and safeguard human security (UNEP, 2007). For most governments to provide timely information and other important intervention strategies, they need to form collaborations with other participating climate change stakeholders (Reid et al, 2012). Reducing vulnerability of smallholder farmers safeguard human life, fulfill of human rights and preserve developmental gains (IPCC, 2007).

From this background, this study evaluates the importance of local farmers' access to seasonal forecast and climate change information. Access to seasonal forecast information is examined its importance on planning and decision-making processes by farmers in coping, adapting and building resilience to climate change disasters. Smallholder farmers' ability to adapt and access seasonal information is scrutinized in the context of government linkages

with local institutions. Government intervention in public and local institutions is examined on the grounds of supporting locals to adapt using their local assets. The use of local assets is analyzed on the premise of acceptability and sustainability by vulnerable smallholder farmers in sampled villages and wards in Bikita.

1.6 Main research questions

1. Is indigenous knowledge important for smallholder farmers in predicting and adapting effects of climate change and variability?
2. Do smallholder farmers have diverse indigenous ways of resilience building and adapting to climate change impacts?
3. Is social capital important in building climate change resilience and adaptation?
4. Are local institutions critical in building resilience and adaptive capacity of smallholder farmers?

1.7 Objectives of the study

The study examines smallholder farmers' use of indigenous knowledge in seasonal forecasting and subsequent adaptive strategies it offers against climate change disasters.

1.7.1 Specific objectives are:

1. To examine smallholder farmers' vulnerability to impacts of climate change and variability.
2. To investigate indigenous knowledge indicators used in seasonal forecasting and adaptation.
3. To determine smallholder farmers perceptions on decision making and the selection of seasonal forecasting sources.
4. To assess gender vulnerability and use of indigenous knowledge in adapting to climate change disasters.
5. To assess the role of social capital and indigenous knowledge in building resilience and adaptive capacity against climate change disasters.
6. To examine the role of local institutions and indigenous knowledge in building resilience and adaptive capacity against negative effects of climate change.

1.8 General methodology and study approach

Bikita district is sub-divided into three main parts namely Bikita-west, Bikita-south and Bikita-east. Bikita-east was selected as the case study area. In Bikita-east there are ten wards which are 14, 15, 16, 17, 18, 20, 21 and 24. Ward 20, 21 and 24 were purposively selected for the study. Ward 21 lies on extreme north-end of Bikita east whilst ward 20 is on the middle and 24 is on extreme south-end. Selection of the three sparsely located wards was driven by the desire to ensure a full coverage of a cross section of the wards in Bikita east. Ward 24 is found in agro-ecological zone V (five) while the other two are found in agro-ecological region IV (four) of Zimbabwe. Agro-ecological IV and V zones are known for receiving inadequate, inconsistent and ephemeral rainfall patterns. Region V receives less than 450 mm of rain per year (Chikodzi et al, 2013). Adverse seasonal and climatic conditions pose severe threats to crop growing and animal husbandry. Table 1.1 provides a summary of wards, villages and socio-demographic characteristics in ward 20, 21 and 24.

Table 1.1: General information on ward 20, 21 and 24

Wards	Total population	No. of villages	Households
Ward 20	7473	45	1779
Ward 21	4174	25	976
Ward 24	4503	15	1047

Source: ZIMSTAT, 2013

In selecting respondents, both probabilistic and non-probabilistic sampling techniques were used. The wards have similar soil types, tree species and other topographic characteristics. Ward 20 had 45 villages, ward 21 had 26 villages and ward 24 had 15 villages. Three villages were randomly selected from each ward. The decision of selecting three villages in each ward was based on two reasons. Firstly, all farmers in the three wards have similar cropping systems, similar soil types and vegetation. Similarities in soils types and vegetation also represent similarities in seasonal forecasting indicators which reduces the need for more villages. Secondly, financial limitations on the part of the research team which limited potential of including many wards and villages in the study.

On focus group discussions (FGDs), both men and women were selected. Participants were drawn from the household lists provided by the local extension workers. Three focus group

sessions were done in each of the selected villages. Each focus group discussion had twelve participants of which six were male and the six were females. Participants were randomly picked. The rigorous process of selecting focus group participants was repeated across all the three wards. On key informants, detailed information on the participants is shown in each chapter. Key informants were selected in accordance with the demands and structure of each objective.

1.9 Study area

Bikita district is one of the seven administrative districts found in Masvingo province in Zimbabwe (Figure 1.2). The other six districts are Zaka, Gutu, Mwenezi, Chiredzi, Chivi and Masvingo urban. Bikita district is dominated by the Karanga people of the Duma totem. It is located 80 km east of Masvingo city and 377.9 km from Harare. Geographically, it lies about 656 meters above sea level. The district is divided into three parts which are Bikita west, Bikita east and Bikita south. The main livelihood activity in this Bikita is agriculture. Smallholder farmers practice mixed farming combining crops and animal husbandry.

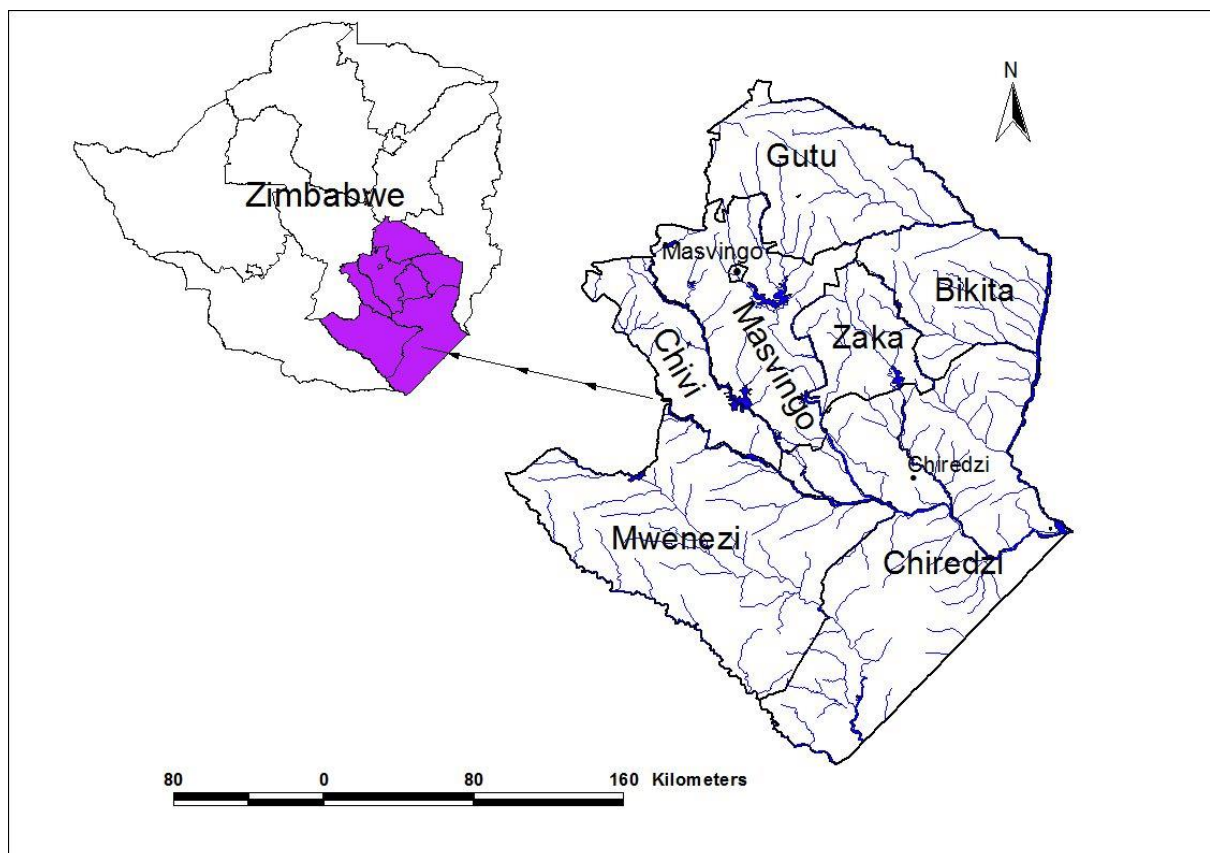


Figure 1.2: Map of Bikita district. Extracted from Chikodzi et al (2013).

Coupled with poor soils and bad topography, food insecurity and vulnerability to other climate change disasters is common in Bikita. Most local farmers adapt through the cultivation of small grains such as rapoko, millet, sorghum. During good seasons, ground nuts are of commercial value albeit faced with reliable market problems. Domestication of cattle, donkeys, goats and sheep acts as sources of draught power and safety nets to supplement failing crop farming is widely practiced. Frequent droughts force many farmers to depend on food handouts from public and private institutions (mainly NGOs and government). Better resourced farmers rely on buying from other areas while others migrate to urban areas and other resourceful areas. Poorer farmers migrate and work for food from irrigated commercial farms in Chipangayi, Chipinge, Middle Sabi, Birchneough and Nyanga.

1.10 Organisation of the thesis

This thesis is presented using the paper format. Table 1.2 gives a general description of the chapters.

Table 1.2: Organization of the thesis

Chapter 1 - Chapter 1 explores the rationale of the study, its importance, the aim of the study. It covers main objectives, conceptual framework and the general methodology.
Chapter 2 - reviews literature on indigenous knowledge, gender, social capital and local institutions. It follows the logical organization of the objectives as outlined above. It unpacks knowledge gap between other studies and this study.
Chapter 3 presents the first objective of the study on vulnerability and adaptation.
Chapter 4 presents various indigenous knowledge indicators used in seasonal forecasting and adaptation. It ends by analyzing the benefits of integrating indigenous indicators and scientific forecasting in seasonal forecasting.
Chapter 5 builds on the insights from the previous chapter. It presents local farmers' perceptions and decision making on the choice of a seasonal forecasting source to rely on.
Chapter 6 assesses gender based vulnerability and subsequent indigenous knowledge strategies they use in adapting to climate change disasters
Chapter 7 evaluates the role of social capital and indigenous knowledge in improving local farmers' resilience and adaptive capacity.
Chapter 8 analyzes the role of local institutions and indigenous knowledge in reducing smallholder farmers' vulnerability to climate change disasters.
Chapter 9 concludes the whole thesis and data gathered. The chapter reveals gaps and potential areas of future research emanating from the gathered data on indigenous knowledge and adaptation

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CHAPTER 2

LITERATURE REVIEW

2.1 Chapter introduction

Though climate change is universal, its impacts on farming communities are not evenly distributed in the global world (AGRA, 2014). Worst affected countries are found in Africa (IPCC, 2007). Some countries in Africa, particularly in sub-Saharan Africa, are more vulnerable than others. Vulnerability to climate change impacts is caused by over dependence on climate sensitive rainfed agricultural production (AGRA, 2014). Rainfed agriculture is largely affected by extreme weather and seasonal conditions (Porter et al, 2014). Scales of vulnerability and adaptive capacity are influenced by wide ranging factors such as gender, politics, economy, ecological zones and possession of assets. Sensitivity and degree of exposure differs from place to place and from time to time (Davies, 2011). This chapter reviews literature on smallholder farmers' vulnerability to climate change risk. It examines the knowledge gap between studies conducted on indigenous knowledge and adaptation. It further unpacks the role of indigenous knowledge in relation to social capital and local institutions in building their resilience and adaptive capacity to climate change risk.

2.2 Understanding the concept of vulnerability

Vulnerability is defined as the susceptibility of a system to damage or harm (Eakin and Luers, 2006). In agriculture, vulnerability is described in the context of farmers' susceptibility to climate shocks such as droughts and food insecurity (Adger, 2006). A combination of extreme climatic conditions and low adaptive capacity worsens local farmers' degree of vulnerability (Yohe et al, 2003; Adger, 2006). Most smallholder farmers in sub-Saharan Africa have weak adaptive capacity due to poverty and extreme seasonal conditions (Adger, 2006). Smallholder farmers who depend on climate sensitive rainfed agriculture are more vulnerable to the impacts of climate change and variability (Davies, 2011). Enhanced adaptive capacity of local farmers is possible with improved livelihood assets, good policies, vibrant social capital and active local institutions (Smit and Pilifosova, 2003).

2.2.1 Categories of climate change based vulnerabilities

Vulnerability is divided into two broad categories in climate change discourse, social and physical vulnerability (Parker et al, 2009). Social and physical vulnerability differ starting

from individuals, households, ecological environments and other variables (Parker et al, 2009). Social vulnerability involves loss experienced by victims based on variables like gender, politics, and relations. Belonging to certain social categories reduces smallholder farmers' ability to cope and adapt to climate change risks and hazards. For example, women in smallholder agriculture are more vulnerable to disasters than men (Manjengwa et al, 2014). Physical vulnerability involves loss of both natural and man-made physical assets (Parker et al, 2009). Among smallholder farmers, physical vulnerability is caused by loss of important livelihood assets such as livestock which may weaken smallholder farmers' adaptive capacity against climatic and non-climatic shocks and stresses.

2.2.2 Vulnerability of agro-based livelihoods in Zimbabwe and southern Africa

Climate change disasters are increasing vulnerability of smallholder farmers in rural Zimbabwe (Manjengwa et al, 2014). The increasing risks and hazards are negatively affecting agro-based livelihoods. Insufficient rainfall patterns are creating serious food insecurity (Dodman and Miltin, 2015; Manjengwa et al, 2014). Deteriorating agricultural conditions in Zimbabwe is a mind-boggling problem on farmers, government and other participating stakeholders in climate change (Manjengwa et al, 2014).

Attempts to deal with negative climate change impacts on agriculture are among some of Zimbabwean government's top priorities (Dodman and Miltin, 2015). Through the Ministry of Agriculture and Ministry of the Environment and Natural Resource various coping and adaptive strategies were promulgated (Manjengwa et al, 2014). Firstly, the two ministries identified various human and environmental variables impacted by extreme weather events. The affected sectors include agriculture, bio-diversity, rangelands, forests, water, health and human settlement and tourism. The government prioritized their attention on agriculture because it is the mainstay human livelihoods (Dodman and Miltin, 2015). To achieve goals of reducing local farmers' vulnerability to disasters, the government opted to incorporate other stakeholders such as local non-governmental organisations (Manjengwa et al, 2014).

Smallholder farmer vulnerability to climate change disasters is not a unique to Zimbabwe but common in southern Africa (Manjengwa et al, 2014). Apart from climate change risk, independent factors such as mal-functioning economies, political conflicts and natural hazards weaken adaptive capacity (Dodman and Miltin, 2015; Pasteur, 2011). Poor performing economies increase local farmer vulnerability by lowering their adaptive capacity

(Pasteur, 2011). The economic challenges in Zimbabwe between 2000 and 2008 left many people vulnerable to chronic poverty (Pasteur, 2011). The most affected were the rural people who could not afford food and other basics. The unfavorable bad political atmosphere deterred intervention from local institutions and international interventions (Dodman and Miltin, 2015).

2.2.3 Towards vulnerability assessments

Vulnerability to disasters is not a uniform condition for all smallholder farmers (Pasteur, 2011). Vulnerability assessments and tools should not be ‘one size fit all’ (ibid). For assessments to be helpful, downscaling to the focal point is important. Reaching the focal point is achieved by the correct identification of victims, their disasters and their needs in specific territories (Pasteur, 2011). Contextual problem identification empowers assessors to observe and evaluate the degree, exposure and sensitivity of risks and hazards with minimum biases (Vincent et al, 2008). Reducing making errors and biases in problem assessment facilitates the crafting of appropriate planning and disaster management models (Pasteur, 2011; Vincent et al, 2008).

Vulnerability assessments can be done at individual levels stretching to wider contexts (Vincent et al, 2008). The most common standards tool utilized in assessing vulnerability is the Vulnerability to Resilience (V2R) framework (Pasteur, 2011). The framework explains the need to identify the problem and assessing its impact before intervention. It encourages participation of all concerned parties is building sustainable resilience and adaptive capacity. Among smallholder farmer adaptation, mutual co-operation between them, government and local institutions will yield positive adaptive strategies (Pasteur, 2011). Positive results are guaranteed by local farmer participation in adaptation, planning and implementation processes. Smallholder farmer participation in adaptation increases their preparedness to face climate change risk (Vincent et al, 2008; Pasteur, 2011).

Use of local solutions as prescribed by the V2R allows local communities to adapt even with minimum or without the help of outsiders (Pastuer, 2011). Use of indigenous knowledge is critical in adaptation (Kolawole et al, 2014). This reduces the need to depend on expensive and unavailable technologies such as those needed for scientific seasonal forecasting. Combining indigenous knowledge, natural assets and outside intervention reduces local farmer vulnerability to increasing climate change risk (Roncoli et al, 2002; Pasteur, 2011).

2.3 Indigenous knowledge systems in seasonal prediction and adaptation to climate change impacts

2.3.1 Indigenous knowledge systems

The term indigenous knowledge is differently referred to due to differences of people's interpretation of their cosmological relationship with the environment (Mapara, 2009). Common noted terms include ethno-science, traditional ecological knowledge, indigenous ways of knowing, organic knowledge, local knowledge and folk knowledge (Mapara, 2009; Chang'a et al, 2010; Kolawole et al, 2014). Indigenous knowledge emerges from a cosmological relationship between local people and the sympathetic nature (Ngara et al, 2014). The mutual relationship between indigenous people and nature is traced through history and pragmatic social organization (Ngara et al, 2014; Kolawole et al, 2014). Social institutions such as families, marriages, kinship systems and cultures generate vibrant organic knowledge. Socially created institutions are bound together by good moral code (Ngara et al, 2014). Well generated tacit moral control mechanisms by indigenous people eased mutual reciprocity between them, animals, plant species and earth (Kolawole et al, 2014).

In the cosmological platform, natural assets are changed from the simple context to high rich symbolic features (Ngara et al, 2014). Mountains, bio-diversity, rivers and pools are transformed into sacred moral assets. Using the moral geography, a regime of sacred sites, shrines and symbolic signs emerged. Shrines become sacred places for hosting important rain making ceremonies, libation inter alia (Ngara et al, 2014). Increase in sacred places, symbolic and mythical beliefs gave birth to African Traditional Religion (ATR) (Mapara, 2009; Ngara et al, 2014). Entrenchment of ATR in the cultural practices sanctified the moral bond between human beings and nature. The mutual bond between human beings and nature has existed for the past centuries (Kolawole et al, 2014; Ngara et al, 2014). The bond is critical in interpreting, predicting and adapting to livelihoods risk such as those from climate change and variability (Roncoli et al, 2002).

Elderly people play significant roles in the development and preservation of indigenous knowledge (Kolawole et al, 2014). Cosmological knowledge base was created through experience, visions and dreams (Eversole et al, 2006). The developed knowledge has become

a way of life across generations. Indigenous knowledge is prescribed among other sustainable grassroots based solutions to problems threatening humanity (Eversole et al, 2006). Studies reveal that indigenous knowledge is a critical human capital in agriculture, environmental management, fisheries and political sectors (Roncoli et al, 2002; Chang'a et al, 2010). Sympathizers of indigenous pointed out that it provides sustainable solutions to disaster management and maximizing positive opportunities in critical life sectors (Alexander, 2011).

2.3.2 Indigenous knowledge systems in the climate change management.

Indigenous knowledge is gaining attention in climate management and adaptation (Roncoli, et al, 2002). It is hailed for providing grassroots and sustainable solutions to problems affecting smallholder agriculture (Chang'a et al, 2010). Integrating indigenous knowledge and bio-physical knowledge is important in seasonal forecasting and adaptation to climate change impacts (Alexander, 2011). Nevertheless, bio-physical approaches overlooked the role of indigenous knowledge in seasonal prediction and climate change adaptation. Sympathizers of indigenous knowledge express that it can work well if supported good policies (Pasteur, 2011). Figure 2.1 shows the mutual relationship between indigenous knowledge and other sectors such as policy in reducing vulnerability.

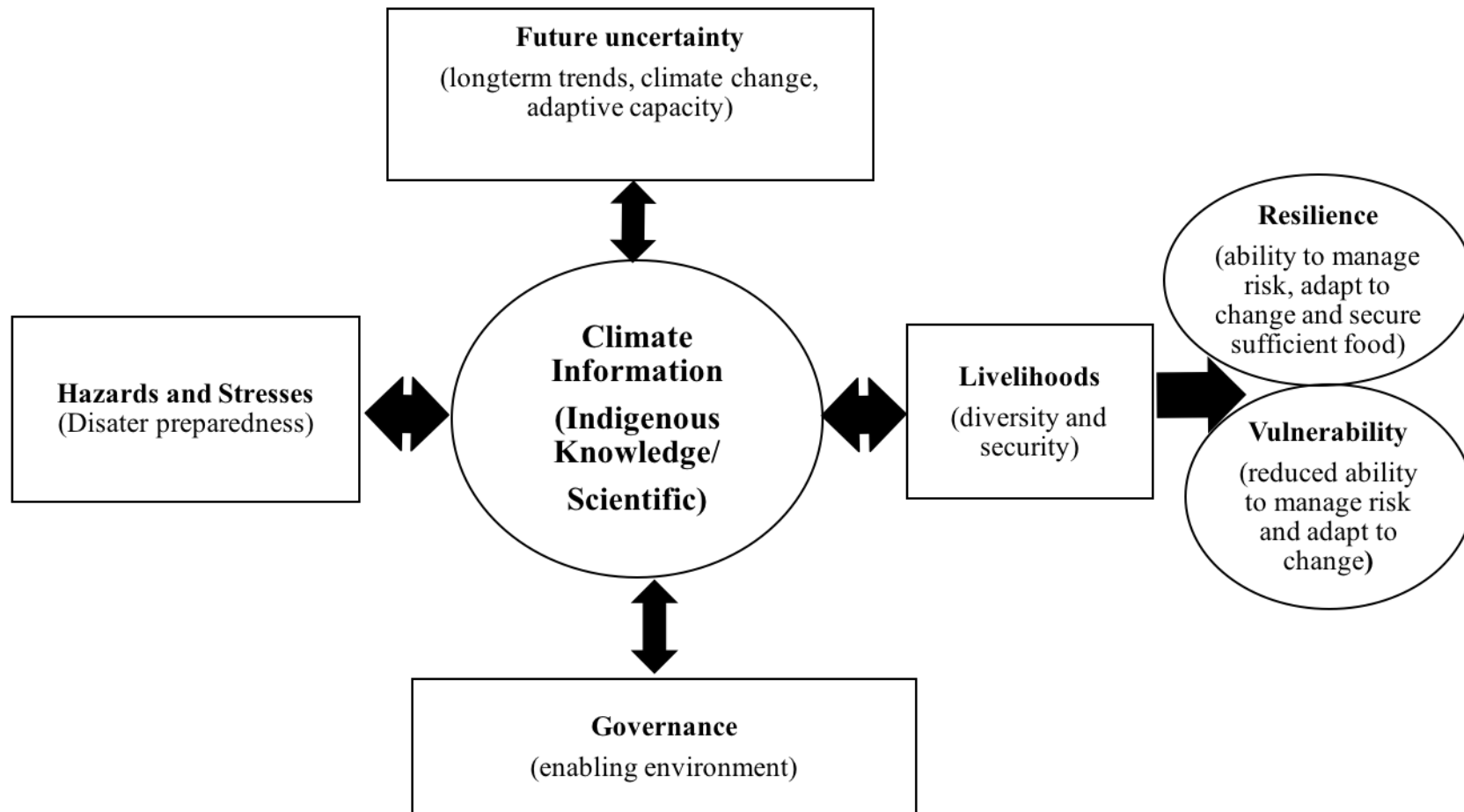


Figure 2.1: Indigenous knowledge systems, seasonal forecasting and adaptation

Adapted and modified from Pasteur, 2011.

Indigenous knowledge information on seasonal forecasting emerges from various natural features (Kolawole et al, 2014, Chang'a et al, 2010). Multiple indigenous indicators provide forecasting information for short and long term seasonal outlook. Local farmers obtain seasonal information through interpretation of behaviors and events from indicators such as domestic and wild animals, trees, insects, birds and terrestrial indicators (Roncoli et al, 2002). Indigenous indicators play an equal role in forecasting just like scientific forecasting. In some cases, the two forecasting sources are used in a complimentary way by local farmers (Chang'a et al, 2010).

Sympathizers of indigenous knowledge encourage its preservation and use in smallholder farming (Alexander, 2011; Kolawole et al, 2014). They regard it as the sustainable bedrock of detecting and coping with climate change risk at local level. Indigenous knowledge is highly ranked because it emanates from interpretations of the natural environment (Gundlanga and Makaudze, 2012). Relying on readily available and locally engineered knowledge fast track adaptation regimes and planning models (Roncoli et al, 2002; Gundlanga and Makaudze, 2012). Local solutions reduce protracted vulnerability to disasters at the same time improving resilience and adaptive capacity.

Despite positive outlooks on the use of indigenous knowledge, it remains an underutilized asset (Alexander, 2011). There are a number of factors impinging upon utilization of indigenous knowledge in forecasting and adaptation. These include lack of research and documentation, rigidity, influence of colonialism and prominence of scientific forecasting (Alexander, 2011; Kolawole et al, 2014). Lack of extensive research on indigenous knowledge symbols, mythology and indicators impacts negatively on its preservation. Lack of preservation and dissemination of indigenous knowledge largely affects its adoption in seasonal prediction and adaptation (Kolawole et al, 2014). Dependence on elders' knowledge alone poses serious threats to the preservation and dissemination of indigenous knowledge across intergenerational gaps. Death of a knowledgeable elder is a big loss to the indigenous knowledge base (Kolawole et al, 2014). Inexperienced younger generations face difficulties in interpreting complex indicators in seasonal forecasting and adaptation (Chang'a et al, 2010).

Some scholars have blamed rigidity of indigenous knowledge as responsible for its disappearance (Dove, 2000). Many bio-physical scientists argue that indigenous knowledge indicators lack flexibility hence making it difficult for farmers understand them in accordance

with changing environments and times. Adaptation of diverse plant and animal species due to extreme climatic conditions is negatively affecting reliability of many indigenous indicators (Cleaveland and Soleri, 2007; Dove, 2000). Unreliability of some indicators is among other factors leading to the disappearance and non-use of indigenous knowledge in smallholder agriculture.

Indigenous knowledge supporters are more positive than their critics (Ossai, 2010, Dove, 2000). They perceive indigenous knowledge as a flexible and progressive resource which can be used by farmers in forecasting and adaptation. Dove (2000) expressed that new knowledge is continuously generated as the environment is changing hence removing doubts on indigenous knowledge's effectiveness in seasonal prediction and adaptation. Indigenous knowledge supporters concur that the cosmological relationship between locals and nature is not fixed. Instead, indigenous people transform their knowledge going in tandem with changing environmental conditions (Ossai, 2010).

On the other hand, less use of indigenous knowledge indicators by smallholder farmers cannot be only cast on climate change and lack of documentation (Ossai, 2010). The blame is also extended to non-climatic factors such as colonialism and western education. Colonial regimes and western education's rigid attack on indigenous knowledge left it vulnerable and slowly disappearing (Ossai, 2010). Juxtaposing indigenous systems and western knowledge increased its consequential disappearance. The severe onslaught experienced by indigenous knowledge was worsened by the lack of power by the indigenes in preserving it (Dove, 2000). Comparing indigenous and western knowledge systems led to the 'otherisation' of the former and replaced by the later.

2.3.3 Indigenous indicators and seasonal forecasting in smallholder agriculture

Smallholder farmers use wild animals and birds, insects, astronomical and other independent natural features in seasonal forecasting (Roncoli et al, 2002; Chang'a et al, 2010; Kolawole et al, 2014). Animal behavior is among important indicators of seasonal forecasting (Kolawole et al, 2014; Chang'a et al, 2010). Breeding patterns of certain birds and the sound they produce, for instance, are critical in providing short and long-term weather and seasonal information. Singing of southern ground hornbill (*Bucorvus leadbeateri*) in Tanzania is associated with imminent rains (Chang'a et al, 2010). Low breeding patterns by some animals indicate impending uncertainties such as droughts (Okonya et al, 2013; Kijazi et al, 2013). To the

contrary, high breeding patterns of certain animals signifies good seasons with enough rain. In other cases, presence or absence common or uncommon animals are differently interpreted. Kijazi et al (2013) pointed out that appearance of scarce bee eaters in October indicates imminent rains in Tanzania. Non-appearance of those animals signifies impending droughts. This information is important in informing decision making, planning and adaptation against climate change disasters. Access to information on imminent rains is integral for farmer planning and preparedness in planting.

Various studies indicated that tree phenology as an indigenous forecasting indicator common than other indicators (Okonya et al, 2013; Shoko and Shoko, 2013; Roncoli et al, 2002). Local farmers use certain tree species in predicting short term and long-term weather and seasonal outlook (Okonya et al, 2013). The indigenes observe tree characteristics such as shedding and shooting of leaves, flowering and fruiting as important indicators of seasonal quality. In Burkina Faso, flowering of coffee indicates imminent rains (Roncoli et al, 2002). For long term seasonal forecasting, some smallholder farmers in Zimbabwe and South Africa use profuse flowering of baobab tree (*Adansonia digitata*) as an indicator for a season with normal or above normal rainfall (Zuma-Netshiukhwi et al, 2013; Shoko and Shoko, 2013). However, profuse flowering and fruiting of trees do not always indicate good farming seasons. In Manicaland province in Zimbabwe, profuse fruiting of trees like muchakata (*Parinari curatellifolia*) indicates dry seasons with no or below normal rainfall patterns (Muguti and Maphosa, 2012).

Some local farmers rely on various insect behavior in seasonal forecasting as a compliment to other indigenous indicators (Kijazi et al, 2013). Presence or absence certain insects provide important forecasting information for short term and long term seasonal outlook (Okonya et al, 2013; Kijazi et al, 2013). Appearance of termites towards the farming season in Uganda indicates imminent rains (Kijazi et al, 2013). In long term forecasting, rural farmers in Manicaland of Zimbabwe rely on red ants in predicting seasonal quality (Muguti and Maphosa, 2012). The presence of big ants indicates a good season with adequate rainfall. In other cases, absence or reduced numbers of common insects in Uganda indicates a season with no or inadequate rain fall patterns (Kijazi et al, 2013).

Studies conducted across different ecological zones reflect that many local communities also rely on atmospheric indicators especially for short term prediction (Zuma-Netshiukhwi et al,

2013; Okonya et al, 2013). Forecasting from atmospheric indicators compliment forecasting information collected from other indigenous indicators. Most local farmers predict weather and seasonal outlook by observing terrestrial movements of clouds, wind type and direction, moon and stars (Kijazi et al, 2013; Okonya et al, 2013). In rural South Africa, movement of stars from west to east at night indicates imminent rains (Zuma-Netshiukhwi et al, 2013). Indigenous farmers use short term predictions for making decisions on activities like planting crops.

The use of rain making rituals is also done by local communities in influencing weather and seasonal outlook (Ngara et al, 2014; Roncoli et al, 2002). Execution or non-execution of rain making rituals has profound influence on seasonal quality. Consistent and correct conducting of the rain making rituals guarantees favorable farming seasons (Roncoli et al, 2002). Rain making ceremonies are common in many parts of Africa such as Burkina Faso (Roncoli et al, 2002), Zimbabwe (Ngara et al, 2014) and Uganda (Okonya et al, 2013). Rain making rituals are performed for inducing rain or thanking ancestors and gods for good harvests. In some cases, rituals are conducted as ways of ending droughts (Roncoli et al, 2002). Rain making ceremonies are both a goal and a strategy of avoiding disasters such as droughts.

2.3.4 The interphase between indigenous knowledge systems and meteorological forecasting

Despite scientific seasonal forecasting enjoying popularity in seasonal forecasting, it has shortcomings especially in remote rural communities (Marshall et al, 2011). Scientific seasonal forecasting fails offer spatial and temporal weather trends in micro-ecological environments. In poor countries of the global south, meteorological base stations provide forecasting information on wider agro-ecological environments (Kolawole et al, 2014; Roncoli et al, 2000; Marshall et al, 2011). Many predictions made over wider context fail to come to pass at certain localities hence increasing doubts and unreliability (Marshall et al, 2011). Another problem affecting smallholder farmers' reliance on scientific seasonal forecasting is communication problems (Speranza et al, 2013). Lack of efficient communication networks affects smooth dissemination and reception of seasonal information in remote areas (Marshall et al, 2011). In most cases, local farmer access to meteorological information is erratic. Dependence on word of mouth has subjected seasonal information to intense distortion. Against this background, juxtaposition of meteorological and indigenous knowledge is recommended as a solution covering shortcomings associated with the types of forecasting

sources (Speranza et al, 2013). Integration of meteorological information and indigenous knowledge is popular in many farming communities in sub-Saharan Africa (Speranza et al, 2013). Observed cases are common in Zimbabwe's farming rural communities in Zaka, (Makwara, 2013), Mberengwa (Shoko and Shoko, 2013) and Manicaland (Muguti and Maphosa, 2012). Similar experiences have been witnessed in some rural parts of Tanzania (Chang'a et al, 2010). Harmonizing the two sources of information improves access to seasonal information which influences decision making and adaptation. Albeit projected positive gains in harmonizing the two sources of seasonal forecasting, the union between the two needs not to be over romanticized (Speranza et al, 2013).

2.3.5 Policies on indigenous knowledge systems and climate change in southern Africa

Whilst the government of Zimbabwe has acknowledged negative impacts of climate change, formulation of policies supporting indigenous knowledge remains a dream to be realized (Gutsa, 2014). Incorporation of indigenous knowledge policies in adaptation to climate change is gaining momentum at the global scale, spearheaded by the UNFCCC (Gorjestani, 2004). Adoption of policies with indigenous knowledge in climate change adaptation is further popularized by prominent international institutions such as World Intellectual Property Organization (WIPO), Food Agricultural Organization (FAO), World Health Organization and International Council of Science (ICSU), Human Rights Council (Manjengwa et al, 2014; Gorjestani, 2004). Inclusion of indigenous oriented policies guarantees sustainable adaptation against climate change impacts.

Some African governments are incorporating indigenous knowledge and cultural practices in climate change adaption (Gorjestani, 2004). The South African government has made progressive steps towards incorporating indigenous knowledge as an important component of human's social and economic development (Government of South Africa, 2004). In 2004, the South African Cabinet adopted the Indigenous Knowledge Systems Policy. Later in 2006, substantive offices were established to support research on indigenous knowledge, its dissemination and preservation (Government of South Africa, 2004). Substantial amounts of money were channeled through the National Research Foundation (NRF) motivating academic research on the role of indigenous knowledge and devising strategies of supporting its the preservation.

In Uganda, the government embraced indigenous knowledge systems in its mainstream policy frameworks (Gorjestani, 2004). The National Council of Science and Technology declared indigenous knowledge as a critical component of human security and development. This idea was made official on the Kampala Declaration of Indigenous Knowledge and received heavy support from the government. Ugandan government incorporated indigenous knowledge in its Poverty Eradication Action Plan. In this plan, the government recommended the implementation of indigenous knowledge strategies in adapting to effects of climate change and variability.

2.4 Smallholder farmers' perceptions and decision making on the use of indigenous knowledge and scientific seasonal forecasting

2.4.1 Smallholder farmer perceptions on the choice of forecasting sources

Perceptions, heuristics, illusions and errors are common terms used in social psychology studies but gaining prominence in other fields of social sciences (Goldstein and Gigerenzer, 2002). These terms are used in explaining the processes and outcomes from various surveys and experiments. The experiments are preoccupied with interrogating variables and factors which influence the human mind in logical thinking, decision making and problem solving (Wang and Ruhe, 2007). Successful experiments are important in showing people's perceptions and how they influence the human mind to act in certain conditions. Studies from other arms of social science are borrowing aspects such as cognition, perceptions and heuristics in other fields such as climate change (Goldstein and Gigerenzer, 2002). In the climate change discourse, these concepts and processes are critical in assessing and explaining different farmers' capacity to think, act and making decisions on adaptation and coping with risk.

Smallholder farmers make decisions aiming to maximize output as well as reducing vulnerability to disasters (Goldstein and Gigerenzer, 2002). Making a hit (correct detection of stimuli) or hitting a miss (incorrect detection of the stimuli) is derived from good or bad judgment made by the farmers (Wang and Ruhe, 2007). The potential of acting or not acting to certain stimuli is largely determined by human agency (Dowlatabadi and McDaniels, 2012). Human beings have instincts that instruct them to strive for avoiding errors which cause dissonance (Goldstein and Gigerenzer, 2002). Dissonance is a mental state which usually

contradicts what the person knows and wants to do. In most cases, human beings with dissonance are prone to make errors.

Smallholder farmers are confounded with contrasting opinions on which forecasting source (indigenous indicators and scientific forecasting) to anchor their decisions (Chen, 2011). Their perceptions are influenced by the strengths and shortcomings associated with the two. To circumvent the weaknesses of the two seasonal forecast sources, some farmers integrate them. Incidences of combining the two are common in many rural farming communities of Zimbabwe (Shoko and Shoko, 2013; Makwara, 2013; Muguti and Maphosa, 2012). Making a choice on the type of forecasting source is determined by factors such as age, gender and experience (Goldstein and Gigerzner, 2002). Farmers of different age groups have different perceptions and knowledge on the reliability of the forecasting sources. In some cases, smallholder farmers rely on both sources (Speranza et al, 2013). Farmers' choices on seasonal forecasting source are influenced by the principled human mind (Goldstein and Gigerzner, 2002). The farmers' principled minds strive to avoid errors which emerge from misunderstanding and wrong decisions. Farmer ability to use a forecasting source with few errors reduces the chances of causing psychological dissonance (Sunstein, 2005). In most cases local farmers like choices that coincide with their knowledge, experiences and interests.

Reliance on indigenous knowledge is common among elderly farmers (Metin and Camgoz, 2011; Sunstein, 2005). Their perceptions are premised on long term cosmological experience which they have mastered. In some cases, strict adherence to indigenous indicators is reinforced by the absence of scientific seasonal forecasting (Alexander, 2011; Sunstein, 2005). Elderly farmers' doubts on scientific seasonal forecasting emerge from challenges associated with prediction of the onset of rains and scientific jargon used in disseminating the information (Chen, 2011; Mustein and Maloney, 2013). Majority of farmers have difficulties in conceptualization of the forecasting language used by meteorological scientists. In some cases, dissemination of seasonal information through statistics creates serious challenges amongst local farmers. Local farmers' inability to encode and decode statistical information increases their chances of making many errors. Making errors increases their vulnerability to disasters such as droughts.

On the other hand, many youthful farmers prefer scientific seasonal forecasting instead of indigenous knowledge indicators. Their perceptions are driven by modern knowledge systems

which are less complicated than the indigenous knowledge systems (Sunstein, 2005). Youthful farmers' decisions on selection of scientific forecasting are an attempt to avoid errors which exposes them to disasters such droughts (Goldstein and Gigerzner, 2002). As a result, they avoid using indigenous knowledge which is complicated to their knowledge world view. Basing on youths' perceptions, scientific seasonal forecasting is more flexible than indigenous indicators (Marshal et al, 2011). Flexibility of scientific seasonal forecasting is driven from the use of technology. Technology is faster and flexible when compared to indigenous indicators (Sunstein, 2005).

2.5 Gender vulnerability and indigenous knowledge in adapting to climate change impacts

2.5.1 Contextualising the concept of gender

Gender is a slippery concept prone to abuse and misinterpretation (Raty and Carlsson-Kanyama, 2009). In most cases it is wrongfully used denoting women. Nevertheless, this term has academic definitions which are neutral and non-conflicting (Ibid). Central to issues of gender are gender blindness, injustice, discrimination and exclusion (Dankelman, 2010). Studies have confirmed that women are oppressed and excluded by men in many social platforms (Raty and Carlsson-Kanyama, 2009; Terry, 2009).

In gender studies, feminists' voices are loud world over regarding women's subjugation exclusion from many platforms (Terry, 2009; Denton, 2000). Women are considered as victims of social institutions, processes and other structures (Raty and Carlsson-Kanyama, 2009). Women's vulnerability is caused by socially constructed gender roles. In smallholder agricultural livelihoods, women are more overburdened by domestic duties than men (Denton, 2000). Their vulnerability is reinforced by existing discriminatory and conservative social processes. The defined gender roles leave women depending on men. Women's dependence on men leaves them vulnerable to challenges affecting subsistent farming livelihoods (Dankelman, 2010). Poor resource base and inadequate information thwarts their potential in devising viable coping strategies.

2.5.2 Gender vulnerability and climate change

Climate change and variability impacts are not gender neutral (Terry, 2009). As such, adaptation strategies need to be gender sensitive (Denton, 2000). All adaptive strategies need to consider gender as an exclusive factor to avoid further exploitation of women. Embracing ‘one size fit all’ approaches in coping with extreme climate effects are disastrous, particularly to women. Vulnerability of women due to increase in climate change impacts is exacerbated by unbalanced arrangements of domestic and public social roles between men and women (Raty and Carlsson-Kanyama, 2009). Mainstreaming gender roles in social organization is the stepping stone towards achievement of gender equality.

In the climate change discourse, eco-feminists are the torch bearers in discussing unbalanced gender experiences between men and women (Dankelman, 2010). Women’s vulnerability context is traced from the existing social order which positioned them in farming and attention on demanding domestic roles (Raty and Carlsson-Kanyama, 2009). In farming, women are primary users of land. Occurrence of droughts and other disasters exposes them to higher demanding responsibilities such as food provision. Multiplying women’s responsibilities amidst extreme climatic conditions makes them permanent climate change refugees (Denton, 2000). As an alternative to failing farming, women spend more time interacting with the environment (Dankelman, 2010). The need for important household resources such as firewood, water, grass for thatching and wild fruits increases their burden. The more the environment is degraded, the more women are exposed to high demanding daily responsibilities. While women spend more time grappling with domestic chores, men are excused from participating in domestic work (Raty and Carlsson-Kanyama, 2009).

Scarce resources such as water and firewood cause unprecedented suffering on women in extreme dry conditions (Jotoafrica, 2011). Incremental trends on rain scarcity and excessive heat waves have multiplying effects on women’s workload compared to men. Drying of water sources such as rivers and aquifers implies double trouble for women. Cases of women travelling long distances to fetch water on foot are documented on studies conducted in sub-Saharan Africa. Rural women in Dodoma district of Tanzania travel long distances looking for domestic water (Terry, 2009). These incidences are also common in Epyeshona and Daures districts in Namibia (Jotoafrica, 2011). Adding water problems, scarce firewood strain women in rural communities. Absence of other sources of energy such as electricity, gas and solar increase women’s responsibilities in providing domestic power. Firewood problems are

worsened by deterioration of environmental quality due to excessive dry spells and over exploitation of forest resources (Terry, 2009). Over dependence on firewood and farming have serious effects on environmental quality (Terry, 2009). Notwithstanding the fact that degenerating environment increases social inequality, scarcity of resources causes outbreak of social conflicts over common pool resources such as pastures, water reservoirs and land boundaries have negative impacts on women's livelihoods (Dankelman, 2010). These negative impacts affect women in their efforts to fulfill routine duties amidst of climate disasters and social unrest.

Precarious climatic conditions affect women's productive and reproductive health (UNDP, 2005). The effects of harsh conditions have serious health problems to women than men. Prevalence of heat waves, excessive rain or lack of it exposes women to diseases such as malaria and sleeping sickness. UNDP (2005) revealed that pregnant women are more vulnerable to malaria than men. Women vulnerability is worsened by limited access to functioning health institutions such as clinics and hospitals (Denton, 2000; Dankelman, 2010). Shortages of efficient health facilities are causing high morbidity and mortality rates of women in sub-Saharan Africa (UNDP, 2005).

Alternative adaptation strategies such as migration are not common amongst many domestic rural women (Ossario, 2003). Moving from high risk areas is mainly a preserve for men. Women's limited mobility potential is caused by their inclination to the domestic sphere. Men as breadwinners escape from disaster prone areas to safer zones (Nhamo, 2003; Mtisi, 2010). Men's search of 'greener pastures' forces women to face disasters without the help of men (Mtisi, 2010; Nhamo, 2003). Evidence of disaster driven male migration are prevalent in Mozambique (Ossario, 2003) and Zimbabwe (Mtisi, 2010; Nhamo, 2003). Perennial occurrence of droughts and floods in Mozambique, and droughts and unemployment in Zimbabwe are the major push factors. Migrant men from Mozambique and Zimbabwe are in disaster free environments in South Africa and their women remain in countries of origin. The women are compelled to duplicate roles as mothers and fathers of the resident families (Ribeiro and Chauke, 2010). They are expected to benefit from migration through remittances. Adding problems to overburdened women, numerous incidences of non-remitting husbands have been cited (Ribeiro and Chauke, 2010; Ossario, 2003). Scenarios of non-remitting husbands are common in Mozambique. Ribeiro and Chauke (2010) expressed that majority of migrant husbands from Mozambique remit HIV and AIDS more than money to their resident

wives. These incidences expose women to danger than men. A combination of HIV and AIDS and precarious climatic conditions increases women's vulnerability to disasters (Dankelman, 2010; UNDP, 2005; Ribeiro and Chauke, 2010).

2.5.3 Women as actors and indigenous knowledge in climate change adaptation

Poverty differentials and vulnerability conditions between men and women requires different adaptation strategies (Rossi and Lambrou, 2005). Different adaptive strategies need to be based on accessible resources. For vulnerable smallholder women with limited assets adaptive strategies should be premised on natural capital and indigenous knowledge. Indigenous knowledge and social capital guarantee readily available solutions to vulnerable groups (Putman, 2000; Kolawole et al, 2014). Capitalizing on indigenous knowledge is profitable to women with more experience tapped from their interaction with the environment (Denton, 2000; Dankelman, 2010). Relying on women's indigenous knowledge receives a peripheral attention in main stream climate change policy debates (Rossi and Lambrou, 2005, Dankelman, 2010). Attempts to put women's indigenous knowledge on climate change policy agenda suffer an onslaught from pervasive patrimonial hegemony (Rossi and Lambrou, 2005). Conservative patrimonial regimes consider women as 'insignificant others'. To the contrary, eco-feminists encouraged adoption indigenous knowledge for gender sensitive adaptation (Denton, 2000; Terry, 2009). Women are the mainstay of indigenous knowledge due to their proximity to it. Women experiential knowledge born out of their interaction with the environment offers gender sensitive solutions compared to those of men (Dankelman, 2010). Women developed gender sensitive environmental agency from their daily negotiation with livelihoods challenges.

Embracing indigenous knowledge in adaptation reduces women vulnerability to complex disasters in agriculture (Rossi and Lambrou, 2005). Women indigenous environmental knowledge safeguards both the environment and its inhabitants (Ibid). These sentiments are reinforced by popular environmental idioms which refer to nature as 'mother earth' (Dankelman, 2010; Terry, 2009; Denton, 2000). The expression reveals an inseparable relationship between women and the environment. Endangering the environment is tantamount of harming women (Rossi and Lambrou, 2005). Women and the environment need mutual respect because they are both givers of life and sustainers of humanity (Dankelman, 2010; Rossi and Lambrou, 2005). Critics from eco-feminism reject embracing indigenous knowledge in climate change and variability adaptation (Dankelman, 2010). They

argued that reverting to indigenous knowledge endangers women. Arguments posed explain that indigenous knowledge is not separable from culturally driven solutions (Mapara, 2009). Cultural based solutions align men and women to unbalanced social roles which expose women to vulnerability more than men (Raty and Carlsson-Kanyama, 2009). They further argued that putting women closer to the environment in fulfilling domestic cultural arrangements offers no better options to their livelihoods (Dankelman, 2010). The division of labor leaves women vulnerable than women.

2.6 Social capital and adaptation to climate change impacts

2.6.1 The role of bonding, bridging and linking capital in coping with climate change impacts

In social capital discourse, social networking is explained under the three dominant axioms that are bonding, bridging and linking (Putman, 2000). Bonding, bridging and linking form strong bedrock for collectivism, trust and balanced reciprocity. These capitals are integral in safeguarding group interests than individualism (Coleman, 1990; Putman, 2000). In social networking capacity to adapt to disasters is realized if group members utilize all the three variables correspondingly (Woolcock and Narayan, 2000).

In bonding capital, closely knit groups and associations are brought together by homogenous socio-demographic traits (Szieter and Woolcock, 2004). The traits include family, culture, tribesmanship, ethnicity and race. These traits act as threads joining group members together. Relying on family members and other social associations is critical for adaptation (Putman, 2000). Collectivism offers social protection, stewardship and improved welfare for group members. Members who deserted their groups are vulnerable to disasters and have low coping and adaptive capacity (Coleman, 1990). Bonding relationships are common among the poor and vulnerable groups. Groups are usually formed as a strategy of coping with uncertainties (Putman, 2000). Figure 2.2 highlights how bonding capital is structured and operates. It shows horizontal relationships amongst different groups and how they provide reciprocity and trust in coping and adaptation.

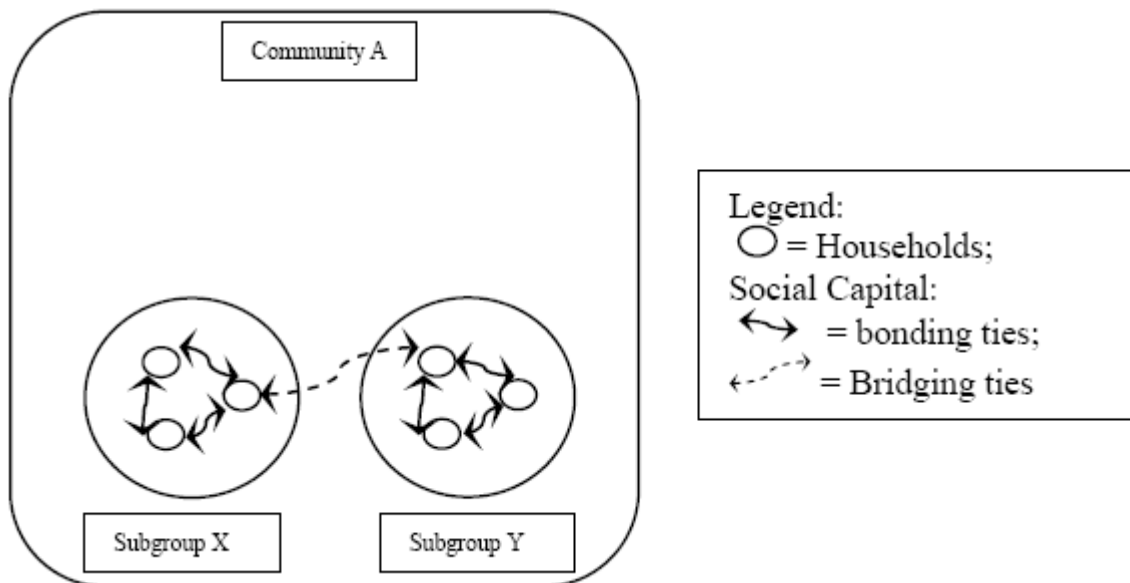


Figure 2.2: Bonding and bridging capitals. Adapted from Agrawal, 2008.

In smallholder agriculture, poor farmers collaborate in sharing labor and seasonal information as adaptive strategies (Szieter and Woolcock, 2004). Through farm groups and other associations, local farmers are able to deal with agricultural threats such as droughts, and environmental degradation. Bonding capital is a defense strategy which supports autonomous and planned adaptation against disasters threatening human livelihoods (Szieter and Woolcock, 2004). Smallholder farm groups and associations are common in many smallholder farming communities in Africa. Large numbers of farming groups are common in rural Kenya and Rwanda (Gugerty and Kremer, 2008). Local farmers are benefiting from unity as an investment for dealing with problems threatening their agro-based livelihoods.

On bridging capital, social networking extends to connections between different groups, villages and communities (Figure 2.3). Bridging relationships are facilitated by similar interests pursued by different groups. Different social groups share different natural capitals such as grazing lands, farm lands and water (Putman, 2000). Sharing of scarce resources is an adaptive strategy on its own. In smallholder farming, different groups, villages and communities depend on each other on sharing water reservoirs for livestock, pastures, markets and seasonal forecasting information (Agrawal, 2008). Mutual relationship amongst different communities, groups and villages facilitates sharing of unevenly distributed resources. Bridging capital and bonding capital strengthen adaptive capacity of vulnerable villages and communities (Putman, 2000).

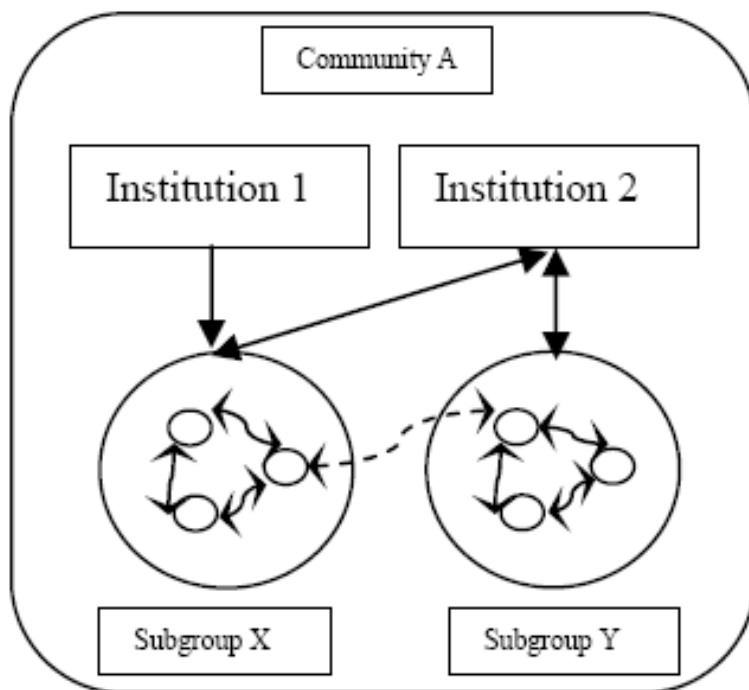


Figure 2.3: Showing bridging and linking capital. Adapted from Agrawal, 2008.

Wider connections and reciprocity have positive results on equal sharing of resources and important knowledge for adapting and coping with disasters (Agrawal, 2008). Villages and communities with organized bridging capital confront poverty and droughts without difficulties compared to disjointed groups. Bridging capital does not only help to respond to threats, but it allows interlinked members to maximize opportunities in good conditions (Putman, 2000). Functioning bridging capital is an exchange programs where new ideas are shared at horizontal scales. Collective efforts at intra and inter-communities reduce the potential outbreak of conflicts. Outbreak of conflicts coupled with disasters and scarce resources increases vulnerability of members to disasters (Agrawal, 2008; Putman, 2000).

Linking capital exists where connections are based on associations between villages, groups and communities with outside local institutions, donor agencies, organizations, government departments (Putman, 2000). The unity is there to fight disasters which threaten human life, property and livelihoods strategies. Partnerships of participating social actors reduce vulnerability to threats risks and hazards such as poverty, droughts and diseases (Putman, 2000). Linking capital provides in-groups or associations and community members with new ideas. Group, village and community members learn new ideas through attending training workshops, study tours, information exchange programs which are organized by outside

institutions (Njuki et al, 2008). Interactions of various social actors open avenues for coming in of new information. New information is tapped and internalized by locals who can use it for both planned and autonomous adaptation (Agrawal, 2008; Gugerty and Kremer, 2008).

Outside practitioners inject the important missing components which are critical in adapting to climate change disasters (Gugerty and Kremer, 2008; Dasgupta, 2003). Recourses such as financial capital improve local farmer adaptive capacity through buying technologies and other critical tools for adaptation. Collapsing of group and associations due to poor linking capital is a common phenomenon in Africa. Various cases have been observed in Kenya and Rwanda. Approximately 200 000 formal farm groups in were registered in Kenya, while in Rwanda 3000 were registered and 30 000 were informal farm groups. All these farm groups collapsed due to absence of linking capital (Gugerty and Kremer, 2008). Absence of external advice and financial capital led to the diffusion of the associations exposing members into vulnerability. Vulnerable communities with weak linking capital are only able to deal with idiosyncratic shocks (Dasgupta, 2003). Without external intervention from development actors and donor agencies, local farmers are unable to deal with systemic shocks such as poverty, droughts and other perennial climate change disasters.

2.6.2 When is social capital necessary in smallholder agriculture?

Agrawal (2008) expressed that social capital is critical amongst smallholder farmers for two reasons. First is the outbreak of unprecedented agricultural disasters and uncertainties. Second is when the state failed to provide livelihoods options to the vulnerable groups. Turning to social capital remains a priority for vulnerable groups in devising sustainable coping and adaptation mechanisms (Adger, 2003). Although social capital is integral in adaptation, integrating it with local institutions speed the rate of coping and adapting to risks and hazards (Adger, 2003; Agrawal, 2008). Furthermore, local institutions fill the vacant roles left by inept governments (Adger, 2006). Communities with strong bonding, bridging and linking capital are better positioned to interpret, share information and their experiences on climate change disasters (Chang'a et al, 2010). Sharing information and experiences of climate change on vertical and horizontal scales is critical for building resilience and adaptation (Bemier and Meinze-Dick, 2014). Grassroots-based relations also help in transferring the tried and tested indigenous knowledge (Chang'a et al, 2010; Roncoli et al, 2002).

Mutual co-operation between communities and local institutions have positive influence on adaptation (Agrawal, 2008). In reinforcing the potential of resilience and adaptive capacity, collaboration between community, local institutions and government is advised (Adger, 2003). The role of government is to create an enabling environment through formation of robust policy frameworks and adaptation strategies. Policy frameworks which incorporate indigenous knowledge are more acceptable in building sustainable adaptive capacity (Agrawal, 2008). Absence of functional adaptive policy frameworks exposes majority of smallholder farmers to multiple climate change disasters.

2.6.3 Challenges of social capital in coping with climate change disasters

Despite positive benefits of social capital in adaptation, critics expressed that benefits need not to be over romanticized (Di Gregorio et al, 2012). The major problem is that it is difficult for vulnerable groups concurrently possess bonding, bridging and linking capitals. Studies revealed that bonding and bridging capitals are common amongst smallholder farmers (Bemier and Meinze-Dick, 2014). Linking capital is not always available to farmers yet it is critical in bringing technology, financial capital and new knowledge (Ibid). Help from outside actors improves local farmer adaptive capacity. During droughts, vulnerable farmers receive food aid during severe droughts from donor and non-governmental organizations (Di Gregorio et al, 2012). Many farmer groups and communities without external connections have low adaptive capacity.

Differences in social classes or stratus are among stumbling blocks to effective of collectivism amongst farmers (Gugerty and Kremer, 2008). Socio-economic variables such as gender, ethnicity, and poverty are central in fostering separatist and exclusionary motives (Di Gregorio et al, 2012). Separatist motives retard the potential of collectivism in adaptation. Climate change and variability disasters have severe effects on disintegrated farmers (Woolcok and Narayan, 2000). Farmers in this condition are incapacitated to autonomously adapt to culminating climate change risk.

2.6.4 Juxtaposing social capital and indigenous knowledge systems in climate change adaptation

Features of social capital and networking are rooted in dealing with economic development, poverty reduction and adapting to climate change impacts (Woolcock and Narayan, 2000). Dasgupta (2003) expressed that social capital alone is not sufficient in facilitating farmer

coping and adaptive capacity against climate change risk. There is need for social capital to be diffused with indigenous knowledge in building farmers resilience and adaptive capacity. Incorporating local social platforms in climate change adaptation is getting recognition ahead of pro-scientific approaches in climate change discourses (Adger, 2003). Integration of social capital and indigenous knowledge is gaining momentum in climate change discourses (Dasgupta, 2003). A combination of the two variables is hailed for providing socially and locally appropriate adaptation strategies against vagaries of climate change. Indigenous knowledge and social capital offer acceptable coping and adaptive solutions entrenched in the environment of the vulnerable communities (Ibid). Furthermore, they strengthen local moral fabric and cohesive relations which provide sustainable resilience. Outside interventions which do not incorporate social capital and indigenous knowledge face eventual collapse (Dasgupta, 2003).

2.7 The role of local institutions and indigenous knowledge in building resilience and strengthening adaptive capacity

2.7.1 Understanding local institutions

Agrawal (2008) defined local institutions as human created formal and informal mechanisms that influence social and individual expectations, interaction and behavior. Furthermore, Jones et al (2010) points out that institutions encompass a wide variety of phenomenon which includes tangible government structures and rules that shape human behavior. Local institutions are classified into three broad categories which are public, private and civic institutions (Agrawal, 2008). Apart from these categories, they are also classified as formal and informal institutions. Categorization of local institutions is based on their forms and function. Formal institutions refer to the well-structured entities that are governed by formal rules, regulations, constitution and laws (Agrawal, 2008). This category encompasses all the public and private institutions. Informal local institutions are unregistered social entities that exist at community level (Vincent, 2010). Informal institutions are a result of social interaction and local associations. Survival of informal local institutions is entrenched on local people's behavioral practices, cultural norms, and other traditional associations (Agrawal, 2008). Common informal local institutions include indigenous groups such as farm groups, burial societies inter alia.

Local institutions are gaining prominence as key drivers of community based development and adaptation to disasters (Agrawal, 2008). Most local institutions operating in rural areas are critical in injecting capital which boost local communities' resilience against climatic and non-climatic disasters (UNSDR, 2009). Furthermore, local institutions are stimulating confidence in management of common pool resources such as fisheries, pastures, forest resources and water. Importance of local institutions is supported by their diverse shapes and functions (Agrawal, 2008). Multiple functions of local institutions are critical in reducing vulnerability amongst victims at the same time boosting their adaptive capacity (Agrawal, 2008). Ellis (2000) expressed that local institutions have three functions which are:

- Structuring the impacts of vulnerability.
- Mediating between the individual and collective responses climate change impacts and shaping the result of adaptation.
- Acting as conduits for delivering external resources that facilitate adaptation processes

2.7.2 Types of and functions of local institutions

According to Agrawal (2008), public institutions include government departments such as agricultural extension services. These departments work direct with communities in mobilizing resources, disseminating information and making vital decisions. Above departments, there are ministries which have the mandate of formulating laws and policies which informs participation of local communities and institutions. The mandate allows the government to superintend all strategies which facilitates capacity building and development (Vincent, 2010). Secondly, civic institutions include both formal and informal categories at various social levels. In most cases they are informal. The list includes village development committees, women's organizations, church groups, farmer groups, small scale credit schemes, co-operatives and youth clubs. These social groups inform resilience and adaptation at a lower level (Agrawal, 2008). Lastly, there are private institutions such as nongovernmental organization (NGOs), charity groups and voluntary associations. NGOs play two important roles in building local adaptive capacity and resilience. They strengthen adaptive capacity by injecting financial capitals inform of aid, loans and insurances (Agrawal, 2008). Availability of financial resources such as credit schemes and insurances act as reinforcement to adaptation amongst poor and vulnerable communities. Also noted is the fact private local institutions can assist local through activism. Through activism, some institutions

may lobby to governments and producing companies to reduce greenhouse gases and environmental degradation (Vincent, 2010).

Efforts made in understanding the structures, form and functions of local institutions showed a lot of ambiguities and diversity (Ellis, 2000). Local institutions have different roles in the disaster reduction and management. The difference in form and size of local institutions also determines their level and scale of operation (Agrawal, 2008). Smaller local institutions are preoccupied with working at community level whilst bigger ones extend to regional and national scales (Vincent, 2010). Diverse in shapes and functions of local institutions is a strategic arrangement critical in covering complex disasters affecting individuals, households and communities.

Central to the diverse sizes and responsibilities of local institutions is horizontal and vertical collaboration between them. Agrawal (2008) pointed out that co-operation between formal and informal local institutions determine the direction and speed of adaption to threatening disasters. The bonding, bridging and linking processes amongst the trio (community, institutions and natural resources) facilitates success and acceptability of climate change resilience and adaptation strategies (Ellis, 2000). Success stories of collectivism are determined by local institutions' possession experiential knowledge, financial resources, information, technology and excellent management skills in both natural and man-made disasters (Adger, 2003). Adaptation to climate change impacts is enhanced by the local institutions' in-depth knowledge and experience in the management of weather dependent resources and related disasters.

Communities with functioning local institutions are able to deal with disasters on horizontal and vertical scales (Agrawal, 2008). Figure 2.4 shows a diagrammatic explanation on the functions of local institutions in informing coping strategies and adapting to disasters. Main functions of local institutions are tallied with a pool of adaptive options available for vulnerable families, social groups and communities (WRI, 2014). As highlighted on Figure 2.4, efficiency of local institutions is necessitated by availability of information, sound financial base, technology and good leadership. Smooth operation of these facets is integral in informing acceptability of intervention strategies by locals. Equally important is co-operation amongst the local institutions in fighting disasters (WRI, 2014). Absence of coordination

between local institutions limits the potential of building sustainable resilience and adaptive capacity of smallholder farmers.

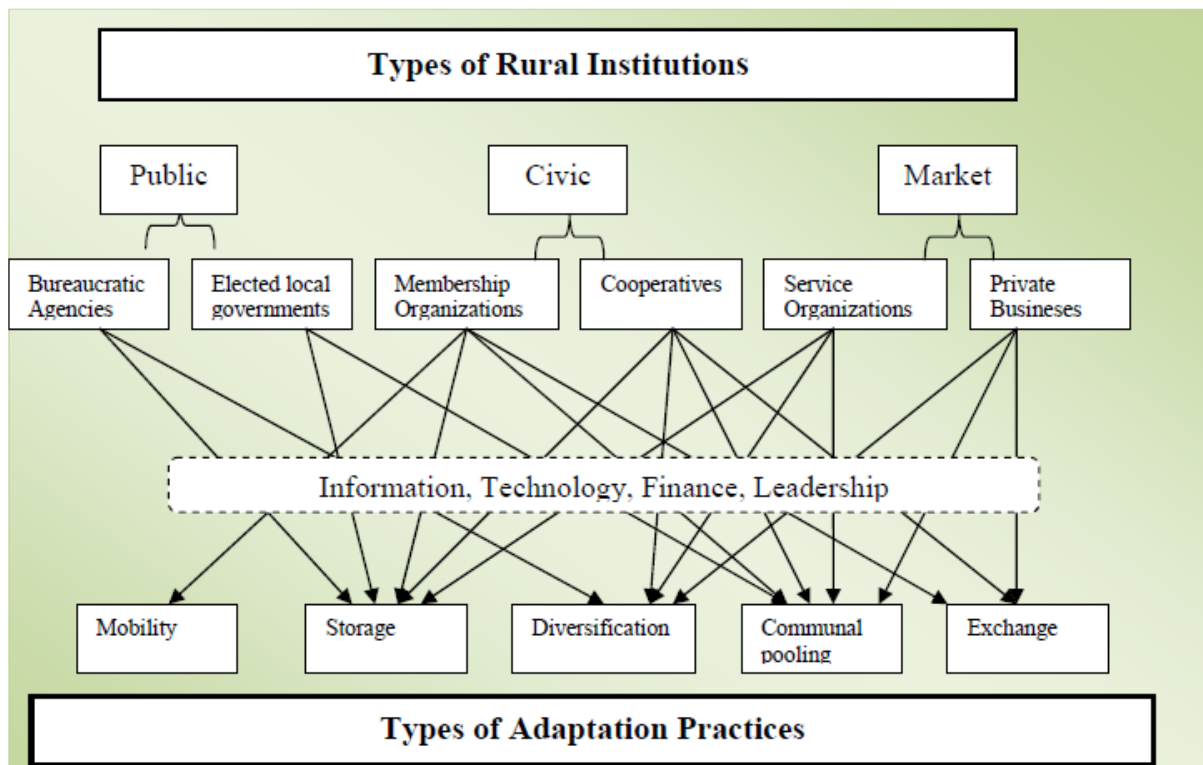


Figure 2.4: Institutions and adaptation. Adapted from WRI, 2014

2.7.3 Local institutions and community adaptation to environmental and climate change disasters

Formal and informal local institutions are crucial in shaping models of adaptation on environmental and climate challenges at local levels (Pasteur, 2011). Availability of local institutions creates the enabling environment for building resilience and adaptive capacity of vulnerable groups (Vincent, 2010). Local institutions connect farmers with their local resources as the starting point of adaptation (Ellis, 2000). In Kenya, Practical Action helped local pastoralists in engaging in dialogue to end long term conflicts over grazing pastures (Pasteur, 2011). The collective participation from the dialogue brought harmony in their restocking processes. The restocking process reduced further conflicts and competition over grazing pastures. Elsewhere, in Nepal, Practical Action assisted local farmers in renting land on long term basis than before (Pasteur, 2011). Local farmers recorded high yield output as well as adoption of sustainable soil conservation strategies. Involvement of locals in adaptation

strategies which are in harmony with their natural resources and knowledge creates positive attitudes and interest towards their participation (Ellis, 2000).

Collaboration between local institutions and locals is important in informing sustainable resilience and adaptation to disasters (Vincent, 2010). In Zimbabwe, Practical Action collaborated with both the local communities in Gwanda and other local institutions to reduce vulnerability amongst smallholder farmers hard hit by droughts (Pasteur, 2011). Locals' voluntary participation aided much to success stories in managing even slow onset disasters such as veld fires (Pastuer, 2011). Local farmer participation created sustainable coping and resilient measures against disasters. Conflicts between local institutions and community members derail adaptive efforts and preparedness in fighting future disasters (Ellis, 2000; Pasteur, 2011). In India, institutional support helped local communities in Chitradurga in adapting to climate change and non-climatic disasters compared to Anantapur communities where absence of local institutions and innovative technologies left local farmers vulnerable (O'brien et al, 2004).

Absence of local institutions is detrimental to vulnerable communities' adaptation (Ellis, 2000). Lack of appropriate agricultural and non-farm technologies and information by the poor farmers precludes them from embracing viable adaptive alternatives (Pasteur, 2011). New technology is crucial if combined with local initiatives in predicting disasters and adapting to them (Ellis, 2000). Absence of institutional support in Kenya saw the collapse of more than 200 000 community groups in 1996 (Gugerty and Kremer, 2008). Lack of support from private institutions weakened the farmer groups' collective efforts against droughts.

Despite the importance local institutions in adaptation, it still remains the government's responsibility to ensure their success (O'brien et al, 2004). Local institutions are supposed to help the governments in difficult times rather than taking a leading role. Governments have the mandate to ensure that their people have the capacity to deal with disasters affecting their livelihoods (Vincent et al, 2010). Governments can achieve this through the formulation of enabling policies and legal frameworks (O'brien et al, 2004; Vincent, 2010). Policies should support local farmers and institutional efforts in coping and adapting to climate change shocks and stresses.

Central to the successful operations of local institutions is the smooth relations between the government and local communities (O'Brien et al, 2004). In Sudan, the relationship between local farmers and extension services department allowed quick attention to disasters such as locusts and pests outbreak which were affecting agricultural output (Pasteur, 2011). The government's swift intervention with modern pest control mechanisms ensured good harvests. The intervention was accepted by local farmers because it supports crop farming and animal husbandry which are their main livelihood strategies.

Calls for networking and partnerships amongst local institutions, communities and government are gaining momentum in managing climate change and environmental problems (Ellis, 2000). On the international platform, institutional collaboration is also encouraged by the global Sustainable Development Goals (SDGs). Availability of horizontal and vertical partnerships is critical in building resilience and innovation in managing climate change disasters (Agrawal, 2008). In Ghana, collaboration between Catholic Relief Agency (CRA) and Adventist Relief Agency (ADREA) reduced smallholder farmer vulnerability to drought. A mutual relationship between the local institutions facilitated flowing of extension services, credit schemes and farming inputs to local farmers (Vincent, 2010). In Morocco, co-operation between formal and informal institutions improved adaptive capacity of poor farmers in mountainous Tabaut community. Collaborative relationships between the Zimbabwean government's various departments, local institutions and communities are critical in improving livelihood chances (Frost and Bond, 2008). Locally formed and managed CAMPFIRE (Communal Areas Management Programs for Indigenous Resources) projects are bringing diverse institutions and local people together in conserving forests and wild life (Frost and Bond, 2008). The links between the government, National Parks, Rural District Councils, NGOs and informal institutions is benefiting many vulnerable communities. Local smallholder farmers are having alternative survival strategies such as sharing of proceeds from wild life and environment. The interaction is an adaptive strategy amid of failing agriculture. Participants in various CAMPFIRE projects benefited basic amenities such as schools, clinics and money (Frost and Bond, 2008).

2.7.4 Local institutions, indigenous knowledge and adaptation

Successful institutional intervention needs to be premised in line with local people's indigenous knowledge beliefs (Ellis, 2000; Roncoli et al, 2002). Incorporating indigenous knowledge in coping and adapting to climate change is gaining momentum amongst local and

international institutions (Gorjestani, 2004). World Intellectual Property Organization (WIPO), Food and Agricultural Organisation (FAO) and World Health Organisation (WHO) are in the forefront of encouraging inclusion of local knowledge in adaptation. These international institutions are calling governments to take the lead in encouraging mutual relationships between local communities and local institutions. In Uganda, the National Council of Science and Technology through the Kampala Declaration of Indigenous Knowledge for Sustainable Development included indigenous knowledge in its Poverty Eradication Action Plan (Gorjestani, 2004). Similarly, in South Africa, various public institutions facilitated the inclusion of indigenous knowledge in policies of resilience and adaptation (Government of South Africa, 2004).

Institutional support with divergent interests increases local farmers' vulnerability to disasters (Agrawal, 2008). Studies carried in different places confirmed the importance of indigenous knowledge in adaptation to disasters (Ibid). Inclusion of indigenous knowledge in adaptation reduces the influence of retrogressive forces and conflicts between what local people are accustomed to and new adaptive strategies (Gorjestani, 2004). The rejuvenation of *ngitiliti* (indigenous word collectivism) by the Ministry of National Resources and Tourism in Tanzania facilitated the collective responses in repairing the degraded environment (Agrawal, 2008). Participation of the local Sukuma people quickened the restoration of barren land back to life. Success of the project improved local farmers' livelihood chances against climate change and environmental disasters. Similarly, in Nepal, participation by local farmers was successful in reducing vulnerability because adaptive strategies brought by local institutions were congruent with their cultural practices.

2.8 Conclusion

The reviewed literature identified various types, degrees of vulnerability and adaptive capacity across many poor smallholder farming communities. Vulnerabilities were scrutinized from wide spectrum including those from climate change and non-climate change disasters. The advantages of relying on indigenous knowledge in reducing vulnerability and building adaptive capacity were unpacked. There are gaps pointing to the lack the linkages on social capital, local institutions and indigenous knowledge in building resilience and adaptive capacity particularly amongst smallholder farmers. In overall, the review identified that sustainable adaptation needs a holistic approach so as to open new avenues on how indigenous

knowledge can be utilized in reducing vulnerability amongst smallholder farming communities.

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CHAPTER 3

SMALLHOLDER FARMERS' VULNERABILITY TO CLIMATE CHANGE AND VARIABILITY IMPACTS

Abstract

This chapter focused on the smallholder farmer vulnerability to complex climate change and non-climate change hazards and risks. Smallholder farmer vulnerability is determined by their ability or inability to cope and adapt to risks and shocks. Data was collected using questionnaires, focus group discussions and key informant interviews. Results show that smallholder farmers, particularly women and the elderly, are vulnerable to drought, loss of livestock and diseases. Vulnerable farmers face serious food insecurity. The worst affected smallholder farmers have low adaptive capacity due to poverty and lack of livelihood assets. Local farmers do not prioritize indigenous knowledge systems and social capital to adapt to climate change and variability. In many cases they improvise adaptive strategies that exacerbate their vulnerability rather than enhance adaptation. Strategies such as selling livestock and migration do not always offer them sustainable adaptive options. On the other hand, intervention by local institutions created the dependency syndrome amongst drought stricken smallholder farmers. Furthermore, factors such as political relations, weak social capital and poor topographic characteristics are negatively affecting the full functioning of local institutions. It is concluded that vulnerability is caused by many factors and there is need for planned decisions to build local farmer adaptive capacity.

Key words: Vulnerability, resilience, adaptation, dependence syndrome, indigenous knowledge, social capital.

3.1 Introduction

Climate change and variability are a menace to contemporary livelihoods (IPCC, 2007). The worst affected global countries are those found in precarious ecological zones (Huq and Ayers, 2007). Most vulnerable countries are found in Africa. Africa's vulnerability is worse despite its minimal participation in the ozone layer depletion (IPCC, 2007). Majority of smallholder farmers in Africa are poor and vulnerable to effects of climate change and variability (Chagutah, 2010). Vulnerable farmers have low adaptive capacity.

The concept of vulnerability is gaining prominence in climate change debates and policy frameworks (Vincent, 2010; Davies, 2011). Local farmer vulnerability is determined by many factors such as poverty, politics and economic conditions (Vincent, 2010). These factors are critical in determining adaptation at individual, household and community levels. Local farmer adaptive capacity can also be determined by possession of important livelihood assets (IPCC, 2007). Assets offer plenty of options in coping and adapting to climate change risk

(Vincent, 2010). The majority of smallholder farmers located in arid and semi-arid ecological zones have weak adaptive capacity (Vincent, 2010; Davies, 2011). In southern Africa, smallholder farmers are vulnerable to climate change disasters due to overdependence on rain-fed agriculture (IPCC, 2007; Davies, 2011).

Reducing vulnerability is possible if correct assessments are done at specific levels and conditions (Davies, 2011). Successful assessments are supposed to be done at an individual, household and community levels. Insights from these three categories are best indicators on the degree, exposure and sensitivity of disasters (Vincent, 2010). Failure by vulnerable groups in adapting to climatic changes is disastrous to both human life and livelihood assets (Davies, 2011; Mogoi et al, 2010; Vincent et al, 2008).

Against this background, this study interrogated local farmer vulnerability to climate and non-climate risks and hazards. It scrutinized individuals, households and community's exposure to social, biological and physical vulnerabilities. The vulnerabilities are squared off against their capacity to cope and adapt to disasters such as droughts. The chapter identifies and analyzes various adaptive strategies adopted by local farmers in responding to climate change shocks and stresses. Lastly, it examined local farmers' use of indigenous knowledge, social capital and local institutions in reducing vulnerability.

3.2 Materials and methods

Both probabilistic and non-probabilistic sampling techniques were used to select respondents. Three wards in Bikita, ward 20, 21 and 24, were purposefully selected for this study. Wards 20 and 21 are found in agro-ecological region IV (four) with semi-arid characteristics. These two wards have similar soil types, tree species and other topographic characteristics. Ward 24 which is found in agro-ecological region V (five) has arid characteristics. The reason for inclusion of ward 24 was to give a cross comparison on adaptation strategies used by farmers with different rainfall patterns. The study squared off indigenous knowledge and adaptive strategies used in the three wards against the background that ward 24 are product of resettlement. Combining the three wards provided rich ground for comparing similarities and differences considering differences in background of farmers and ecological characteristics.

After purposive selection of wards, the names of all villages in each ward were recorded as provided by the ward councilors, village headmen and extension service officers. Ward 20 had 45 villages, ward 21 had 26 villages and ward 24 had 15 villages. Despite the three wards having different number of villages, three participating villages were randomly selected from each ward. The decision of selecting three villages in each ward was based on two reasons. Firstly, all farmers in the three wards have similar cropping systems, similar soil types and vegetation and secondly financial limitations. Lack of adequate research resources limited the numbers of participating villages and households. Furthermore, similarities in soils types and vegetation also represent similarities in indigenous knowledge seasonal forecasting indicators and this pushed me to reduce the need for more villages.

From the selected villages, households in each of the three selected villages of each ward were listed. From the listed households, ten households were selected from each village making a total of thirty participants from each ward. Selection of ten households per village was influenced by financial challenges, similarities in cropping behaviors and similarities in soil types, tree species and other topographic characteristics. The process of purposive selection and random selection of participants was repeated across other two wards. All the selected participants selected in this category answered the questionnaires. Three research assistants in helped in administering questionnaires. The study was carried out in six months.

On focus group discussion (FGD) both men and women were selected as participants who were drawn from the household lists prepared for those that participated in the questionnaire. Three focus group sessions were purposely done in each of the selected villages. Each focus group discussion had twelve participants of which six were male and the six were females. Participants were randomly selected. The rigorous process of selecting focus group discussion participants was repeated across all the three wards. Different key informants were selected based on their positions and knowledge they possess in farming and smallholder farmers' vulnerability and adaptation to climate change disasters. Unstructured interviews were used in collection of data key informants. Table 3.1 summarizes the breakdown of purposively selected key informants.

Table 3.1: Number of key informants of the study

One CARE International programs officer – the programs officer operating in the three wards confirmed that CARE International’s involvement in reducing local vulnerability through building coping and adaptive strategies against multiple climate change risks and hazards
One SAT programs officer - the officer operating in the three wards provided detailed information on smallholder farmers’ vulnerability and also highlighted many adaptive strategies they provide in fighting disasters such as droughts and diseases.
One PLAN International programs officer - One programs officer operating in the three wards reflected that they work in collaboration with the Department in the Ministry of Social Welfare in reducing smallholder farmers’ vulnerability and build resilience against climate change risks and hazards.
One representative from the Ministry of Social Welfare - He confirmed working with some NGOs in the three wards in reducing local farmers’ vulnerability to disasters affecting their farming livelihoods.
Three extension services officers - extensions services officers drawn from each ward confirmed that local farmers are vulnerable to due to extreme weather and seasonal conditions and poor topographic conditions. These conditions affect their agro-based livelihoods
Three ward councilors - ward councilors confirmed the areas as vulnerable to droughts and diseases. They also highlighted their collaboration with local leadership and NGOs in reducing local farmers’ vulnerability and enforcing adaptive strategies.
Nine Village headmen - village heads were drawn from nine villages which were selected from the participating three wards. They expressed that most local farmers are vulnerable mainly to droughts and diseases affecting both human beings and livestock. They also highlighted working with local NGOs coping and adapting with disasters.

3.3 Study area

Bikita is one of the seven administrative districts in Masvingo province in Zimbabwe (Figure 3.1). The other six districts are Zaka, Gutu, Mwenezi, Chiredzi, Chivi and Masvingo urban. Bikita District is located 80 km east of Masvingo city and 377.9 km from Harare. It lies about 656 meters above sea level. Bikita district is dominated by the Karanga people of the Duma totem. The Karanga people depend on mixed subsistent farming.

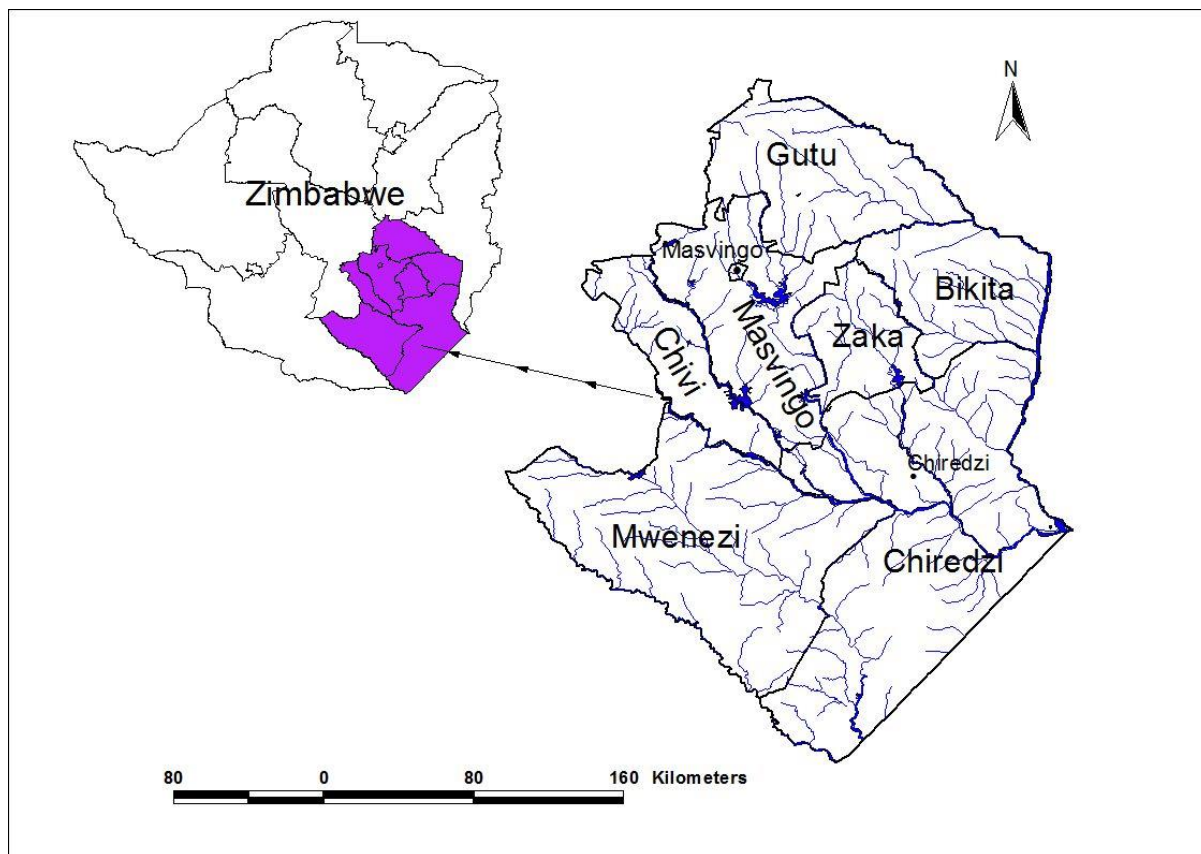


Figure 3.1: Map of Bikita district. Extracted from Chikodzi et al (2013).

Most parts of Bikita are found in arid and semi-arid belt with poor topographic characteristics. Most farmers' dependence on rain fed agriculture increase their vulnerability to perennial to droughts. Farmers grow small grains such as rapoko, millet and sorghum. Growing small grains is an adaptive strategy against harsh seasonal conditions. Harsh conditions limit cultivation of maize, the staple cereal. Apart from small grains, groundnuts are cultivated for commercial reasons despite serious market challenges. Domestic animals such as cattle, donkeys, goats and sheep are common. Domestic animals save two main functions. Firstly, bigger livestock such as cattle and donkeys are used as source of draught power. Secondly, they are used as safety nets during disasters. Farmers sell domestic animals in coping with disasters such as droughts. Apart from selling livestock in coping with disasters, majority of vulnerable farmers depend on food aid from local institutions. The main food donors are NGOs and government's Ministry of Labor Social Welfare. Furthermore, local farmers adapt to disasters through migration to big cities and working in irrigated commercial farms in Chipangayi, Chipinge, Middle Sabi, and Birchneough.

3.4 Results

3.4.1 Sources of smallholder farmers' vulnerability in ward 24

Results from the selected respondents in ward 24 showed different types of vulnerability amongst local farmers. Varying typologies of vulnerability were provided by responses drawn from focus group discussion, key informant interviews and questionnaires. Information obtained from questionnaires indicated five climatic and non-climatic causes of vulnerability. (Figure 3.2). The mentioned climatic and non-climatic disasters reduce their capacity to cope and adapt to challenges affecting agro-based livelihoods strategies.

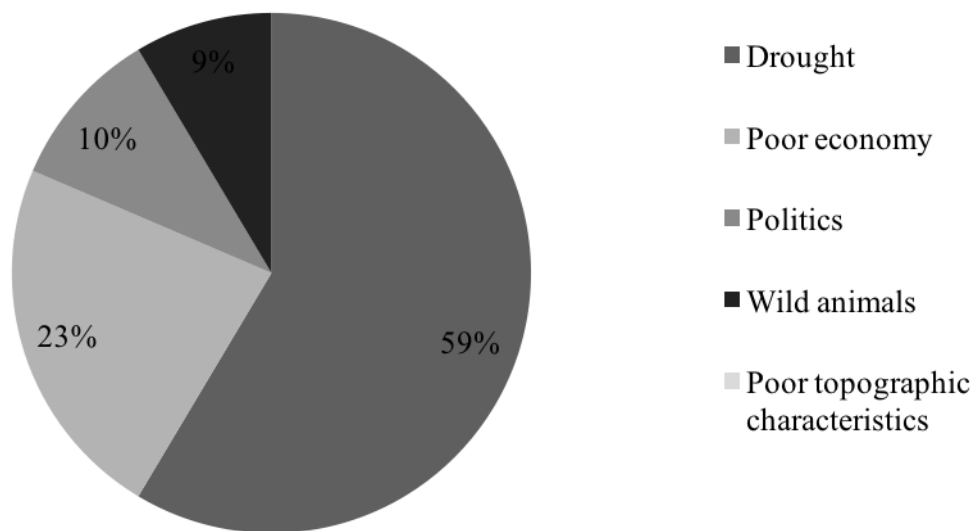


Figure 3.2: Various sources of vulnerability. Source: Field work questionnaires, 2015.

Statistical comparison from the pie chart showed a significant difference between drought and other four sources of vulnerability. Drought is the main disaster affecting majority of smallholder farmers. Detailed explanation on causes of local farmers' vulnerability was provided by focus group discussions. Smallholder farmers explained that low amounts of rains are affecting both crop and animal production. They pointed out that bad topographic conditions such as poor soils types and dry weather and seasonal conditions are negatively affecting their agro-based livelihoods. The dry weather and seasonal conditions are affecting animal and crop production leading to serious food insecurity. Summarized information on causes of vulnerability drawn from focus group discussions is shown in Box 3.1.

Box 3.1: Non-climate change factors which increases local farmers' vulnerability

Poor performing economy – majority of farmers confirmed the poor performing economy is affecting them in accessing credit schemes to buy early maturing seeds, modern technology to cope and adapt to disasters. Poor economy is affecting government's role in providing the needed financial help to vulnerable smallholder farmers.

Politics – hostile political relations amongst local farmers is affecting full operation of farm groups and other associations which are critical in reinforcing collective efforts in fighting disasters such as droughts. Political belonging is affecting operation of NGOs. It is also affecting the distribution of food aid on supporters from opposition and ruling parties.

Wild animals – wild animals such as elephants, baboons, monkeys, quelea birds are a serious threat to small grains. Animals such as lions and hyenas and wild dogs which usually break from adjacent Devure Range are a serious threat to livestock.

Diseases – farmers pointed out that diseases such as malaria and HIV and AIDS are increasing their vulnerability on top of other disasters. Lack of money and functional clinics and hospitals is causing serious threats to human life and their livelihoods strategies.

Information from key informant interviews confirmed local farmers' vulnerability to different climate change and non-climate change disasters. Through in-depth interviews, key informants revealed that the risks and hazards are negatively affecting their livelihoods. Box 3.2 shows different key informants' reflections on local farmers' vulnerability and adaptive options to disasters.

Box 3.2: Key informants' views on local farmers' vulnerability

Village heads – Nine village heads confirmed that their areas are prone to droughts and wild animals which affect local farmers' crop and animal production. Local farmers' poverty limits their ability to cope and adapt to disasters. They confirmed working with local councilors, district administrators and NGOs in coping and adapting to disasters.

Ward councilor – confirmed that the ward is exposed to serious disasters which affect agriculture. Local farmers need food aid and other projects from the government and donors to sustain their livelihoods.

Extension services officer – he confirmed that poor topographic conditions and climate change are extremely affecting both crop and animal production amongst smallholder farmers in ward 24. Local farmers need financial assistance, on time and reliable weather and seasonal information to help them in reducing their vulnerability to droughts.

Care International Programs officer – confirmed that local farmers in ward 24 are vulnerable to perennial droughts. He explained that they give them food aid through VGF (Vulnerable Group Feeding) projects. Political tension between supporters from the two political parties Zanu PF and MDC is hindering the success of sustainable self-help projects which reduces vulnerability to disasters.

SAT Programs Officer – he confirmed similar information regarding local farmers' vulnerability and their intervention. He acknowledged the challenge of political conflicts and how they affect their operations.

PLAN International Programs officer – the officer confirmed local farmers' vulnerability to droughts and diseases. Like other NGOs in the area, he reflected food aid as the main coping strategy they offer to vulnerable households. PLAN International works partnership with the Ministry of Social Welfare in identifying vulnerable households as well as giving them food handouts.

Ministry of Social Welfare representative – the representative confirmed the partnerships between the ministry and NGOs in providing food aid. He further explained that financial limitations are affecting the government to introduce sustainable projects for adaptation.

3.4.2 Impacts of disasters on livestock and crop production

As indicated above, information drawn from questionnaires and focus group discussion showed that livestock are an important asset for local farmers. The information showed that

goats, cattle and donkeys are the domestic animals kept in many households. Through focus group discussions, local farmers pointed out that around year 2000, there were more goats than cattle and donkeys. (Figure 3.3; $P \leq 0.05$). They preferred goats because the seasonal and environmental conditions were favoring goat production ahead of other livestock. Participants in the focus group discussions complained that owning more goats was less helpful in coping with disasters such as droughts and Cyclone Eline which occurred in 2000. It was expressed that proceeds from goats are far less below households needs in coping and adapting to disasters to droughts.

Focus group participants explained that continuous deterioration of the seasonal conditions is affecting goats and cattle production than donkeys. They explained that cattle are more vulnerable to droughts and they die in large numbers every year. On the same note, cattle are also vulnerable to wild animals such as lions and hyenas which frequently break from Devure Range. As a result, local farmers are keeping more donkeys and goats than cattle. During the time of research between 2015 and 2016, donkeys were more than other animals due to their resilience to harsh weather and seasonal conditions. Participants in focus group discussions complained that donkeys are less valuable in coping with droughts because their market value is very low compared to that of cattle.

Information obtained from focus group discussions concurred with the data collected from questionnaires. Questionnaires showed an evolving trend where extreme seasonal conditions were determining livestock's vulnerability and adaptive capacity to harsh seasonal conditions. Figure 3.3 shows respondents' views livestock vulnerability over long periods of time.

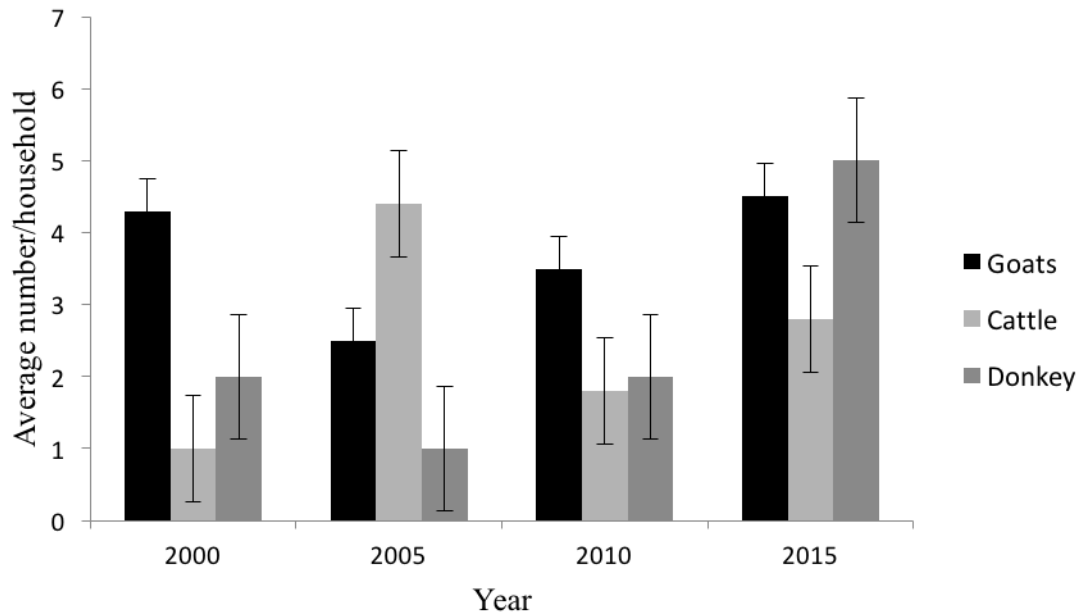


Figure 3.3: Average number of livestock kept by smallholder farmers. Source: Field work questionnaires, 2016.

Information gathered using questionnaires revealed that wild animals are such as elephants, baboons, monkeys and quelea birds are a serious threat to crop production. A follow up through focus group discussions highlighted that the area’s proximity to mountains and Devure Range pose a threat to crops. Farmers are finding it difficult to control wild animals that feed on their yields. Apart from animals, frequent visits by quelea birds from neighboring Chipangayi and Middle Sabi farms pose a serious threat to their small grains such as millet, rapoko and sorghum. Participants in the focus group discussions expressed that wild animals increase their vulnerability to food insecurity even during favorable seasonal conditions.

3.4.3 Strategies of reducing vulnerability by smallholder farmers

Data collected using questionnaires and focus group discussions showed that agriculture is the main livelihood source for the smallholder farmers. The increase in climate change risk has forced them to improvise wide ranging adaptive strategies. The observed adaptive strategies include migration, piece jobs, selling assets and engaging local institutions. Participants in the focused group discussions expressed that the adaptive strategies are not similar between men and women. Box 3.3 highlights a summary of various strategies that are employed by local farmers in adapting to climate change disasters.

Box 3.3: Adaptive strategies employed by local farmers

Piece jobs – able boded farmers engage in piece jobs as a coping strategy to disasters with droughts. They work in other farmer’s fields or performing any available task to earn money or food. The money used to buy food or other important household basics. Elderly farmers do not rely on this strategy due to physical disabilities.

Migration – common among able boded male farmers. During disasters, mostly males migrate to near and distant places seeking for wage labor and food. For food, local farmers visit near commercial farms and irrigated places in Chipangayi, Middle Sabi, Birchneough and Chipinge. Some go to urban areas such as Harare, Mutare, Chiredzi and Masvingo. They remit money to cover risks and disasters faced back home. Women’s migration as any adaptive strategy ends in near places and they are not permanent than those of men.

Selling assets – local farmers with assets such as livestock sell them as a coping strategy to droughts, health problems and other important basics. Cattle and goats are important sources of income during difficult times. Selling livestock assets increase their vulnerability to perennial disasters.

Food aid – food handouts from local institutions is a survival strategy which farmers depend on during severe droughts. Local farmers confirm that most vulnerable people such as widows, orphans, elderly and poor farmers without assets are the main beneficiaries of food aid from NGOs. They pointed out that food aid is not permanent but a temporal solution.

Engaging in community projects – Most local farmers participate in small community projects which are spearheaded by NGOs. Observed projects in ward 24 are high breed goat projects which was aimed to boost farmers’ goats which high quality goat breed. Other failed small-scale projects are community gardening, credit schemes and burial society.

Complimenting data shown in Box 3.3, smallholder farmers’ responses from questionnaires showed adaptive strategies are not similar between men and women. Figure 3.4 shows the participation of farmers in various adaptive strategies. Apart from agriculture being the main survival strategy, farmers mainly depend on food aid in coping up with droughts. Women are the main beneficiaries of food aid due to their domestic roles. Women’s domestic duties limit their ability to engage in adaptive strategies like those employed by men.

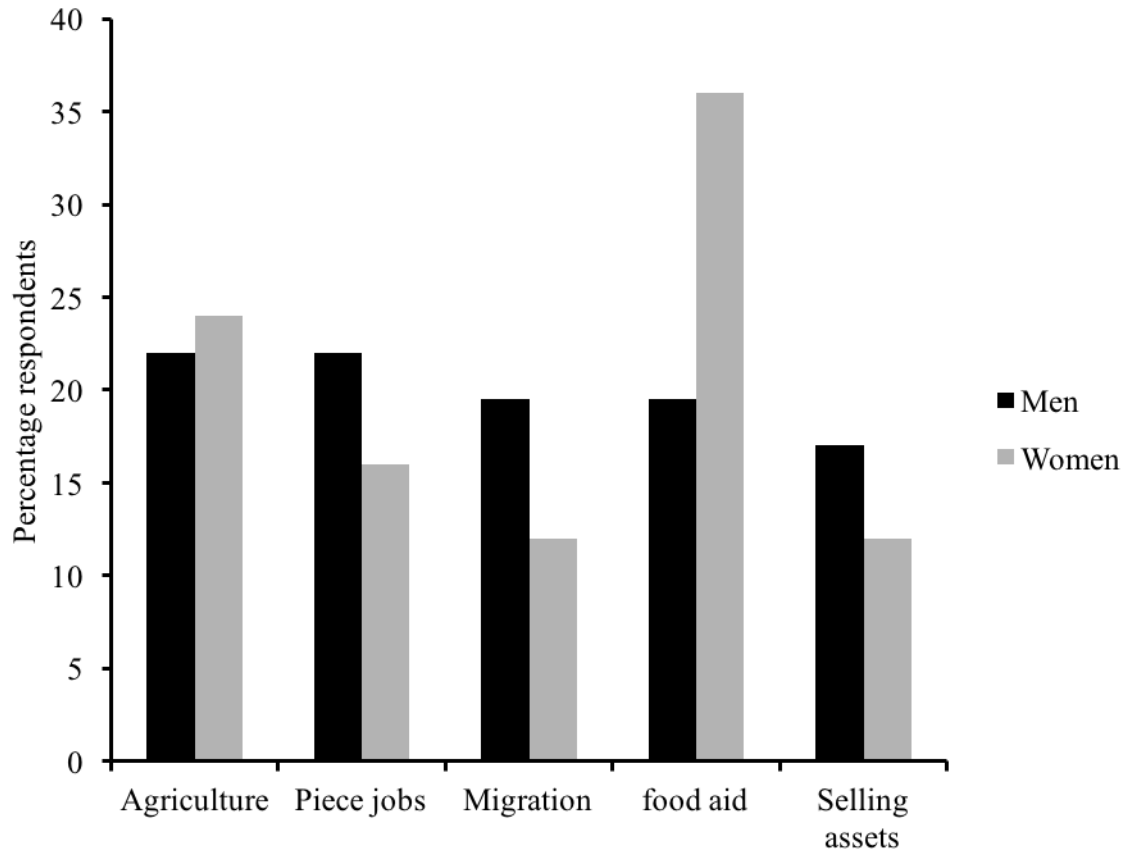


Figure 3.4: Farmers’ livelihoods strategies. Source: Field work questionnaires, 2015

In-depth interviews with the key informants drawn from NGOs confirmed that small scale projects are among other adaptive strategies which they offer to local farmers. Small community projects such as community gardening, high breed goat projects and small-scale credit schemes failed because of poor social relations amongst members. A programs officer from Care International confirmed introducing a high breed goat project to local farmers. The hybrid goat projects failed to boost local breeds as well as increasing local farmers’ earnings from selling the goats. He confirmed that goats are ideal in the area with arid characteristics. Box 3.4 shows reflections from CARE program officer regarding the failure of the goat project.

Box 3.4: Key informant's reflections on high breed goat projects

The project failed because the local farmers here are divided on political lines and they are also impatient. When we introduced the project, we put people into groups and leader of the group was supposed to keep the goats at his/her place until they are ready for selling. Apart from selling we wished them to replace their low-quality goats. Bad social relations between local farmers hindered success of the projects because of differences in political affiliation to Zanu PF and MDC (political parties). Conflicts amongst members led to the abandonment of the project before earning an income. Some participating farmers complained that the project needs more time and they were expecting immediate results because they were facing serious food insecurities.

3.4.4 Indigenous knowledge, social capital and adaptation in ward 24

Through focused group discussions and key informants, participants to the study acknowledge the presence and importance of indigenous strategies which they can use to reduce vulnerability from agro-based disasters. From the questionnaires, local farmers raised that *majaka* (thrashing co-operatives), *humwe* (farming co-operatives), *mukweverera* (rain making ceremonies) and *zunde ramambo* (chief's granary) are important in easing labor shortages. They pointed out that these local farm groups are no longer vibrant as they used to do in previous years. Figure 3.5 shows the scale to which farmers rely on the collective indigenous farm groups in farming.

Through focus groups discussions, local farmers concurred that *majaka* (thrashing co-operatives) and *humwe* (farming co-operatives) are fast disappearing due to two main reasons. Firstly, poor social relations amongst local farmers in ward 24 is damaging the potential of collectivism among them in pooling their labor in farming and thrashing their yields. Social conflicts are mainly caused by differences in political belonging and the political violence which happened between Zanu PF and MDC supporters in 2008. Secondly, frequent droughts are also limiting the potential of collectivism amongst themselves due to lack of trust and reciprocity.

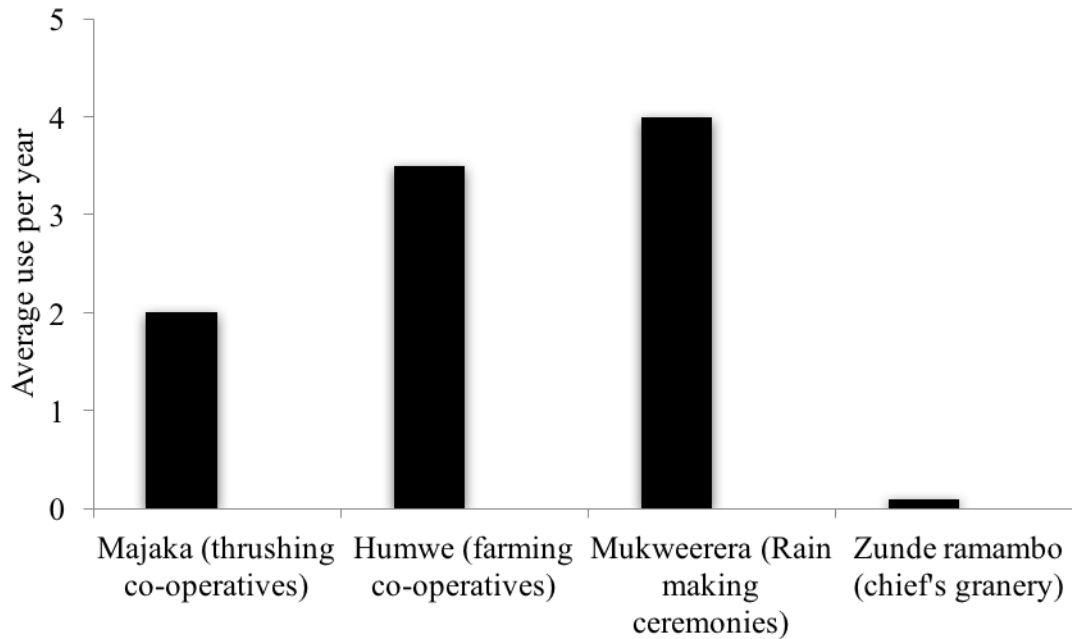


Figure 3.5: Indigenous farming associations. Source: Field work questionnaires, 2015

Unstructured interviews with the key informants who are the village heads revealed that rain ceremonies (*mukweverera*) and chief’s granary (*zunde ramambo*) are becoming less important in local farmers’ livelihoods. Rain making ceremonies are losing their relevance due to increase in churches and perennial droughts. On chief’s granary, the village heads expressed that perennial droughts and bad social relations amongst local farmers are affecting the potential of unity even in good seasons. They further expressed that people opt to suffer from droughts than uniting because of political conflicts which happened in 2008.

3.4.5 Vulnerability and adaptation in ward 20 and 21

It has been noted that local farmers in ward 20 and 21 are vulnerable to droughts and diseases. Information obtained from questionnaires and focused group discussions pointed out the crop production is affected by availability of rain and wild animals such as baboons and monkeys. Through focus group discussions, local farmers expressed that these wild animals are common in the mountainous area. Furthermore, the research participants expressed that small grains such as rapoko, millet and sorghum are threatened by visiting quelea birds. They noted that wild animals increase food insecurity even in good farming seasons.

On animal production, local farmers expressed that dry spells have detrimental impacts on cattle which are their main priority in mixed farming. Through focus group discussions, it

emerged that loss of cattle exposes many households to disasters. Dependence on other livestock such as goats, sheep and donkeys is minimal due to their low market value despite them being more resilient than cattle.

3.5.6 Reflections on coping and adaptive strategies in ward 20 and 21

Farmers in ward 20 and 21 have various coping and adaptive strategies they use in adapting to climate change disasters. Through focus group and questionnaires, it was noted that participating in piece jobs (*maricho*), migration, small scale projects and dependence on food aid are common in ward 20 and 21. Small scale projects are more common in the two wards. On small scale projects, participants in focus group discussions pointed out that there are four projects initiated by CARE International, SAT and PLAN International. Gardening projects and small-scale credit schemes (Fushai) are dominated by women. Participants in Fushai and gardening confirmed good results though they are far less from disasters such as droughts. Focus group participants expressed that success of Fushai in ward 20 and 21 is facilitated by good social relations amongst local farmers.

Participants expressed that strategies such as migration and piece jobs are temporal and they rarely arrest disasters they face in farming livelihoods. On the other hand, questionnaires and focus group discussions highlighted that most vulnerable households depend on food aid during droughts. Key informants from the NGOs confirmed giving food handouts to vulnerable farmers. One key informant from Care International expressed that food aid is also used in building local farmers' adaptive capacity. He explained that they use food as bait in attracting farmers to participate in the Food For Assets (FFA) projects. FFA projects involve local farmers building their assets such as dams, bridges, roads among others. FFA empowers local farmers in reducing vulnerability through building their own assets for future use. He explained the need for collaboration between NGOs, local farmers and government for projects to be successful. Box 3.5 shows a key informant from CARE International's reflections on FFA projects.

Box 3.5: Key informant's reflections on FFA projects

CARE's Programs officer – apart from giving food aid, we introduced food for assets project. In these projects, we encourage farmers to work in repairing roads and identifying projects which leaves them with assets rather food alone. Noted successful stories are the damming projects are in Nyadanda (ward 20) and Nebarwe (ward 21). Collective efforts from local farmers helped much in seeing the success of the small dams. The dams are helping local farmers in harvesting water for livestock and gardening projects.

3.6.7 Indigenous responses and adaptation to climate change impacts in ward 20 and 21

Focus group discussions and questionnaires in ward 20 and 21 revealed various indigenous strategies used by local farmers in reducing vulnerability to dry spells and droughts. Local farmers pointed out that thrashing (*majaka*), farming co-operatives (*majangano*), chief's granaries (*zunde ramambo*) and rain making ceremonies (*mukweverera*) used to flourish amongst local farmers. Farm groups such as *majaka* and *majangano* are no longer vibrant as they used to be due to perennial dry spells and droughts. *Zunde ramambo* is also disappearing due to many factors affecting agro-based livelihoods.

On the other note, execution of rain making rituals is still a common practice among local farmers. Information obtained from the focus group discussions revealed that differences in religious beliefs, education, and knowledge of science are negatively performance of rain making rituals. It emerged that some from Christianity are affecting correct execution of rituals which affects positive results. On the other end, young participants pointed out that it was no longer effective to belief in ancestors for rain. Two key informants (two village heads) blamed these views as the causes of their vulnerability.

3.5 Discussion

Vulnerability to climate change and variability impacts is a common phenomenon amongst many farming communities who depend on rainfed agriculture. The common disaster affecting them is drought. Droughts have serious impacts on food security and livestock production. Smallholder farmers without assets have low adaptive capacity. Furthermore, low adaptive capacity of smallholder farmers is worsened by the presence of multiple climate change and non-climate change shocks and stresses. As noted from the study in ward 24, extreme weather and seasonal conditions and non-climate change shocks and stresses such as

weak social capital, poor performing economy, bad political relationships inter alia weakened local farmers' resilience and adaptive potential. Parker et al (2009) expressed that communities which are hard hit by multiple sources of disasters have low adaptive capacity. Multiple sources of disasters cause both social and physical vulnerability (Davies, 2011). Physical vulnerability involves loss of physical assets which are fundamental for adaptation while social vulnerability involves the loss of social wellbeing including social capital which is critical in adaptation (Parker et al, 2009).

Farming communities which have physical and social vulnerability cannot adapt on their own without outside help as noted in ward 24. Cases of vulnerable farming communities which have low adaptive capacity due loss physical assets are common. A study by Selvaragu et al (2014) revealed that smallholder farmers in Bangladesh have low adaptive capacity after losing approximately 90% of their crop yields to floods and wild animals. The prevalence of climate change and non-climate change impacts increases majority of smallholder farmers' susceptibility to both social and physical vulnerability.

In climate change discourses vulnerability is not a similar across smallholder farmers. There are many variables which determine an individual, household and the community's the levels of vulnerability and adaptive capacity. The commonly noted variables in all the three wards are gender, age and ecological location. On gender, women's limited ownership and control of livelihoods assets and confinement to the domestic sphere limits their adaptive capacity. On the contrary, men are less vulnerable due to their flexible adaptive options. A study conducted by Manjengwa et al (2014) in various parts of Zimbabwe confirmed the gender based differences in levels of vulnerability and adaptive potential. Common facts noted cases on women's vulnerability and limited adaptive capacity are driven by culture which restricts them ownership of vital livelihoods assets.

On ecological zoning, some places are located in disaster prone areas. Extreme ecological factors such as extreme weather and seasonal conditions and poor topographic characteristics militate against smallholder farmers' resilience building. As noted in ward 24, poor ecological and seasonal conditions increased their susceptibility to multiple climate change impacts. Local farmers' susceptibility to climate change disasters reduced their potential of adaptation. Studies conducted world over showed that ecological location is not a problem affecting only local farmers in Bikita, but common everywhere. Davies (2011) noted that local farmers in the

North-Eastern Mozambique are more vulnerable to flooding compared to other farmers located in the southern and eastern parts. Likewise, in the selected in Bikita, wards 20 and 21 are less vulnerable to disasters due to ecological location. Better ecological assets and other capitals are integral in reducing vulnerability.

Vulnerability and low adaptive of smallholder farmers to climate change disasters is not only caused by dependence on rain fed agriculture, age, gender and ecological zoning alone. There are other multiple causes of vulnerability such as diverse adaptive strategies employed by local farmers. Various coping and adaptive strategies such as selling livestock and migration have a mitigating impact against sustainable adaptation. Pasteur (2011) expressed that selling livestock is known as erosive adaptation in the climate change discourse. The erosive character emerges from the fact that smallholder farmers would be eroding their invaluable assets which performs two main functions in agro-livelihoods. Cattle and donkeys are critical as sources of draught power and safety nets during disasters. Losing livestock which is the backbone of smallholder farming reduces adaptive potential of many local farmers.

As noted from the study, selling of goats, sheep, donkeys and cattle is a form of maladaptation. Local farmers without livestock have low potential of enforcing planned and autonomous adaptation. Findings from the sampled wards in Bikita indicated that most farmers have limited adaptive capacity due to depreciating livestock. Embracing of erosive adaptive strategies amongst smallholder farmers is not a unique phenomenon in ward 20, 21 and 24 of Bikita. A study by Davies (2011) amongst smallholder farmers in Phelantaba village in Lesotho revealed that over 55% of the smallholder farmers respond to droughts by selling goats and cattle. Losing crops and livestock is a double tragedy for many communities. Majority of them are left vulnerable and in many cases, depend on linking capital from the local institutions (DFID, 2000; Putman, 2000).

On migration, it has been noted that it works on two-fold when it comes to adaptation. On one hand, migration is helpful in coping with droughts and on the other hand it exposes those that migrate and those that remain behind. In this case, it emerged that women are the worst victims of migration apart from other multiple disasters they face compared to their male counterparts. Cultural roles limit women from migrating like men and they are left to face challenges such as fetching water, firewood and other daunting household chores. On this argument, men appear to be better off compared to women. Women's vulnerability to climate

change impacts in the absence of men has been confirmed by other studies conducted in many farming communities of the Africa. In Namibia, women in Epyeshona and Daures districts are vulnerable to water scarcity and they are compelled to carry water containers for long distances (Jotoafrica, 2011). Furthermore, their social roles of rearing children and providing domestic needs preclude them from migrating. As a result, they are climate change refugees (Denton, 2000) with the least potential of coping and adapting to multiplying climate change shocks and stresses.

In the broad discussions of adaptation, ideas have emerged that inclusion of local institutions is critical in reducing vulnerability through building adaptive capacity (Agrawal, 2008). From the study, good stories were noted in ward 20 and 21. Strong linking capital and social capital facilitated the success of community based projects such as community gardens, FFA and small-scale damming projects. The success of the community projects aided much to other adaptive strategies despite low returns compared to the degrees of disasters. Furthermore, the strategies reduced vulnerability when compared to those farmers in ward 24.

Nevertheless, the role of local institutions in reducing vulnerability and adaptive capacity of local farmers needs not to be over romanticized. Despite the trickling in of financial capital and human capital (technocrats) from local institutions, there are many other factors which militate against the building of resilience and adaptive capacity of vulnerable farmers. In ward 24 of Bikita, the presence of local institutions such as CARE, PLAN International inter alia failed to reduce local farmers' vulnerability to climate change risks and hazards. The commonly noted factors include but are not limited to politics, economy, poor topographic characteristics and poor social capital.

Poor social capital and bad political relationships amongst smallholder farmers witnessed the collapse of important adaptive strategies introduced by local institutions such as the high breed goat projects. Social disharmony thwarts collective motives which intend to empower local farmers with self-help ideas and assets. A study by Davies (2011) amongst local farmers in Phelantaba village in Lesotho revealed that only 21% of the village population belonged to the community association while 46% belong to burial society. Lack of unity amongst local farmers reduces the potential of collective efforts in coping and adapting to disasters affecting their livelihoods. Majority of local farmers end up depending on food aid from local

institutions rather than sustainable solutions which empowers them to fight disasters on their own.

Most poor and vulnerable smallholder farming communities utilize their linking capital in order to get food aid as a strategy of coping with droughts. Dependence on food aid from local institutions is a common phenomenon amongst many poor smallholder farmers. As noted in the study, most households confirmed receiving food aid from NGOs. Vulnerable farmers' dependence on food aid is also prevalent in other parts of Zimbabwe. Smallholder farmers in Matabeleland's Bulilima and Mangwe districts depend on food aid in coping up with perennial droughts (Pasteur, 2011). Food aid is a critical coping strategy for farmers with low adaptive capacity. Despite food aid offering a life line to vulnerable households, critical thinkers pointed them as doing less in empowering local farmers in adaptation. Pasteur (2011) expressed that food aid is palliative care which cannot address the needs of local farmers for sustainable adaptation.

Lastly local farmers' use of indigenous knowledge in adaptation is no longer popular than it used to be before. Some positive scholars on indigenous knowledge consider it as the starting point of sustainable adaptation (Kolawole et al, 2014). They argued that local farmers can rely on natural capital (in form of trees, birds, animals, insects and other atmospheric indicators) and human capital (knowledgeable elders) in seasonal forecasting. Access to seasonal information helps them in preparedness for disasters as well maximizing gains in good conditions. Furthermore, maximizing indigenous strategies such as pooling labor through farmer groups and other community associations is critical in reducing vulnerability. As noted from the study in ward 20 and 21 extreme seasonal conditions negatively affected collective indigenous social groups. To the contrary in ward 24, bad political relationships and poor social capital together with extreme seasonal conditions increased their vulnerability to climate change impacts. Most of these farmers have low adaptive capacity.

3.6 Conclusion

The results from this study showed that majority of smallholder farmers in ward 20, 21 and 24 are vulnerable to many climate change and non-climate change disasters. However, ward 24 is the more vulnerable due to complex climate change and non-climate change factors. The common noted disasters are droughts and diseases. These disasters are thwarting local

farmers' capacity to build resilience and adaptive strategies. Furthermore, local farmers vulnerability is also worsened by adaptive strategies they employed such as selling livestock and migration. Migration affects women most as they are left to cope up with demanding domestic roles and adaptation during the absence of their husbands. Despite presence of local institutions, reducing vulnerability is not automatic because of other external factors such social capital politics and economy. For external intervention to be successful, there is need for collectivism amongst NGOs, local farmers and the government. Food aid from NGOs is good only for coping with droughts but cannot improving local farmers' resilience and adaptive capacity. Lastly, vulnerable farming communities need to incorporate indigenous knowledge amongst other adaptive strategies to reduce vulnerability to multiple climate change impacts.

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CHAPTER 4

THE ROLE OF INDIGENOUS KNOWLEDGE SYSTEMS IN SEASONAL PREDICTION AND ADAPTATION TO CLIMATE CHANGE IMPACTS

Abstract

This chapter examined various indigenous indicators which are used by local farmers in seasonal forecasting and adaptation to climate change disasters. The study highlights their importance in decision making and adapting to disasters. In collecting data, the researcher triangulated qualitative and quantitative techniques. Focused group discussions, key informant interviews and questionnaires were data collecting tools and information gathered is discussed using Sustainable Livelihoods Frameworks (SLF). Results indicated diverse indigenous indicators in seasonal forecasting. The indicators are critical in predicating short and long term seasonal forecasting. Knowledge on indigenous indicators is skewed towards elderly farmers than young farmers. Dependence on indigenous knowledge on seasonal prediction and adaptation is declining. Major factors behind the decline are unreliability of some indicators, Christianity, education and prevalence of scientific seasonal forecasting. These factors are increasing the disappearance of indigenous knowledge systems. The study concluded that integration of indigenous indicators and scientific seasonal forecasting is critical in increasing seasonal information for local farmers. Integrating the two also assures the survival of indigenous knowledge from disappearing.

Key words: indigenous indicators, forecasting, prediction, adaptation, decision making

4.1 Introduction

Climate change and variability pose serious threats to livelihoods and the impacts are severe (IPCC, 2007). Perennial droughts, extreme heat waves, floods and disease outbreaks are common disasters which expose majority to vulnerability (Ajani et al, 2013). Extreme climate events are reducing crop and livestock production among smallholder farmers. Rockstrom and Falkenmark (2000) observed that local farmers are losing approximately one tone per hectare due to extreme weather and seasonal events. Extreme weather events are increasing serious food insecurity (Ajani et al, 2013). Most farmers particularly in Sub-Saharan Africa are facing severe food insecurity. Smallholder farmers affected with food insecurity have low adaptive capacity due to poverty and dependence on rain fed agriculture (Ibid).

Availability or unavailability of adequate seasonal and climate change information determines local farmers' ability or inability to cope and adapt to disasters (Muguti and Maphosa, 2013). Absence of seasonal information limits local farmers' preparedness in decision making and planning on farming (Roncoli et al, 2002). Farmers with adequate seasonal information are better positioned to reduce vulnerability or maximizing their livelihoods chances during good

seasonal conditions (Roncoli et al, 2002; Kolawole et al, 2014). Local farmers utilize indigenous indicators the main source of seasonal information (Chang'a et al, 2010).

Use of indigenous knowledge in seasonal forecasting is important for local farmers with limited or without adequate access to scientific forecasting technology (Muguti and Maphosa 2013; Shoko and Shoko, 2013). Using indigenous knowledge is enabled by the availability of natural, human and social capitals (DFID, 2000). Drawing from the list of capitals, availability of knowledgeable elders is critical in interpretation of events from indigenous indicators (Kolawole et al, 2014; Roncoli et al, 2002). Information obtained from indigenous indicators is invaluable for crop farming and livestock production. Locally based knowledge reinforces sustainable decision making and planning for disasters (Shoko and Shoko, 2013).

This chapter identifies multiple indigenous knowledge indicators and related rituals used by local farmers as sources of weather and seasonal forecasting. It examines the importance of indigenous indicators in decision making and planning for adaptation against climate change shocks and stresses. The study also scrutinizes challenges experienced by farmers on their use of indigenous indicators in seasonal prediction. Lastly, the study scrutinizes the potential of integrating indigenous indicators and scientific seasonal forecasting in seasonal forecasting adapting to climate change disasters.

4.2 Materials and methods

Both probabilistic and non-probabilistic sampling techniques were used to select respondents. Three wards in Bikita, ward 20, 21 and 24, were purposefully selected for this study. Wards 20 and 21 are found in agro-ecological region IV (four) with semi-arid characteristics. These two wards have similar soil types, tree species and other topographic characteristics. Ward 24 which is found in agro-ecological region V (five) has arid characteristics. The reason for inclusion of ward 24 was to give a cross comparison on adaptation strategies used by farmers with different rainfall patterns. The study squared off indigenous knowledge and adaptive strategies used in the three wards against the background that ward 24 are product of resettlement. Combining the three wards provided rich ground for comparing similarities and differences considering differences in background of farmers and ecological characteristics.

After purposive selection of wards, the names of all villages in each ward were recorded as provided by the ward councilors, village headmen and extension service officers. Ward 20 had 45 villages, ward 21 had 26 villages and ward 24 had 15 villages. Despite the three wards having different number of villages, three participating villages were randomly selected from each ward. The decision of selecting three villages in each ward was based on two reasons. Firstly, all farmers in the three wards have similar cropping systems, similar soil types and vegetation and secondly financial limitations. Lack of adequate research resources limited the numbers of participating villages and households. Furthermore, similarities in soils types and vegetation also represent similarities in indigenous knowledge seasonal forecasting indicators and this pushed me to reduce the need for more villages.

From the selected villages, households in each of the three selected villages of each ward were listed. From the listed households, ten households were selected from each village making a total of thirty participants from each ward. Selection of ten households per village was influenced by financial challenges, similarities in cropping behaviors and similarities in soil types, tree species and other topographic characteristics. The process of purposive selection and random selection of participants was repeated across other two wards. All the selected participants selected in this category answered the questionnaires. Three research assistants helped in administering questionnaires. The whole study was carried in six months.

On focus group discussion (FGD) both men and women were selected as participants who were drawn from the household lists prepared for those that participated in the questionnaire. Three focus group sessions were purposely done in each of the selected villages. Each focus group discussion had twelve participants of which six were male and the six were females. Participants were randomly selected. The rigorous process of selecting focus group discussion participants was repeated across all the three wards. Different key informants were selected based on their positions and knowledge they possess in farming and smallholder farmers' vulnerability and adaptation to climate change disasters. Table 4.1 summarizes the breakdown of purposively selected key informants with knowledge of indigenous indicators.

Table 4.1: Number of key informants

Nine village headmen – selected village headmen so that they confirm indigenous indicators as well as their roles in controlling execution of rain making ceremonies
Three extension services officers – drawn from the three wards and wanted them to confirm if they use or encourage local farmers with seasonal forecasting from indigenous indicators. They also confirm their ideas on the value of rain making ceremonies in farming.
Eighteen elderly farmers – In each village, two elderly farmers a male and a female were selected who were above 65 years. The selected farmers helped in confirming various sources of indigenous indicators as well as the relevance of rainmaking ceremonies.

4.3 Study area

Bikita is one of the seven administrative districts in Masvingo province in Zimbabwe (Figure 4.1). The other six districts are Zaka, Gutu, Mwenezi, Chiredzi, Chivi and Masvingo urban. Bikita District is located 80 km east of Masvingo city and 377.9 km from Harare. It lies about 656 meters above sea level. Bikita district is dominated by the Karanga people of the Duma totem. The Karanga people depend on mixed subsistent farming.

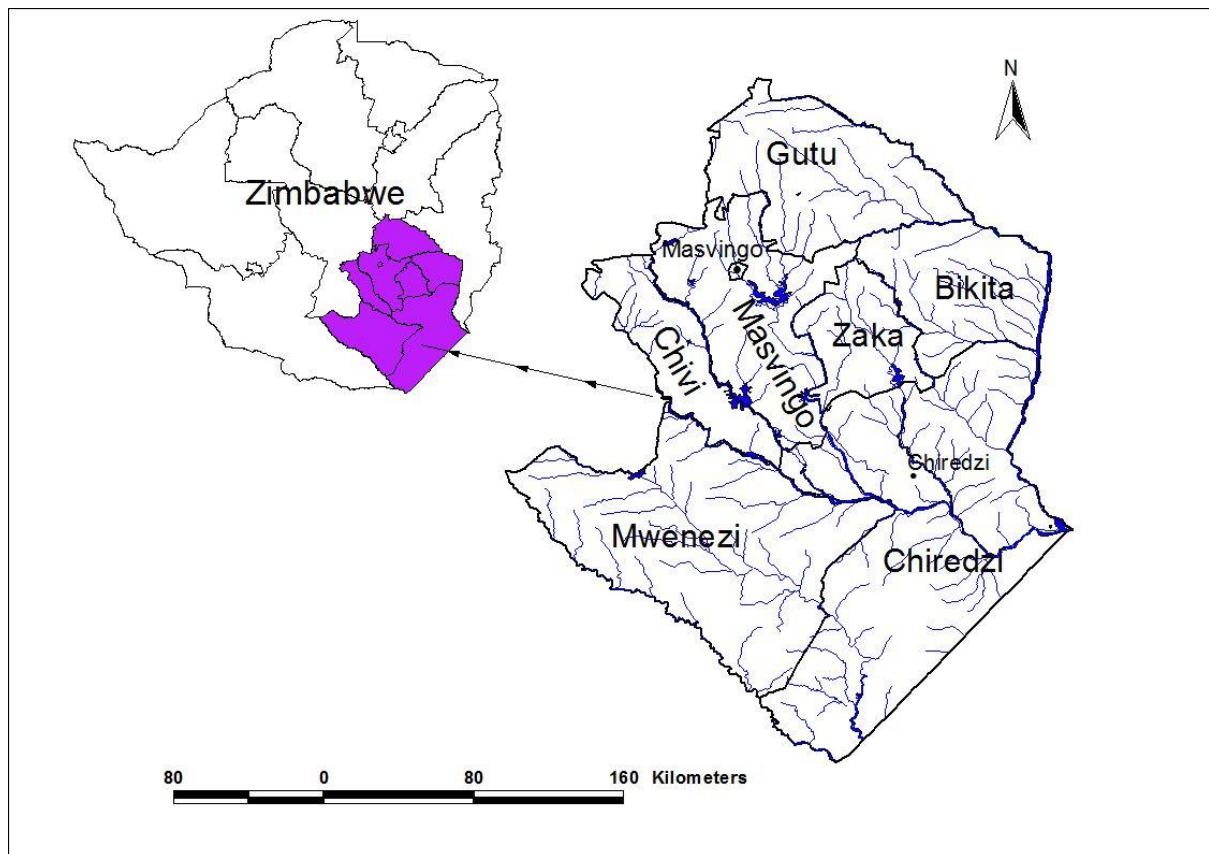


Figure 4.1: Map of Bikita district. Extracted from Chikodzi et al (2013).

Most parts of Bikita are found in arid and semi-arid belt with poor topographic characteristics. Most farmers' dependence on rain fed agriculture increase their vulnerability to perennial to droughts. Farmers grow small grains such as rapoko, millet and sorghum. Growing small grains is an adaptive strategy against harsh seasonal conditions. Harsh conditions limit cultivation of maize, the staple cereal. Apart from small grains, groundnuts are cultivated for commercial reasons despite serious market challenges. Domestic animals such as cattle, donkeys, goats and sheep are common. Domestic animals save two main functions. Firstly, bigger livestock such as cattle and donkeys are used as source of draught power. Secondly, they are used as safety nets during disasters. Farmers sell domestic animals in coping with disasters such as droughts. Apart from selling livestock in coping with disasters, majority of vulnerable farmers depend on food aid from local institutions. The main food donors are NGOs and government's Ministry of Labor Social Welfare. Furthermore, local farmers adapt to disasters through migration to big cities and working in irrigated commercial farms in Chipangayi, Chipinge, Middle Sabi, and Birchneough.

4.4 Results

4.4.1 Indigenous indicators used for seasonal forecasting

Data collected from ward 20, 21 and 24 using focus group discussions, key informant interviews and questionnaires showed that there are multiple sources of indigenous indicators used by local farmers. Local farmers get seasonal forecasting information by interpreting tree phenology, bird behaviors, insect behaviors, animal behaviors, atmospheric characteristics and other independent indicators. Key informant interviews and focus group discussions revealed that indigenous indicators are critical in forecasting seasonal quality, predicting the coming of rains, and coming of dry spells throughout the rain season. Information on various trees and other plant species which are used by smallholder farmers in seasonal forecasting is shown in Table 4.2.

Table 4.2: Various tree phenology indicators used in Bikita district

Long term indicators on seasonal quality	Behavior	Action for farmers
Mukwakwa tree (<i>Sclerocarya birrea</i>)	Profuse fruiting indicates severe drought	Conserve food and collecting more fruits as food reserves
Muuyu tree (<i>Adansonia digitata</i>)	Heavy flowering indicates good season	Prepare a good season
Muswati tree (<i>Dalbergiella nyasae</i>)	Heavy flowering indicates good season	Bumper harvest and also a good season for cow peas
Mutuva tree (<i>Kirurite mucugucugu</i>)	Profuse flowering means good rains	Good season
Mushumha tree (<i>Diospyros mespiliferims</i>)	Heavy fruiting indicates good season	Good season
Gavakava -Aloe plant (<i>Aloe vera</i>)	Heavy flowering and seeds means a good season. Scattered seeds mean scattered rains or drought	Be prepared for good season or drought
Mupanda - Rain tree (<i>Philenoptera violacea</i>)	Heavy flowering means a good season	Good season for even water demanding maize crop.
Munhengeni tree (<i>Ximenia caffra</i>)	Profuse fruiting indicates good rains	Prepare for good rains
Muunze tree - (<i>Brachystegia glaucescens</i>)	Shooting new leaves means imminent rain whilst maintaining green leaves means good rains	Be prepared for rain season
Mukamba tree – mahogany Tree (<i>Azelia qunzeisis</i>)	Heavy flowering means good harvests	Less flowering indicates the need for food alternatives due to insufficient rains.
Guhunga tree	Heavy flowering means good rains	Be prepared for good season.
Mumveva - sausage tree (<i>Kigelia pinnata africana</i>)	Heavy flowering	Be prepared for a good season
Short term indicators on seasonal quality	Behaviors	Action for farmers
Muonde - Fig tree (<i>Fiscus carica</i>)	Shooting brownish leaves shows imminent rains	Be prepared for cultivation
Mupani tree (<i>Colophospermum mopane</i>)	Shooting of brownish leaves indicates imminent rains	Be prepared for cultivation

Source: Field work, questionnaires, FGDs and key informant interviews, 2015

4.4.2 Insects, small creatures and seasonal forecasting

Data collected through focus group discussions, key informant interviews showed that insects are also important in providing short term and long-term weather and seasonal prediction. Local farmers confirmed relying on adapting to extreme weather and seasonal conditions. Table 4.3 highlights different species of insects and small creatures which are used by indigenous farmers in seasonal prediction and adaptation.

Table 4.3: Insects and creatures in seasonal forecasting

Long term indicators	Behavior and meaning	Action for farmers
Madora - caterpillars (<i>Lepidopteran</i>)	Moving around in abundance means good season	Be prepared for a good season
Nyezhe / nyenze - Christmas beetle (<i>Cicadas</i>)	Heavy sounding indicates imminent rains	Be prepared for planting.
Majuru / unheza - termites (<i>Ancistrotermes</i> pp)	When seen collecting grass and stocking indicates droughts	Get prepared for severe food shortages.
Nyuchi - honey bees (<i>Appis mellifera</i>)	When many and flying around means abundant rains since they depend on flowers	Be prepared for a good season.
Makwama - monitor lizard (<i>Varanus griseus</i>)	When abundant in numbers it means good season	Be ready for a fruitful season
Mhashu / magwatakwata/ madowindo - grasshoppers (<i>Schistocerca americana</i>)	Appearing in large numbers or swarms means abundance of food	Be ready for a fruitful season
Makurwe - sand crickets (<i>Grylliade</i>)	Appearing in numbers	Be ready for a fruitful season
Short term indicators	Behavior and meaning	Action for farmers
Mazongororo - millipedes (<i>Diplopoda</i>)	When seen moving around indicates imminent rains	Get prepared for cultivating
Mashikishira	When going into hiding in the ground rains are imminent	Get prepared for cultivation
Rwangachena - white frog (<i>Litoria caerulea</i>)	Sounding means imminent rains	Be prepared for planting season
Mukonikoni - dragon fly (<i>Anisoptera</i>)	When flying in numbers means coming of rains	Get prepared for cultivation
Mabhururungwa - flying termites (<i>Peticulitermes</i>)	When flying after rains indicates coming of a dry spell	Get more time to weed fields due some dry spell

Source: Field work questionnaires, FGDs and key informant interviews, 2015

4.4.3 Bird's behaviors as indigenous indicators

Focus group discussions, questionnaires and key informant interviews highlighted the role played by birds in weather and seasonal prediction. They confirmed that forecasting information from birds compliments other sources such as trees, insects inter alia. Various bird types and their functions are shown in Table 4.4.

Table 4.4: Birds and seasonal forecasting

Long term indicators	Behaviours	Action for farmers
Ngozha quelea birds (<i>Quelea quelea</i>)	Visiting the area before and during farming season means good harvests especially small grain crops	Planting more millet, rapoko and sorghum
Mherepere - sparrows (<i>Passerdae</i>)	Flying over skies usually means a good season	Prepared for a good season
Usvore - white stock bird (<i>Ciconia ciconia</i>)	Visits by these migrant birds means a good season since the stay in wet and humid places	Good season
Short term forecasting indicators	Behaviours	Action for farmers
Dendera – southern ground hornbill (<i>Bucorvus leadbeateri</i>)	Sounding means imminent rain	Get prepared for planting
Chivangazuva – sun bird	Sounding means coming of dry spell or rains are still away	Be prepared for drier times
Kowhera- cuckoo (<i>Cuckoo cuculiformes</i>)	Sounding means imminent rains	Get prepared for planting
Gunguwo - Crow (<i>Genus corvus</i>)	Flying in skies indicates dry spells	Get prepared for less or dry spells.

Source: Field work, questionnaires, FGDs and Key informant interviews, 2015

4.4.4 Astronomical indicators

Information on astronomical indicators was gathered mainly from key informants who were the elderly farmers. Focus group discussions provided other information though it was not much compared key informant interviews. Detailed information on astronomical indicators is shown in Table 4.5.

Table 4.5: Astronomical signs in forecasting

Astronomical indicator	Behaviour	Action for farmers
<i>Mwedzi</i> (Moon) <i>Zuva</i> (Sun)	Halo around sun or moon indicates good season with normal or above normal rains	Get prepared for intensive farming
<i>Mhepo</i> (Wind)	Wind blowing from east to west indicates imminent rains. Wind blowing from west to east indicates dry spells.	Get prepared for cropping or vice versa
<i>Mvumi</i> (Nimbus clouds)	Mum indicates onset of good rains	More intensive farming
<i>Mheni</i> (Lighting)	Lighting spells during rainy season indicates coming of dry spells	Prepared to endure dry spells
<i>Murarabungu</i> (Rain bow)	During rainy season indicates coming of dry spells.	Prepared to endure dry spells
<i>Kupisa</i> / <i>Kutonthora</i> (cold and warm temperature)	Extreme winter temperature (between May and August) are usually associated with a good farming season	Prepared for intensive farming

Source: Field work key informants and FGDs, 2015.

4.4.5 Other ethno-metrological indicators

In-depth key informant interviews and focus group discussions pointed out other independent indicators apart from those from trees, insects, birds, astronomical and animals. Through focus group discussions, participants highlighted that they are not popular with most smallholder farmers. Elderly farmers and some few key informants have the knowledge on interpreting the independent indicators. Table 4.6 highlights various independent indicators which compliment seasonal forecasting drawn from other common indicators.

Table 4.6: Other indigenous indicators

Indicator	Interpretation	Action for farmers
<i>Mbira</i> (Rock rabbit) (<i>Ochotona collaris</i>)	Their squeaking indicates imminent rains or coming of guti (cloudy and humid conditions)	Getting prepared for cultivating crops or humid conditions
<i>Kuzvarwa kwevasikana vazhinji</i> (Birth of many girls)	Bumper harvests are expected.	More intensive farming
<i>Kuzvarwa kwevakomana vakawanda</i> (Birth of many boys)	Associated with drought	Farmers getting prepared for coping up droughts
<i>Makomo anoera</i> (sacred mountains)	Sounds from sacred mountains towards rain season means imminent rains	Farmers should prepare their fields for cultivating

Source: Field work, key informant interviews and FGDs, 2015

Information gathered on indigenous indicators showed that their roles are not the same and they differ through time and space. Through questionnaires, it was observed that seasonal forecasting from tree phenological indicators significantly contribute more seasonal information compared with other noted sources (Figure 4.1). Local farmers pointed that that trees are more common and less complex than other sources seasonal forecasting. Interpreting leafing, flowering and fruiting of trees makes it more common to farmers of all age groups. Other indicators are less popular due to their complicatedness.

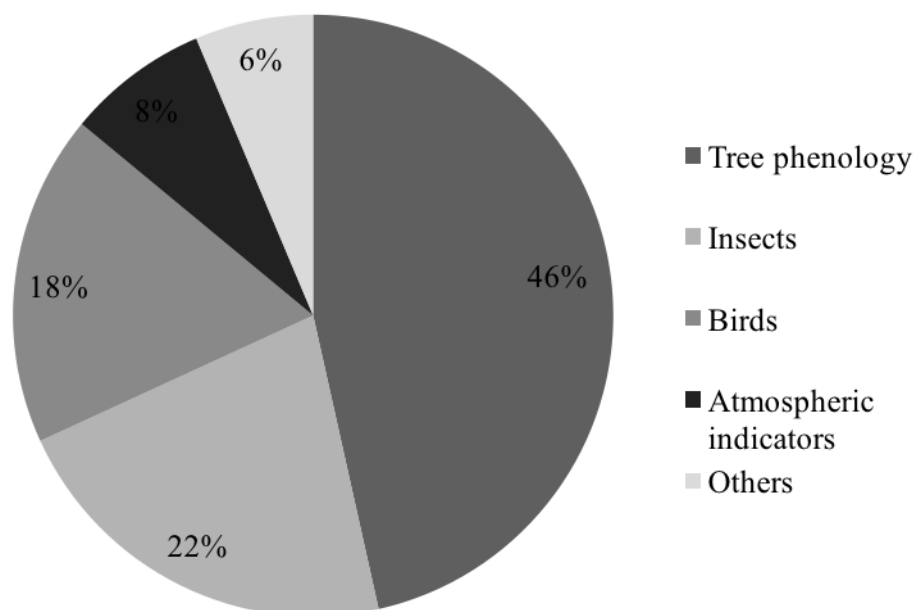


Figure 4.2: Indigenous seasonal indicators. Source: Field work questionnaires, 2015

A follow up inquiry on key informant interviews and focus group discussions revealed that birds are not popular because they are declining in their numbers. Majority of the birds important in seasonal forecasting are disappeared. One key informant a 78-year-old man expressed that the remaining birds are no longer reliable as they use to do before. Box 4.1 below showed his reflections on the contribution of birds in seasonal forecasting.

Box 4.1: Key informant’s reflections on birds in seasonal forecasting

A 78-year-old key informant – These days birds are no longer reliable as they used to in weather and seasonal prediction. We don’t know exactly what is causing them to change. Birds such as Dendera (*Bocavus lidibiateri*) are no longer reliable. Another problem is that many people especially the youth are killing scared birds threatening our indigenous knowledge.

Focus group discussions further pointed out that astronomical indicators and other indicators are not popular because only few elders are still conversant with them. They reiterated that this is the main reason for the disappearance of such knowledge. Elderly key informants expressed that astronomical indicators and other indicators are not popular but are the most

reliable in seasonal forecasting. They acknowledged refusal of younger generations to learn more about them.

4.4.6 Intergenerational views on indigenous and scientific forecasting indicators

From the collected data, it was observed that knowledge on various indigenous indicators is uniform across different age groups. Information obtained from the questionnaires showed that younger generations below 40 years of age have limited knowledge about indigenous indicators (Figure 4.2). There is a significant difference between the ages that do not know indigenous indicators and those that know it below the age of 40 years (Figure 4.2; $P \leq 0.05$). Younger generations also do not rely on indigenous knowledge in making decisions about farming. Alternatively, they rely on scientific seasonal forecasting in making decisions on cropping and livestock production.

On the hand, elderly farmers showed in-depth knowledge about various indigenous indicators as shown on the information above. Focus group discussions revealed that they also rely on scientific seasonal forecasting despite their knowledge on local indicators. They pointed out that unreliability of some indigenous indicators is compelling them to integrate the two sources of seasonal forecasting.

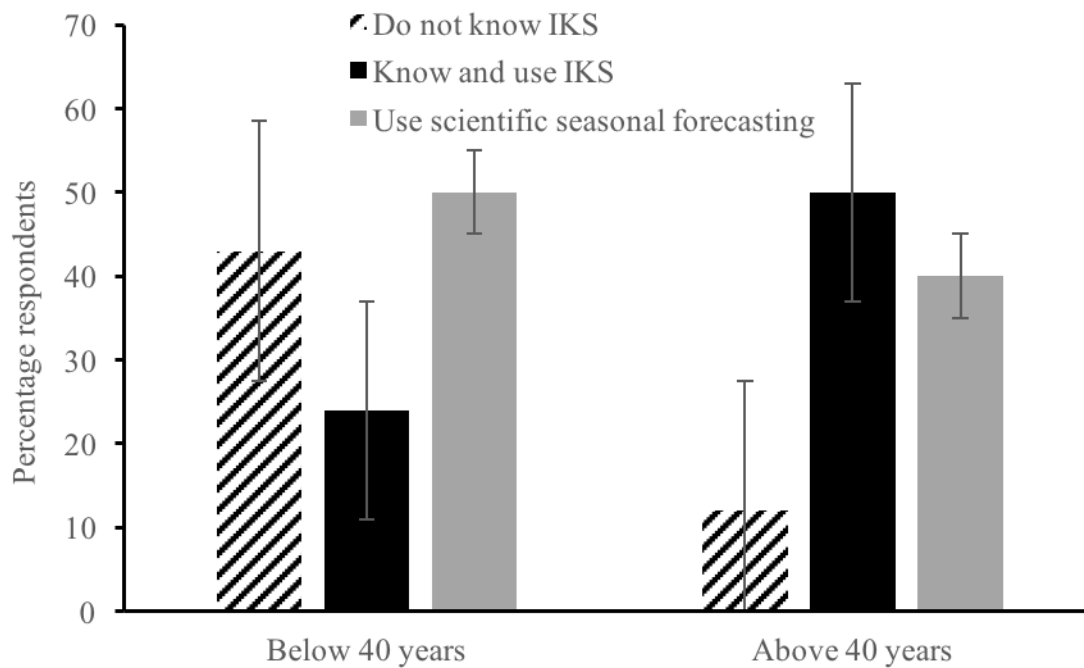


Figure 4.3: Knowledge of indigenous indicators based on age. Source: Field work questionnaires, 2015

Another key indigenous indicator and adaptive option which was raised in focus group discussions and key informants is rain making ceremonies (*mukweverera*). Key informants agreed that rain making ceremonies guarantees local farmers disaster free farming seasons. Performance of the rain making ceremonies provided them good farming seasons with bumper harvests. Rain making ceremonies are also help in ending droughts. Nine village heads as key informants expressed challenges which they face in the execution of rain making rituals. They revealed that churches, education and age differences are affecting successful rain making rituals. These ideas were supported by responses from focus group discussions. Discussions pointed out that differences in beliefs and education is affecting execution of rituals as well as the positive results. Three of the local extension services confirmed their encouragement of local farmers to perform rituals such as rain making ceremonies. Also, they expressed the fact that they encourage farmers to rely on scientific seasonal forecasting since the indigenous indicators are less reliable.

4.5 Discussion

The use of indigenous knowledge indicators in seasonal forecasting and adaptation to extreme seasonal events is common in many smallholder farming communities. Forecasting information is mainly drawn from tree phenology, insects, birds, astronomical indicators inter alia. In the study in Bikita, local farmers' ownership of many natural and physical capitals offers them wide range of invaluable indigenous indicators for seasonal forecasting. Reliance on indigenous indicators in seasonal prediction is not only unique to Bikita. Various studies confirmed indigenous indicators are used in various parts of Africa. Use of indigenous indicators has been witnessed in rural parts of Burkina Faso (Roncoli et al, 2002), Tanzania (Chang'a et al, 2010) and Uganda (Kijazi et al, 2013). This knowledge is critical for decision making amongst local farming communities.

Positive thinkers on indigenous knowledge are praising it as the main grassroots based capital for poor and vulnerable smallholder farmers. Indigenous knowledge indicators are praised since they are developed through local farmers' experience through their interaction with natural and physical capitals (Chang'a et al, 2010). The cosmologically developed knowledge is critical on informing their decision making on crops to grow, preparedness to plant and preparedness for adapting to disasters (Roncoli et al, 2002; Kolawole et al, 2014). As noted from the study in Bikita, local farmers' endowment with multiple sources of indigenous indicators is critical in accessing seasonal forecasting information.

In the pool of indigenous indicators tree phenology is more common than other indicators. Tree phenological indicators are common because they are less complicated than interpreting birds' behavior, insects and astronomical indicators. Despite smallholder farmers possessing diverse indigenous indicators, using them in seasonal forecasting and adaptation is diminishing. There are many factors that have been pointed as responsible for the diminishing role of indigenous indicators. They include extreme weather and seasonal conditions, Christianity, age, modern science and education.

Indigenous indicators which are drawn from tree phenology are largely affected by extreme seasonal conditions. Perennial droughts, insufficient rainfall amounts and hot temperatures have affected the reliability of many tree species hence disregarding the role of indigenous indicators in seasonal prediction and adaptation. Other species such as birds and insects are adapting to changes brought in by impacts of climate change and variability. Changes are

causing unreliability and increased doubts amongst users of indigenous indicators in seasonal prediction. In many instances, majority of smallholder farmers are adapting by combining both indigenous indicators and scientific seasonal forecasting. Notable cases of combining the two sources of seasonal forecasting has been observed in many parts of Zimbabwe such as Mberengwa and Zaka (Shoko and Shoko 2013; Muguti and Maphosa, 2012). Juxtaposing indigenous indicators and scientific seasonal forecasting reflects some challenges associated with both forecasting methods.

The coming in of scientific forecasting, education, beliefs in science and prevalence of Christian beliefs is also affecting the preservation and transmission of indigenous knowledge. These factors combined with other independent factors such as colonialism are adding a blow to survival of indigenous knowledge in coping and adapting to climate change impacts (Alexander, 2011). Loss of knowledgeable elders through death is also quickening the disappearance of undocumented indigenous knowledge (Kolawole et al, 2014). It is noticeable that presence of functional human capital (knowledgeable elders) is critical the preservation of indigenous knowledge. The importance is premised critical decisions made in timing crop planting as well as choices of crops to be grown.

4.5.1 Cosmology in turmoil: climate change vulnerability in absence indigenous indicators and rain making ceremonies

Prevalence of extreme climate change and variability impacts are exposing majority of smallholder farmers to vulnerability. Most vulnerable farmers have low adaptive capacity (Adger, 2006; IPCC, 2007). The main cause of vulnerability is caused by smallholder farmers' less access to critical weather and seasonal information. Unavailability of seasonal information is impacting negatively their potential of making sound decisions on farming livelihoods (Kolawole et al, 2014). As noted above, the disappearance of indigenous knowledge is forcing them to combine indigenous knowledge forecasting with scientific forecasting. The effort is to consolidate the unreliable information they have in attempt to reduce vulnerability. Poverty and lack of financial capital to buy modern technology limits their chances of accessing accurate weather and seasonal information.

As indicated in the earlier discussion, prevalence of science, education and Christianity is affecting younger generations' understanding and acceptance of indigenous indicators. Non-usage of indigenous indicators by the youth facilitates their disappearance. The modernized

youth and Christianized local farmers are in the fore front of rejecting the performance of rain making ceremonies. Pessimistic writers on indigenous knowledge regarded rain making ceremony as an important capital possessed by local communities. It is considered as the backbone of successful crop and animal production (Roncoli et al, 2002; Ngara et al, 2014). Rain making ceremonies are regarded as both a strategy and a goal in sustainable agro-based livelihoods. Successful performance of rain making ceremonies indicates a good season ahead. They also reduce the potential outbreak of disasters such as droughts and diseases. Outbreak of droughts affects both human life and other livelihoods strategies.

Information obtained from the study revealed that differences in beliefs and knowledge are detrimental to traditional rain making ceremonies. In this platform, a combination of local farmers with diverse world views on religious beliefs and rituals complicate the performance of rain making ceremonies. In many instances, the contestations are disastrous to collective objective of ending droughts and diseases. As noted in many cases, most religious beliefs and practices are facilitating its disappearance. As noted in Uganda (Kijazi et al, 2013) and Burkina Faso (Roncoli e et al, 2002) prevalence of science and different religious beliefs are negatively affecting the importance of rain making ceremonies. Positive thinkers of indigenous knowledge and rain making ceremonies expressed that disasters such as droughts can be avoided if all scared rituals are properly executed (Roncoli et al, 2002; Ngara et al, 2014).

4.6 Conclusion

The study identified multiple indigenous indicators used by smallholder farmers seasonal forecasting. Various indigenous indicators provide short term and long term seasonal information which is used for planning, decision making and adapting to disasters affecting their farming livelihoods. Knowledge on indigenous indicators is not common amongst all farmers but found mainly from elderly farmers. Young farming generations' ignorance and non-reliance on indigenous indicators is caused by factors such as unreliability of some indicators, prevalence of science, education and Christianity. These factors are negatively affecting the use of indigenous indicators in seasonal forecasting. Furthermore, these factors are also militating against the successful execution of traditional rain making ceremonies. In coping with challenges of accessing seasonal information, smallholder farmers are using both the indigenous indicators and scientific forecasting. Limited access to vibrant technology is

limiting local farmers' access to reliable scientific seasonal forecasting. Integration of the two seasonal forecasting sources is to cover up for the weaknesses they both possess. It can be concluded that integrating indigenous indicators and scientific seasonal forecasting is critical in providing seasonal forecasting information amongst poor and vulnerable smallholder farmers.

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CHAPTER 5

PERCEPTIONS AND DECISION MAKING ON THE USE OF INDIGENOUS KNOWLEDGE AND SCIENTIFIC SEASONAL FORECASTING AMONGST SMALLHOLDER FARMERS

Abstract

This chapter focused on smallholder farmers' perceptions on the selection and use of indigenous knowledge indicators and scientific seasonal forecasting in farming. Local farmer perceptions are examined in the context of decision making in farming and adaptation against climate change disasters. Data in this study was gathered using focus group discussions, questionnaires and key informant interviews. Results showed that factors such as age, religious beliefs and academic background are influential on the selection and use of indigenous indicators or scientific seasonal forecasting on crop and livestock production. Elderly farmers prefer indigenous indicators in making decisions and planning against disasters because they have mastered it as strategy which preclude them from making errors and wrong decisions. Errors increase their vulnerability to disasters. To the opposite, young farmers prefer scientific seasonal forecasting than indigenous indicators. Academic and religious beliefs are the main deterring factors towards their reliance on indigenous indicators. Lastly, it is observable that integrating the two is ideal in covering shortcomings associated with each forecasting source.

Key words: perceptions, decision making, errors, indigenous indicators, scientific forecasting

5.1 Introduction

Climate change and variability impacts are increasing vulnerability amongst farmers (Roncoli et al, 2002). Vulnerable farmers need to adapt to avoid loss of human life and property (IPCC, 2007). Adaptation is possible if farmers possess adequate seasonal and climate change information. Smallholder farmers have two sources of weather and seasonal forecasting (Muguti and Maphosa, 2013). The forecasting information comes from indigenous knowledge and scientific seasonal forecasting. Use of indigenous knowledge indicators in seasonal forecasting is gaining prominence amongst climate change scholars (Shoko and Shoko, 2013; Chang'a et al, 2010). They suggested that indigenous knowledge should be incorporated in climate change debates, policy formulation and adaptation strategies.

Most smallholder farming communities don not depend much on indigenous knowledge in seasonal forecasting due to a number of reasons (Alexander, 2011). Peripheral use of indigenous knowledge is growing despite calls for its rejuvenation (Roncoli et al, 2002; Kolawole et al, 2014). Those that support indigenous knowledge considered it noble for

offering sustainable grassroots based adaptive solutions amongst many smallholder farmers. Grassroots solutions are considered critical in offering a wide range of solutions for autonomous and planned adaptation (Alexander, 2011). Integrating indigenous knowledge and scientific seasonal forecasting provides local farmers with vital seasonal information which is critical for planning and decision making (Chang'a et al, 2010). Integrating the two knowledge systems allows farmers to compare forecasting information before making critical decisions to avoid vulnerability to disasters such as droughts (Shoko and Shoko, 2013; Muguti and Maphosa, 2013).

This chapter examines smallholder farmers' perceptions on the selection of the source of forecasting information between indigenous knowledge and scientific seasonal forecasting. It scrutinizes the role played by various factors such as age, religious experiences and education in the reliance on either of the two forecasting sources. Selection and reliance on either of the forecasting source is examined in the context of planning and decision making on cropping calendars, harvesting, and storage of harvests as well as adapting to disasters. The decisions made are assessed on the context of how they yield both negative and positive results in the farming enterprise. Furthermore, the focus is extended to how perceptions can influence farmers' participation in rain making rituals. The chapter closes by examining the importance of integrating indigenous indicators and scientific seasonal forecasting showing both positive and challenges of isolating them.

5.2 Materials and methods

Both probabilistic and non-probabilistic sampling techniques were used to select respondents. Three wards in Bikita, ward 20, 21 and 24, were purposefully selected for this study. Wards 20 and 21 are found in agro-ecological region IV (four) with semi-arid characteristics. These two wards have similar soil types, tree species and other topographic characteristics. Ward 24 which is found in agro-ecological region V (five) has arid characteristics. The reason for inclusion of ward 24 was to give a cross comparison on adaptation strategies used by farmers with different rainfall patterns. The study squared off indigenous knowledge and adaptive strategies used in the three wards against the background that ward 24 are product of resettlement. Combining the three wards provided rich ground for comparing similarities and differences considering differences in background of farmers and ecological characteristics.

After purposive selection of wards, the names of all villages in each ward were recorded as provided by the ward councilors, village headmen and extension service officers. Ward 20 had 45 villages, ward 21 had 26 villages and ward 24 had 15 villages. Despite the three wards having different number of villages, three participating villages were randomly selected from each ward. The decision of selecting three villages in each ward was based on two reasons. Firstly, all farmers in the three wards have similar cropping systems, similar soil types and vegetation and secondly financial limitations. Lack of adequate research resources limited the numbers of participating villages and households. Furthermore, similarities in soils types and vegetation also represent similarities in indigenous knowledge seasonal forecasting indicators and this pushed me to reduce the need for more villages.

From the selected villages, households in each of the three selected villages of each ward were listed. From the listed households, ten households were selected from each village making a total of thirty participants from each ward. Selection of ten households per village was influenced by financial challenges, similarities in cropping behaviors and similarities in soil types, tree species and other topographic characteristics. The process of purposive selection and random selection of participants was repeated across other two wards. All the selected participants selected in this category answered the questionnaires. Three research assistants helped in administering questionnaires. The study was conducted in a space of six months.

On focus group discussion (FGD) both men and women were selected as participants who were drawn from the household lists prepared for those that participated in the questionnaire. Three focus group sessions were purposely done in each of the selected villages. Each focus group discussion had twelve participants of which six were male and the six were females. Participants were randomly selected. The rigorous process of selecting focus group discussion participants was repeated across all the three wards. Different key informants were selected based on their positions and knowledge they possess in farming and smallholder farmers' vulnerability and adaptation to climate change disasters. For this study, a total number of 21 key informants were purposively selected. Eighteen respondents were drawn from nine villages in the selected wards. In each village, two male and female elderly respondents above 65 years of age were selected. Elderly key informants provided critical information on their perceptions on the role of indigenous knowledge and decision making in farming livelihoods. Lastly, three extension services officers were selected. They provided information on how

local farmers' perceptions based on age and experience influence the use of indigenous knowledge and science in seasonal forecasting.

5.3 Study area

Bikita is one of the seven administrative districts in Masvingo province in Zimbabwe (Figure 5.1). The other six districts are Zaka, Gutu, Mwenezi, Chiredzi, Chivi and Masvingo urban. Bikita District is located 80 km east of Masvingo city and 377.9 km from Harare. It lies about 656 meters above sea level. Bikita district is dominated by the Karanga people of the Duma totem. The Karanga people depend on mixed subsistent farming.

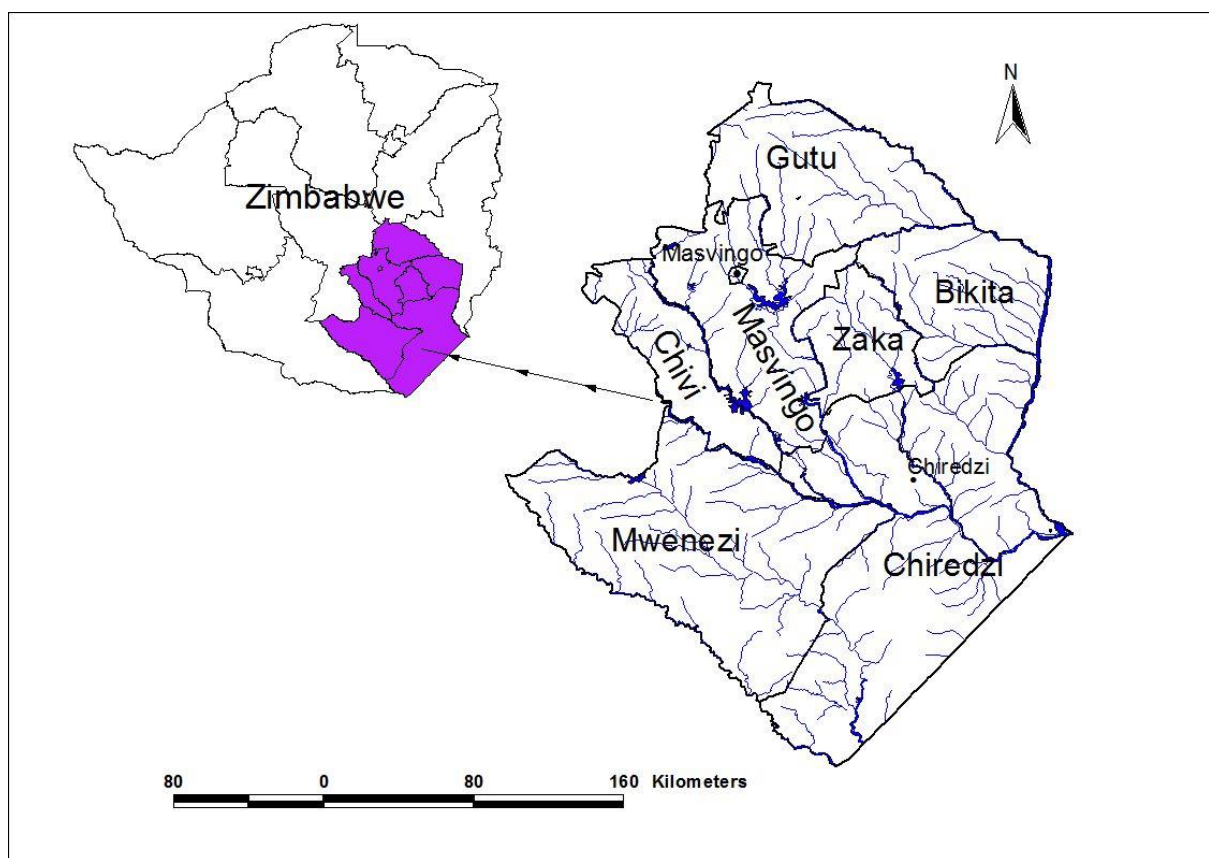


Figure 5.1: Map of Bikita district. Extracted from Chikodzi et al (2013).

Most parts of Bikita are found in arid and semi-arid belt with poor topographic characteristics. Most farmers' dependence on rain fed agriculture increase their vulnerability to perennial to droughts. Farmers grow small grains such as rapoko, millet and sorghum. Growing small grains is an adaptive strategy against harsh seasonal conditions. Harsh conditions limit cultivation of maize, the staple cereal. Apart from small grains, groundnuts are cultivated for commercial reasons despite serious market challenges. Domestic animals such as cattle,

donkeys, goats and sheep are common. Domestic animals save two main functions. Firstly, bigger livestock such as cattle and donkeys are used as source of draught power. Secondly, they are used as safety nets during disasters. Farmers sell domestic animals in coping with disasters such as droughts. Apart from selling livestock in coping with disasters, majority of vulnerable farmers depend on food aid from local institutions. The main food donors are NGOs and government's Ministry of Labor Social Welfare. Furthermore, local farmers adapt to disasters through migration to big cities and working in irrigated commercial farms in Chipangayi, Chipinge, Middle Sabi, and Birchneough.

5.4 Results

5.4.1 Farmer perception and decision making on seasonal forecasting sources

Data collected using questionnaires reflected various indigenous indicators which are used by local farmers in planning, making decisions and adapting to farming disasters. Questionnaires revealed that in the 1990s, astronomical indicators were more reliable compared to birds and tree phenology (Figure 5.1). Further inquiry highlighted that during such times, there were more knowledgeable elders who understand and interpret them well. Reliability of astronomical indicators made most elderly farmers to depend more on indigenous indicators than scientific forecasting for seasonal information. In 2015, the study observed that majority of farmers were relying more on tree phenology than other indicators. Smallholder farmers explained that loss of knowledgeable elderly persons due to death reduced their reliance on astronomical factors. Most farmers who depend on indigenous knowledge derive it from trees and other plant species because of their reliability and simplicity in interpretation.

On the other hand, reliability of birds in seasonal forecasting was declining. Participants to the study pointed out that those birds were becoming few and this affected their role in seasonal forecasting. Furthermore, some birds are no longer producing sounds as they used to do before for weather and seasonal prediction. Young farmers (below 40 years of age) did not appreciate birds as indicators because some of them did not know the birds.

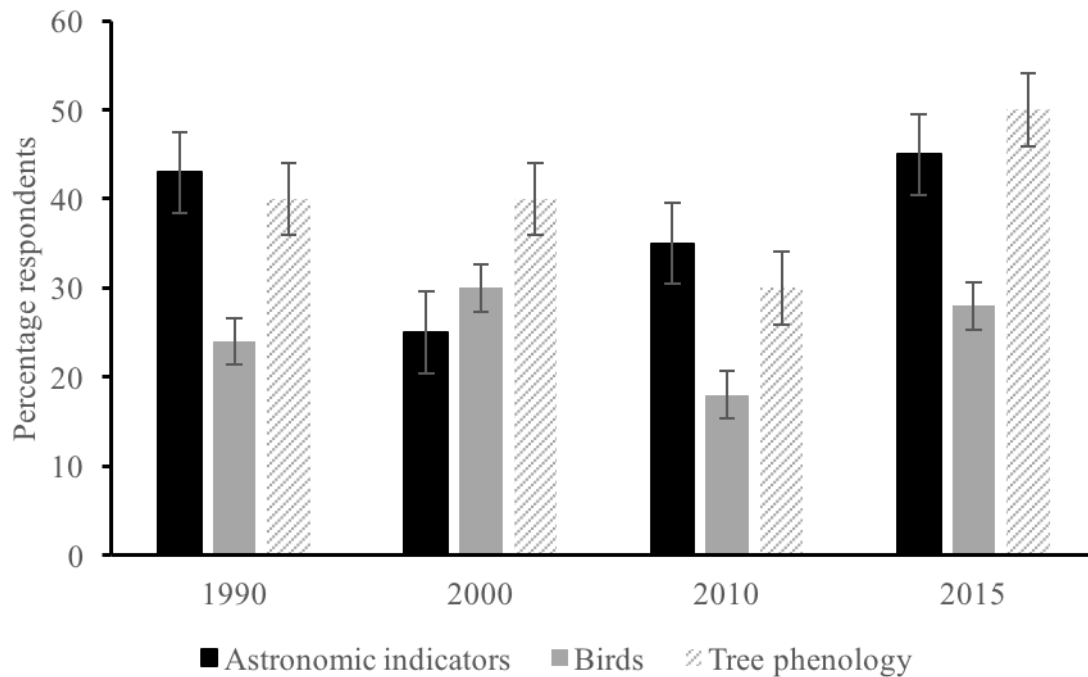


Figure 5.2: Use of indigenous indicators in Bikita district. Source: Filed questionnaires, 2015

Information obtained through focus group discussions depicted that both young farmers (below 40 years of age) and elderly farmers (above 40 years of age) experienced problems with indigenous indicators in weather and seasonal prediction. They pointed out that some of the shortcomings affected the reliability of such indicators hence directing them to use both indigenous indicators and scientific seasonal forecasting. Table 5.1 shows responses from focus group discussions on smallholder farmers’ perceptions on the role of indigenous indicators. It also points out how they affect farmers’ perceptions on relying on them.

The shortcomings associated with indigenous indicators were pointed among other factors which discourage young farmers from relying on indigenous indicators for seasonal prediction and adaptation. Reliability of tree phenological indicators directed knowledgeable elderly farmers to depend on trees in planning and making decisions in farming and coping with disasters. To the contrary, young farmers reject local indicators because of the shortcomings they possess.

Table 5.1: Reflections on the unreliability of various indigenous indicators

Indigenous indicator	Reliability
Tree phenology	Most of the mentioned trees are reliable both short term and long term seasonal prediction. They pointed out those trees such as <i>muuyu</i> (<i>Adansonia digitata</i>) and <i>mupanda</i> tree (<i>Philenoptera nelsii</i>) are still reliable. Some trees were disappearing and dried due to dryness.
Birds	They expressed that most birds such as <i>kohwera</i> , (Cuckoo), <i>dendera</i> (<i>Bucorvu leadbeateri</i>) <i>chivangazuva</i> (<i>Cinnyris jugularis</i>) are no longer reliable than they used to do. Birds with weather and seasonal predicting capacity have disappeared in ward 24. The few that are found in ward 20 and 21 are no longer behaving as they used to do in seasonal prediction.
Astronomical indicators	Astronomical indicators such as wind direction, clouds, temperatures among others are very reliable in supplying seasonal information. The problem is that majority of farmers do not know to interpret them.
Insects	Majority of weather and seasonal predicting insects have disappeared making it difficult for knowledgeable farmers to rely on them.

Source: Field work questionnaires, 2015.

Information gathered from elderly key informants showed that selection of indigenous indicators is largely determined by farmers' experiences. One of the key informants (a 78-year-old woman) expressed that unreliability of local indicators in seasonal prediction is making them to make wrong decisions. Wrong decisions increase their vulnerable to droughts. She further expressed that unreliability of local indicators is forcing them to gamble in making decisions on appropriate action to take in farming.

5.4.2 Decision making on the commencement of a farming season

Information gathered through focus group discussions revealed that unreliability of local indicators is creating serious problems for elderly farmers in making cropping calendars. Most young farmers confirmed that they have decided to adhere to scientific seasonal forecasting when their elders are struggling to have forecasting information on time. Both young and elderly farmers highlighted challenges they face in getting seasonal information from scientific seasonal forecasting. The groups pointed out that they hardly get seasonal forecasting information on time. Focus group discussions drawn from ward 20 and 21 expressed that they receive minimum attention or sometimes no attention from their local extension services officers. They also pointed out that lack of access to radios, televisions and newspapers reduce their chances of getting accurate scientific forecasting information. In ward

24, farmers confirmed that they receive assistance from the extension services officer but they find it difficult to use the information on making decisions. They pointed out that some of the information they get on the commencement of rain season is sometimes unreliable. Focus group discussions revealed that most of the predictions do not come to pass because they made wide areas.

Both young and elderly farmers confirmed that sometimes they rely on general knowledge about the commencement of a farming season. They explained that in most cases they get prepared for farming in mid-October. Elderly farmers expressed that they stick to these dates despite signs of delayed rains from both indigenous indicators and scientific seasonal forecasting. Most farmers expressed that there are conflicting decisions which are made by farmers due to unreliability of forecasting from two sources. In most cases local farmers do compete in planting despite unclear information on the commencement of the farming season. One elderly farmer from the focus group discussion said that, '*mujaho wemujecha unoda kutangirana nevamwe*' (people should start sand marathon at the same time). She further explained that both young and old farmers base their decisions on common knowledge rather than depending much on forecasting information from indigenous knowledge and scientific forecasting.

5.4.3 Local farmer knowledge on seasonal quality

Through focus group discussions, elderly farmers expressed that depend on indigenous indicators despite some of them being inefficient in forecasting like they used to do before. Most respondents agreed that they trust heavy flowering and profuse fruiting of *Muuyu* (*Adansonia digitata*) and *Mupanda* (*Philenoptera nelsii*) in indicating a good farming season. Heavy flowering instructs them to grow even water demanding crops such as maize cereals among others.

To the contrary, young farmers' challenges in interpreting tree phenological characteristics on seasonal quality led them to ignore it. On choice of crops to grow they concentrate on small grains because they know that the area is semi-arid. Both young and elderly farmers concurred that despite challenges of accessing information on seasonal quality, they continue with farming since it is their main livelihood strategy. One of the focus group participants expressed that, '*kurima akuna benzi*' (farming is never considered as madness). All the

smallholder farmers reflected that lack of other livelihood strategies compel them to invest much in farming despite their vulnerability to disasters such as droughts.

From the focus group discussions, elderly farmers confirmed that despite indigenous indicators predicting a good season, they need to understand the distribution of rain patterns though out the season. Farmers from ward 20, 21 and 24 confirmed that sometimes they rely on indigenous indicators in detecting episodes such as the coming of dry spells. They expressed that knowledgeable farmers rely on birds and insects for information on coming of dry spells. Furthermore, these help farmers on making good decisions such as when to weed, apply fertilizer, when to pool their labor resources among other behaviours. On the other hand, young farmers expressed their ignorance and use of indigenous indicators in determining the coming of dry spells.

5.4.4 Farmer decisions on the types of crops to grow

Data gathered through focus group discussions and key informant interviews showed that both young and elderly farmers have similar views on the choices on crops to cultivate. They expressed that the dryness of their areas directs them to grow drought resistant crops such as rapoko, millet and sorghum. Young farmers agreed that most decisions they make on crops to grow come from elders and extension services officers in their areas. Furthermore, young farmers confirmed their desire in farming commercial crops for money but they are forbidden to do so by the harsh weather and seasonal conditions. Elderly farmers also expressed that despite maize being the main staple cereal consumed locally, they find it difficult to grow it due to dry conditions. They avoid growing maize in big portions to avoid succumbing to droughts especially during dry seasons.

Participants in the focus group discussions further expressed that decisions they make on crops to grow is also reinforced by intervention of local institutions. They confirmed receiving small grain seeds from NGOs such as CARE International and SAT (Sustainable Agricultural Trust). Apart from receiving sorghum and rapoko seeds, local farmers are also given farming expert advice from the NGOs officers. Despite positive benefits from NGOs, some elderly farmers complained about the help they get from NGOs. One case cited from the focus group discussion revealed that in 2015 farming season, most farmers received toxic red sorghum from CARE International. They expressed that the seeds were toxic if consumed by livestock such as cattle and goats. It was confirmed that majority of farmers lost their cattle and goats

after they ate red sorghum plant. Most elderly farmers expressed that problems caused by modern technologies and knowledge is detrimental to their livelihoods. As a result, they explained why they opt for indigenous crops and their knowledge in planning, making decisions and adapting to extreme seasonal conditions.

5.4.5 Farmers’ perceptions on participation in rain making rituals

Data gathered using questionnaires showed some varying trends on local farmers’ perceptions and participation in rain making ceremonies. Around the 1990s, there was significant difference between rain making rituals and Christian rituals (Figure 5.2; $P \leq 0.05$). Most farmers were participating in Christian rituals compared to traditional rain making ceremonies. Around 2015, traditional rain making ceremonies were more than Christian rituals of making rains. Local farmers expressed that perennial droughts and dry conditions compelled majority of local farmers to participate traditional rain ceremonies as an adaptive strategy of reducing vulnerability to disasters. It also emerged that elderly farmers dominate in the execution of traditional ritual ceremonies. Most young farmers participate in both Christian and traditional rain making ceremonies.

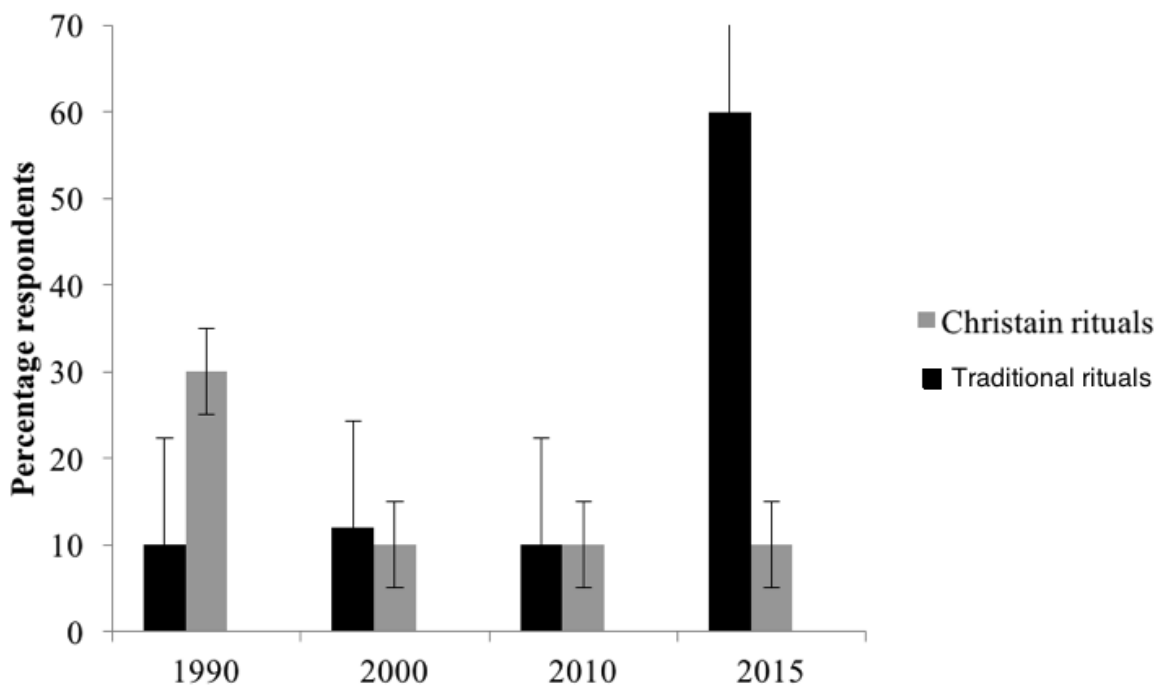


Figure 5.3: Traditional and Christian rain making rituals. Source: Field work questionnaire, 2015

Information gathered through focus group discussions highlighted that education, science and loss of experienced traditional leadership impacted negatively to the performance of rain making ceremonies. Participants expressed that loss of elderly and knowledgeable traditional leadership negatively affected how rituals are conducted. Elderly respondents pointed out that government's involvement in installation of chiefs have negatively affected ritual processes selecting local leadership. They expressed that young leadership are disturbing ritual process. They highlighted that younger generations' lack of knowledge on the role of rain making ceremonies is increasing its disappearance.

On other aspects such as science and education, young farmers expressed their lack of understanding on how the rain making ceremonies induce rain or avoiding disasters. They indicated that their knowledge gave them clear information of how rain and disasters can be managed and avoided. On the opposite end, elderly respondents expressed that running away from their traditional beliefs is among other causes of unreliability of rain making ceremonies. They expressed the need to go back and follow what their ancestors used to do before rain seasons and after the farming seasons.

5.5 Discussion

It has been noted that smallholder farmers' ownership of natural and human capital is integral in the provision of seasonal forecasting information. Local farmers' access to forecasting information is very important in planning, decision making and adaptation to climate change impacts. Farmers with adequate weather and seasonal information are tipped to safeguard their agro-based livelihoods (DFID, 2000). In Bikita, smallholder farmers' dependence on indigenous indicators and scientific seasonal forecasting is not the same on all farmers. Main noted factors behind the selection of a forecasting source is influenced mainly by age, experience in farming, education and religion. These factors play an important role in influencing local farmers' perceptions on the selection of seasonal forecasting source.

As highlighted earlier, age has tremendous influence on farmers' perceptions on using indigenous indicators and scientific forecasting on seasonal prediction. As noted in the findings elderly farmers are the more inclined to local knowledge in making decisions on farming livelihoods. Adherence to indigenous indicators is driven by the cosmological relationship developed by farmers when interacting with their environment. To the contrary,

younger generations find it difficult to base their decisions on indigenous indicators because different experiences and knowledge world view. Considering these two diametrical standpoints, it is undisputable that most farmers avoid depending on what they don't understand. Making decisions on what local farmers don't understand compel them to make errors and wrong judgments (Wang and Ruhe, 2007). Local farmers who make errors or wrong decisions are vulnerable to disasters such as droughts inter alia. Quick adjusting to embrace either indigenous knowledge or scientific seasonal forecasting is problematic to many local farmers (Eply and Gilovich, 2006). Many local farmers' perceptions are fundamental in determining their possible step and action to take on cropping calendars, harvesting and preserving yields.

As indicated earlier knowledge on indigenous indicators is common amongst elderly and experienced farmers. To the opposite, young farmers' negative perceptions are reinforced by their lack of experience as well reduced efficiency of indigenous indicators. Extreme climate change impacts are also in part to blame on reducing indigenous indicators' efficiency in seasonal prediction. Unreliability of indigenous indicators creates to cognitive illusions when it comes to decision making in farming (Chen, 2011). Wrong decisions which subject farmers to vulnerability to climate change impacts increases dissonance (Ibid). In most cases, farmers especially the young without firm grounding on indigenous indicators will reject it while considering scientific forecasting as the better alternative.

Positive perceptions on scientific seasonal forecasting are reinforced by other factors such as education, belief in science and Christianity. A combination of these factors is detrimental to the disappearance of indigenous indicators. Whilst education, science and Christianity create consonance on young farmers, it has a repelling impact on elderly farmers. Elderly farmers' lack of knowledge on modern knowledge systems is disastrous to the decisions and action they take in either reducing vulnerability or adapting. In many cases, elderly farmers have comfort in local knowledge despite some notable challenges they experience with it (Chang'a et al, 2010).

Despite different perceptions on use of indigenous knowledge and scientific seasonal forecasting, most local farmers are dependent on each other. The strategy of mutual dependence between farmers of different age groups and knowledge world view is known as adjustment heuristics (Eply and Gilovich, 2006). Adjustment heuristics are common in many

occasions such as planting time lines, choice of crops to plant among other important decisions. In some cases, young farmers admitted banking on available human capital (knowledgeable elders) on planting calendars and adapting to disasters such as droughts and diseases. To the contrary, some elderly farmers also reflected their dependence on scientific forecasting on disasters preparedness. It can be deduced that integration of the two seasonal prediction sources is important in reducing local farmers' vulnerability to climate change shocks and stresses (Sunstein, 2006). Local farmers use the rule of thumb in incorporating what they miss in broadening their scope of coping and adapting uncertainties. Local farmers who integrate forecasting information from the two sources are better positioned to make less costly errors in making decisions. Moreover, local farmers who always make good decisions are well positioned to adapt as well as to maximizing their livelihood chances.

5.5.1 Local farmers' perceptions and decisions on rain making ceremonies

Rain making rituals / ceremonies are common practices in many indigenous farming communities in Africa (Roncoli et al, 2002; Kijazi et al, 2013). It is a critical human capital used by farmers in inducing favorable seasonal conditions at the same time avoiding impending dangers from angry ancestors and gods. Appeasing gods and ancestors is performed some few months or days before rain seasons (Roncoli et al, 2002). As observed in Bikita rain making ceremonies are common practices. In spite of the fact that rain making ceremonies are popular in Bikita, it is amongst other indigenous practices under threat. Most threats to rain making ceremonies are caused by the proliferation of modern science, education and Christianity.

Variables such as different religious beliefs, education and science have huge impact on local farmers' negative or positive perceptions on rain making ceremonies. As observed in the study, young farmers' negative perceptions on rain making rituals are driven by their lack of knowledge about it. Furthermore, extreme climate change impacts also affected they way they believe in them as an adaptive strategy to fight disasters such as droughts and other misfortunes. To the opposite, elderly farmers who have been depending on it are more positive of it than those that criticize them. The strategy of turning to gods and ancestors provide comfort to elderly farmers who have a cosmologically driven knowledge and world view in subsistence farming (Goldstein and Gigerenzer, 2002; Mustein and Maloney, 2013).

Young farmers' negative views on rain making ceremony is premised on their ignorance of failing to understand the symbiotic relationship between brewing beer and rain (Roncoli et al, 2002). Young farmers' strict adherence to what they know and opposing what they don't know is known as anchoring heuristics (Metin and Camgoz, 2011). Anchoring heuristics is a condition when one sticks to what he or she knows and reluctant admit new knowledge. Young farmers' scientific and Christian background negatively affects their decisions to participate in rain making ceremonies.

Negative perceptions on rain making ceremonies largely affect how the ceremonies are performed. Uncoordinated performance of rain making ceremonies usually affects the targeted outcome. Combining disagreements on execution of rain making ceremonies put it in serious doubts about its potential of predicating good seasons with fewer misfortunes to agro-based livelihoods. Furthermore, different religious beliefs such as Christianity pose more threats to the existence and effectiveness of rain making ceremonies. As a way of breaking the deadlock, most farmers end up combining both practices (traditional rain making and Christian based rain making ceremonies (Metin and Camgoz, 2011). Combining the two usually reduces psychological stresses amongst local farmers of different backgrounds and world views.

Combining different farmers with different views on rain making ceremonies has the propensity of affecting the procedures and outcomes. Involvement of inexperienced farmers has increased doubts as well as breaking laid procedures. For example, the presence of youth has seen rituals being performed with forbidden plastic containers. The use of plastic containers replaced the cosmologically approved clay pot and this is believed to negatively affect the outcome. Diverging views are dangerous to the whole ceremony. In most cases, majority of youthful farmers and Christian oriented followers end up shunning the ceremonies altogether. To the contrary, elderly farmers pointed such inconsistencies among other factors which affect the success of the rituals.

Apart from age and religious differences, politics also impacts on local farmers' perceptions and participation in rain making ceremonies. As noted from the study, absence of knowledgeable and elderly traditional leadership contributes to the negative thoughts surrounding rain making ceremonies. As highlighted, the involvement of Ministry of Local Government in selection and installation of traditional leadership has opened floodgates for corruption, nepotism and power buying. Such incidences opened the room for educated and

energetic young people at an advantage of grabbing power at the expense of knowledgeable and deserving elders. Grabbing of power by the youth poses severe challenges on who, where, when and how to execute the rituals. The two opposing mindsets created serious psychological dissonance between because each act was contradicting the knowledge and experience of the other. Antagonistic generational accelerate the emergence of conflicts and struggles amongst the local farmers (Downlatabadi and McDaniels, 2012; Chen, 2011). Local farmers with pronounced conflicts are vulnerable to disasters with limited adaptive capacity.

5.6 Conclusion

Smallholder farmers have different perceptions on the selection of sources of seasonal forecasting sources. Different perceptions on the choice of a forecasting source are based on different variables such as age, education, experience inter alia. Adherence to indigenous indicators is driven by age and experience by farmers in weather and seasonal forecasting as well as decision making. In addition, adherence to scientific forecasting is caused by modern science, education and Christian based religious beliefs. Each category's attachment to a forecasting source is a strategy of avoiding making errors and wrong decisions which subjects local farmers to farming disasters. Nevertheless, shortcomings associated with each forecasting sources propel local farmers to combine the two in accessing forecasting information. The obtained information is important in planning, decision making, coping and adapting to farming shocks and stresses. Lastly, variables such as education, age, experience inter alia plays a bigger role on performance of rain making ceremonies. Categories with diverse beliefs and knowledge have different perceptions on rain making ceremonies. Different views are centered on processes of executing them, who should execute them and also the results. All conflicting standpoints largely affect the whole processes and the expected positive outcomes of avoiding potential threats such as droughts and diseases.

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CHAPTER 6

GENDER VULNERABILITY AND IN INDIGENOUS KNOWLEDGE IN ADAPTATION TO CLIMATE CHANGE IMPACTS.

Abstract

The study scrutinized gender based vulnerability in the face of climate change and variability amongst smallholder farmers in Bikita. It examines the impact of climate change risks and hazards in adaptation on gender relations, roles and inequalities. Thereafter, it interrogates the role of indigenous knowledge in building resilience and adaptive capacity. Data was collected using key informant interviews, focus group discussions and questionnaires. Findings from the study revealed that vulnerability to extreme climate change impacts is not gender neutral. Women are more vulnerable to multiple climate change shocks and stresses than men due to unbalanced gender roles. Women's vulnerability is worsened by both on-farm and off-farm adaptive strategies. Adaptive strategies such as exploiting natural resources, buying and selling and involvement in multiple small-scale projects overburdens women time and labor but with diminishing returns. Though men are also victims of climate change impacts, their adaptation strategies such as migration and seeking wage labor is less demanding than those of women. It is concluded that women do not use indigenous knowledge in adaptation hence they are more vulnerable than men.

Key words: gender, vulnerability, gender mainstreaming, indigenous knowledge

6.1 Introduction

Climate change and variability are posing serious global threats to humanity world over (Porter et al, 2014). Climate change like other disasters such as wars, earthquakes and diseases threaten human security. Severities of climate change and variability impacts are exposing many poor people to severe shocks and stresses with low adaptive capacity (IPCC, 2007). The most vulnerable groups are women and children in agro-based smallholder communities in sub-Saharan Africa (IPCC, 2007). Vulnerabilities of women and children are worsened by disease outbreaks, pest multiplication, unprecedented droughts, rising tides and heat waves.

Severity of climate change and variability impacts reduces smallholder farmers' adaptive capacity (Porter et al, 2014). Low adaptive capacity is further worsened by poverty, poor performing economies and lack of technologies. Local farmers' lack of financial capital, technical expertise and vibrant climate change policies reduce their adaptive capacity to climate change disasters (IPCC, 2007). Implementing irrigation as an alternative to rain fed farming is limited in southern Africa due to financial limitations (Porter et al, 2014). Irrigation reduces local farmers' vulnerability by supporting dry land farming.

Impacts of climate change are not neutral to the human race worldwide (Dankelman, 2010; Terry, 2009). Various studies confirmed that women and children are more vulnerable than men (IPCC, 2007). Most vulnerable women have low adaptive capacity. Women's ability or inability to adapt to climate change impacts is determined by possession or non-possession of assets and seasonal information (Dankelman, 2010). Women's lack of assets and vibrant livelihood strategies is caused by unbalanced gender based role allocation (Denton, 2000). Furthermore, women's vulnerability to complex climate change disasters is exacerbated by some of the adaptive strategies they employ.

This chapter interrogates gender based vulnerability against climate change disasters amongst smallholder farmers in Bikita district. It explores the impact of coping and adaptive strategies in enhancing livelihoods options or worsening gender based vulnerabilities. This is achieved through scrutinizing men and women's diverse experiences in responding to various climatic change shocks and stresses. It also traced the influence of patrimonial and conservative culture on women's vulnerability to climate change disasters. Lastly, the study evaluates the importance of indigenous knowledge systems in adaptation.

6.2 Materials and methods

Both probabilistic and non-probabilistic sampling techniques were used to select respondents. Three wards in Bikita, ward 20, 21 and 24, were purposefully selected for this study. Wards 20 and 21 are found in agro-ecological region IV (four) with semi-arid characteristics. These two wards have similar soil types, tree species and other topographic characteristics. Ward 24 which is found in agro-ecological region V (five) has arid characteristics. The reason for inclusion of ward 24 was to give a cross comparison on adaptation strategies used by farmers with different rainfall patterns. The study squared off indigenous knowledge and adaptive strategies used in the three wards against the background that ward 24 are product of resettlement. Combining the three wards provided rich ground for comparing similarities and differences considering differences in background of farmers and ecological characteristics.

After purposive selection of wards, the names of all villages in each ward were recorded as provided by the ward councilors, village headmen and extension service officers. Ward 20 had 45 villages, ward 21 had 26 villages and ward 24 had 15 villages. Despite the three wards

having different number of villages, three participating villages were randomly selected from each ward. The decision of selecting three villages in each ward was based on two reasons. Firstly, all farmers in the three wards have similar cropping systems, similar soil types and vegetation and secondly financial limitations. Lack of adequate research resources limited the numbers of participating villages and households. Furthermore, similarities in soils types and vegetation also represent similarities in indigenous knowledge seasonal forecasting indicators and this pushed me to reduce the need for more villages.

From the selected villages, households in each of the three selected villages of each ward were listed. From the listed households, ten households were selected from each village making a total of thirty participants from each ward. Selection of ten households per village was influenced by financial challenges, similarities in cropping behaviors and similarities in soil types, tree species and other topographic characteristics. The process of purposive selection and random selection of participants was repeated across other two wards. All the selected participants selected in this category answered the questionnaires. Three research assistants in helped in administering questionnaires. The study was carried out in six months.

On focus group discussion (FGD) both men and women were selected as participants who were drawn from the household lists prepared for those that participated in the questionnaire. Three focus group sessions were purposely done in each of the selected villages. Each focus group discussion had twelve participants of which six were male and the six were females. Participants were randomly selected. The rigorous process of selecting focus group discussion participants was repeated across all the three wards. On key informants, two participants who comprised an expert in poaching and one in diamond panning were selected. These two participants provided information on how they perceived gender based risks and vulnerability in adapting to climate change impacts.

6.3 Study area

Bikita is one of the seven administrative districts in Masvingo province in Zimbabwe (Figure 6.1). The other six districts are Zaka, Gutu, Mwenezi, Chiredzi, Chivi and Masvingo urban. Bikita District is located 80 km east of Masvingo city and 377.9 km from Harare. It lies about 656 meters above sea level. Bikita district is dominated by the Karanga people of the Duma totem. The Karanga people depend on mixed subsistent farming.

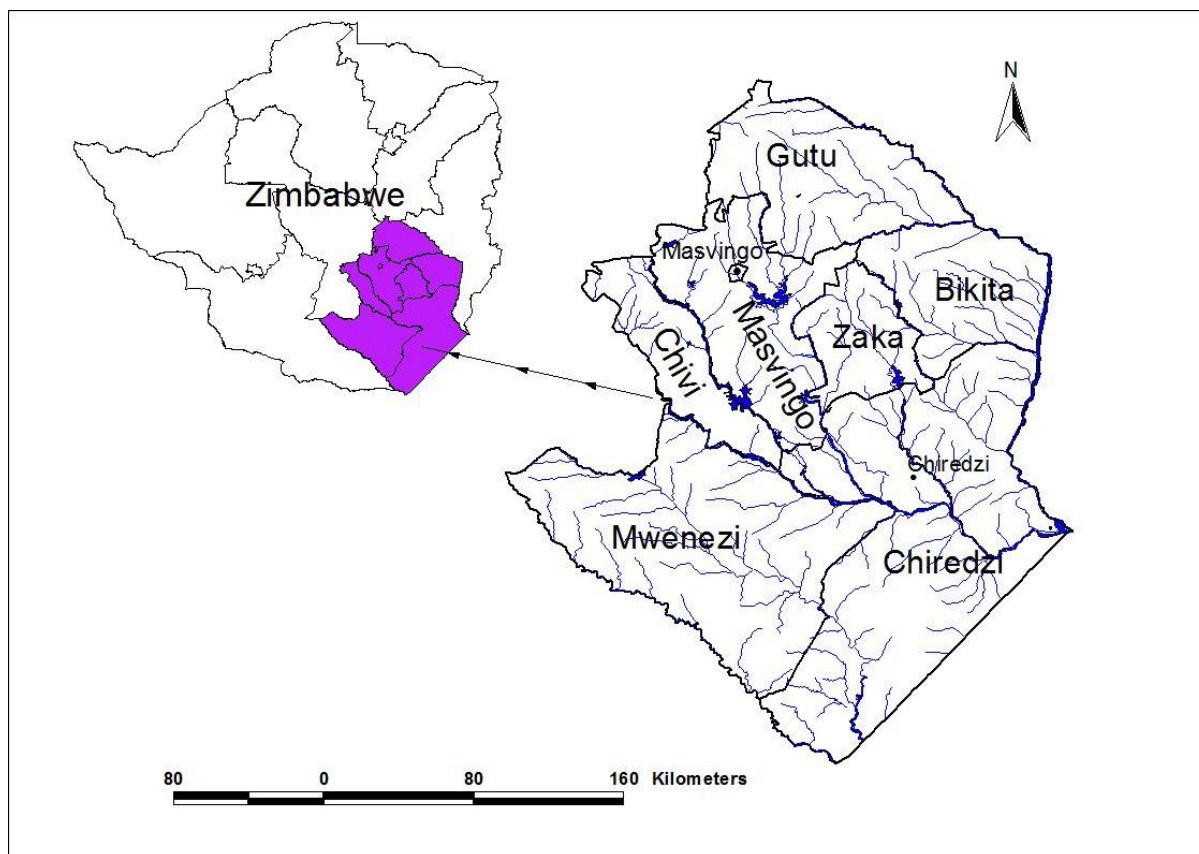


Figure 6.1: Map of Bikita district. Extracted from Chikodzi et al (2013).

Most parts of Bikita are found in arid and semi-arid belt with poor topographic characteristics. Most farmers' dependence on rain fed agriculture increase their vulnerability to perennial to droughts. Farmers grow small grains such as rapoko, millet and sorghum. Growing small grains is an adaptive strategy against harsh seasonal conditions. Harsh conditions limit cultivation of maize, the staple cereal. Apart from small grains, groundnuts are cultivated for commercial reasons despite serious market challenges. Domestic animals such as cattle, donkeys, goats and sheep are common. Domestic animals save two main functions. Firstly, bigger livestock such as cattle and donkeys are used as source of draught power. Secondly, they are used as safety nets during disasters. Farmers sell domestic animals in coping with disasters such as droughts. Apart from selling livestock in coping with disasters, majority of vulnerable farmers depend on food aid from local institutions. The main food donors are NGOs and government's Ministry of Labor Social Welfare. Furthermore, local farmers adapt to disasters through migration to big cities and working in irrigated commercial farms in Chipangayi, Chipinge, Middle Sabi, and Birchneough.

6.4 Results

6.4.1 Gender and age based vulnerability in ward 24

Information obtained from questionnaires administered in ward 24 revealed that vulnerability among smallholder farmers is not gender neutral. Women are more vulnerable to climate change disasters than men. Nevertheless, respondents also pointed out its not women who are vulnerable to climate change and non-climate change disasters. Through questionnaires, focus group discussions and key informant interviews they highlighted that there elderly people and children are also vulnerable compared to men.

Information gathered through focus group discussion showed that differences in men and women's social-cultural responsibilities increase their vulnerability to extreme climate change impacts. It was also obtained that in as much as men can perform domestic duties women perform them more than them. Also in there some women perform adaptation strategies embraced by men but they remain more vulnerable than men. They pointed out embracing men's culturally assigned doubles their responsibilities. Table 6.1 shows women's complex domestic roles increase their vulnerabilities.

Table 6.1: Gender based roles

Women's domestic roles	Men's domestic roles
-Working in the fields	-Working in the fields with women
-Cooking for the family	-Looking after cattle
-Caring for children, the sick and old	-Thatching houses
-Fetching water, firewood etc.	-Offering minor help to women in other roles
-Harvesting thatching grass	

Focus group discussions revealed that women's domestic responsibilities are more complex and demanding than those of men. Female respondents expressed those domestic duties such as fetching water, firewood, thatching grass, cooking for family, caring for children, the elderly and the sick strain them. Apart from domestic responsibilities, on-field duties also negatively affect women's vulnerability to climate change disasters. Women explained that they spend more time working in the fields, tilling, planting, weeding, harvesting and making sure that the harvests are safely kept. They expressed that in most cases women single handedly performs these duties without or with minimum help from men.

Questionnaires and focus group discussions also pointed out that elderly woman farmers are another vulnerable category in ward 24. Elderly women farmers are finding it difficult to cope up and adapt to disasters affecting their agro-based livelihoods. These farmers' lack of energy and assets limit their ability to work for themselves compared to energetic farmers. They further explained that their vulnerability is worsened by disasters such as HIV and AIDS. Some elderly women respondents from focus group discussions revealed that they are overburdened by caring for orphans left by HIV and AIDS victims. Absence of government's help was increasing their vulnerability to climate change risks and hazards. For survival, they acknowledged depending on food aid NGOs. They explained that food aid does not strengthen their adaptive capacity against climate change risks and hazards.

Lastly, focus group discussions considered men outside the vulnerable category despite different views from them. Female respondents expressed that men are better off due to their ownership of assets. They also argue that adaptive strategies which are employed by men such as migration are better than those employed by women.

6.4.2 Women's adaptive strategies nexus vulnerability

Data gathered through focus group discussions revealed that women employed various off-field coping and adaptive strategies against climate change disasters. Female respondents expressed that their adaptive strategies are labor demanding at the same time have diminishing returns compared to those of men. Also it was noted that though some women embrace adaptive strategies employed by men, they will be adding more to their daily responsibilities. Table 6.2 highlights different adaptive strategies employed by smallholder women and men in ward 24.

Table 6.2: Gender based adaptation

Women’s adaptive strategies	Men’s adaptive strategies
<ul style="list-style-type: none"> -Selling caterpillar and firewood for survival -Brick laying with minimal help from men -Participation in burial societies, community gardens and small-scale credit schemes -Pottery projects -Weaving and basket making -Brewing and selling beer 	<ul style="list-style-type: none"> -Temporal and permanent migration in cities and abroad -Participating in poaching and diamond punning -Performing minor duties helping women

Source: Fieldwork FGDs and key informant interviews, 2016.

On harvesting and indigenous insects such as selling caterpillars (*Lepidopteran*) women experience a lot of challenges with minimum returns. Focus group discussion participants expressed difficulties in harvesting caterpillars from mopane trees (*Colophospermum mopane*). The harvesting and drying them is labor demanding because they do it manually. Also selling caterpillars is problematic due unavailability of the markets. Majority of them sell them in undesignated selling points along the Mutare-Masvingo highway. Some women confirmed that other projects like brick laying also stressing but with minimum returns. In most cases, poor women singled handedly participate in these activities with less or no help from men. Furthermore, women are also revealed that they are also expected to participate in small scale projects such as credit schemes, burial societies and community gardens which strain them. Lastly, women pointed that widows are another vulnerable category without help from men.

In opposition to women’s views, men who participated in the focus group discussions explained that their adaptive strategies are more risk and hard compared to those of women. Though some women acknowledge the role played by men in survival, they blamed majority of men for being irresponsible with money and their families. Nevertheless, men in the focus group discussions expressed themselves as hard working and being responsible. They revealed that strategies such as diamond punning from Chiadzwa and poaching wild animals from Devure Range are riskier than women’s duties. These arguments were further supported by two key informants who participated in the poaching and diamond punning. Box 6.1 highlights reflections and experiences encountered by men’s adaptive strategies.

Box 6.1: Reflections on poaching and diamond punning

A 33-year-old poacher – poaching is a risk business for us. We form groups and cross the Devure Range fence hunting for wild animals. We are not selective on the animals but we prioritize bigger game such as zebras, wild beasts and sometimes buffaloes. We are exposed to dangers such as being attacked by wild animals, being arrested or short by game rangers and police. Other challenges we face is storage of meat and the market. We risk losing our meat and hides which we sell for money.

A 35-year-old diamond panner – in diamond punning, we face many challenges which are different from those of women at home or fields. We travel long distances to Chiadzwa and illegally dig diamonds. We face risks of being arrested or short by police officers and soldiers who are protecting the Chiadzwa mines. Furthermore, some of us die from collapsing tunnels. Lastly, market is also problematic for our diamonds. We work so hard but we are losers in the end because buyers don't pay us what we deserve.

Apart from poaching and diamond panning, men expressed that strategies such as migration are more demanding than those of women. Male participants in the focus group discussions expressed that in migration, they are exposed to life threatening risks such as working in hazardous environments. They also agreed that temporal jobs like *maricho* (piece jobs) in Chipinge, Birchneough, Chipangayi, Middle Sabi and sugar cane plantations in Chiredzi are more painful than domestic duties. Migrants crossing to South Africa without legal travelling documents are exposed to risks when crossing crocodile infested Limpopo River. On the other hand, illegal migrants to Mozambique are exposed to landmines which were planted during the wars in Zimbabwe and Mozambique. Furthermore, men expressed that illegality in foreign countries subject to occasional arrests and inhuman treatment compared to women at home.

6.4.3 Gender vulnerability and adaptation in ward 20 and 21

Information obtained through questionnaires, focus group discussions and key informant interviews in ward 20 and 21 confirmed that domestic responsibilities strain them on top of other adaptation strategies against droughts and diseases. They expressed that they work in the fields with minimal or without help from men. They pointed out that perennial droughts and water problems largely affects their agro-based livelihoods. In coping with droughts, women

engage in time consuming and labor demanding activities which offers them little returns. Detailed information on women’s adaptive strategies is shown in Table 6.3.

Table 6.3: Women’s adaptive strategies in ward 20 and 21

Adaptive strategies	Execution of the strategies
Basket making and pottery	Pottery and basket supplement women’s their household income. These activities labor demanding with diminishing returns.
Beer brewing	Women brew beer using as rapoko, millet and sorghum. overburden them than men. Beer brewing is labor demanding and all the proceeds they get are taken by men. Prevalence of traditional beer increases domestic violence.
Harvesting and selling wild fruits	Most women engage in harvesting and selling indigenous fruits such as <i>nyii</i> (<i>Berchemia discolor</i>). They have no ready markets for the fruits. Some travel long distances reach Masvingo-Mutare highway. A 20 litre bucket of <i>nyii</i> is sold at \$7.00 (US dollars) and resold in urban areas for \$25 or more. Women get far less despite their hard work.
Social groups	Women participate in small scale projects such as community gardens, small scale credits, poultry projects and burial societies as adaptive strategies. Small scale projects are labor demanding and stressful.

Women expressed that they employ indigenous strategies such as pottery, basket making and selling indigenous fruits. They pointed out that the strategies increased their workload with minimum benefits. Also growing traditional crops for survival worsens their livelihood activities but with minimum benefits. Women also explained that their low status social roles limit their influence of performance of rain making rituals as a strategy of reducing droughts. On the opposite side, men argued that women’s adaptive strategies are simple and confined to the domestic sphere. Participants in the focus group discussion expressed that men endure challenging responsibilities at home and abroad.

6.5 Discussion

In the climate change discourse, issues of gender based vulnerability are debatable (Dankelman, 2010). Despite many studies confirming that climate change impacts affect everyone, women are singled out as an exclusive category. Women’s vulnerability to climate change impacts is caused by factors such as gender roles and the subsequent adaptive strategies they employ. In smallholder livelihoods, women are driven into labor demanding activities at the same time not exonerated fulfilling routine domestic duties. Domestic

responsibilities consume most of women's time and labor with minimum benefits compared to their male counterparts. Furthermore, women's non-ownership of critical livelihoods capitals such as livestock limits their potential of adaptation compared to men. In most cases women end up engaging in coping and adaptive strategies that increases their vulnerability to disasters.

It is arguable that women's vulnerability is also centered on various adaptive strategies they employ. Some adaptive strategies employed by women play an important role in weakening women's adaptive capacity. Persistence of low adaptive capacity leads to maladaptation and increased vulnerability on women. For example, women's limited mobility potential reduces their chances of avoiding or reducing the impact of disasters. To the contrary, men are better as migrants because they ran away from disasters compared to resident women.

Cases of men migrating from disaster ridden areas to greener pastures are common world over. In the local context, perennial droughts and unemployment in Zimbabwe forced men particularly from Masvingo province (mainly Chiredzi, Mwenezi and Chivi districts) to flood in South Africa searching wage labor (Mtisi, 2010; Nhamo, 2003). Similar trends of male migration are also common in the Gaza province of Mozambique. Perennial droughts and floods forced men from Mabalane, Chibuto, Chicualacuala, Musangena and Chigubo to emigrate into the neighboring South Africa (Ossario, 2003). On this standpoint, men's adaptive strategies are simple and flexible compared to those of women resident women. In most cases, migrant men are regarded as on holiday where they enjoy greener pastures leaving women with double responsibilities. Women's double responsibilities include adaptation as well as gender based domestic duties and family upkeep.

Various studies conducted in different parts of the world revealed that women's double roles reduce their adaptive capacity to climate change disasters (Denton, 2000; Dankelman, 2010). Women's dependence on migrant men is more disastrous than a relief to their embattled livelihoods strategies. In many instances cases of non-remitting migrant men is forcing women to diversify their coping and adaptive strategies. Multiple adaptive strategies increase women's work load than relieving them from climate change shocks and stresses.

Migration of men is blamed for increasing women's social and health problems on top of increased work load. For example, in Bikita, some migrant men are forgetting their family

responsibilities in the greener pastures. In some cases, separation of spouses has created domestic conflicts. Evidence of problems caused by migration is not only unique to Bikita. Similar trends have been observed in countries such as Mozambique and South Africa. Ossario (2003) expressed that majority of migrant men from Mozambique are remitting HIV and AIDS to their resident wives rather than financial capital for them to cope with effects of disasters such as droughts and floods. Similarly, in South Africa, migrant husbands mainly from rural areas were remitting HIV and AIDS instead of money (Babugura, 2010). Coming of HIV and AIDS is more disastrous to already troubled women. Multiplication of problems on retards women's adaptive capacity by increasing their vulnerability to climate change shocks and stresses. Multiple risks and hazards among smallholder farmers widens social inequality gap between women and men (Terry, 2009; Dankelman, 2010).

In the gender based vulnerability discourse, masculine voices differ with the popular views which regard women as climate change refugees. Feminine arguments pointed out that woman's duties are many and stressing compared to men. Nevertheless, andocentric perceptions highlighted that women's duties are many but less risk compared to those of men. For example, women's survival strategies such as '*kushuzha*' (looking for food in harvested areas) or '*maricho*' (working for food), basket making and pottery are safe when compared to men's experiences. Men as breadwinners faced many challenges through engaging in riskier adaptive strategies. On migration men are exposed to threatening risks such as facing arrests to many without proper documents in foreign countries. On the same case, some are exposed to harsh and unhealthy working conditions. To the opposite, women view border jumping as a capital resource which allows men to run away from disasters. Men's running away from disasters increases their vulnerability to multiplying climate change risks and hazards.

On the same issue of adaptation, some strategies make it difficult for one to judge gender based vulnerability. For example, men participating in diamond punning and poaching are more vulnerable compared to women's adaptive options. However, it can be noted that the number of men participating these risky strategies is insignificant. It is agreeable that in most cases women are more exposed to potential harm than men.

The escalating climate problems and absence of men makes women embrace a wide range of adaptive options. Apart from utilizing their human capital (labor) in the fields, women participate in project such as selling firewood, nyii and carpenter which are demanding. These

duties are added to the already overloaded schedule. Engaging in small scale projects as adaptive measures are not unique practices in Bikita. Similar trends have been observed in some rural parts of Mozambique (Ribeiro and Chauque, 2010). In Gaza, women participate in the full processing of charcoal and as well as selling them. In both cases, women benefit less because the proceeds are amassed by men.

Apart from selling caterpillars, women's linking capital helps them in participating in community associations such gardening and other small-scale projects. As pointed out earlier, women's adaptive strategies are more demanding compared to the benefits accrued. The strategies seldom improve women's adaptive capacity against climate change impacts and their effects. A study conducted in Epyeshona and Daures in Namibia confirmed that women's involvement in petty projects is detrimental to their livelihoods (Jotoafrica, 2011). Small scale projects increase their concentration at the same time restricting them from participating in other profitable alternative activities. Women's commitment to demanding and less profitable projects is not of their own making (Terry, 2009). Cultural arrangements are blamed for the creation of unbalanced social order. Women's lack of assets, power and knowledge forbids them to graduate from petty projects which drain their power and time without enjoying sustainable proceeds.

Furthermore, women's other arguments revealed that women's vulnerability can be attributed to their non-usage of indigenous strategies in adaptation. Though planting of indigenous small grain crops is hailed as an adaptive strategy against low rainfall amounts, the benefits are more disastrous to women. Brewing of beer and benefits accrued are never enjoyed by women. It can be expressed that even indigenous strategies of coping with disasters have little impact in improving women's adaptive capacity. In most cases indigenous strategies of adaptation exacerbates women's vulnerability to climate change impacts.

6.5 Conclusion

The study noted controversial debates on gender vulnerabilities and adaptation to climate change impacts. Cultural orientations and adaptive strategies employed by vulnerable smallholder farmers are influential in shaping local farmers' perceptions on gender based vulnerability. Women's experiences, adaptive strategies and gender roles reduce their adaptive capacity compared to men. Duties such as fetching firewood, water and other domestic roles

are more demanding when compared with men's migration inter alia. On the other hand, culture is a critical capital resource utilized by men in reducing vulnerability to disasters through strategies such as migration. Though men claimed engaging in riskier responsibilities in adaptation, their numbers are insignificant compared to women. It can be concluded that women's use of indigenous knowledge strategies such as growing small grains increases their vulnerability. Adding to farming and other adaptive strategies reduces their adaptive capacity. The more precarious the climate change impacts the more women's vulnerability chances.

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CHAPTER 7

THE ROLE OF SOCIAL CAPITAL AND INDIGENOUS KNOWLEDGE IN BUILDING RESILIENCE AND ADAPTATION TO CLIMATE CHANGE IMPACTS

Abstract

This chapter explored social capital and indigenous knowledge systems employed by smallholder farmers in coping and adapting to impacts of climate change. It scrutinized advantages of embracing social capital as well challenges associated with it in adaptation. Data in this study was collected using questionnaires, focused group discussions and in-depth key informant interviews. Results showed that sampled villages in ward 24 have fragmented bonding and bridging capitals which is caused by different historical socio-demographic characteristics and polarized political affiliation. The fragmented relations negatively affect collectivism in farm groups, community gardens and other associations which reduce their vulnerability to climate risks and hazards. Dependence on linking capital is not enough in sustaining self-help and coping and adaptive strategies to reduce vulnerability. To the contrary, strong bonding, bridging and linking capital in ward 20 and 21 strengthen smallholder farmers' coping and adaptive strategies such as community gardens, farm groups, burial societies and small-scale dam projects. Collective attitudes in ward 20 and 21 is also strengthened strong linking capital with NGOs such as CARE International, SAT and PLAN International. It is concluded that full utilization of social capital and indigenous knowledge is important in sustaining smallholder farmers' resilience and adaptive capacity against climate change risks and hazards.

Key words: bonding, bridging, linking, resilience, adaptation, social capital

7.1 Introduction

Studies on climate change confirmed that the impacts are severe and have created serious humanitarian crisis in the 21st century (IPCC, 2007). Climate change shocks have devastating impacts on poor smallholder farmers who rely on rain fed agriculture. Vulnerability of farmers is worsened by lack of assets, technology and climate change information. Possession of these assets facilitates robust adaptation (Moser, 2008). Adaptation is an important component for sustainable livelihoods. Devising robust resilient strategies is achieved at grassroots level (IPCC, 2007). Grassroots adaptation can be achieved through maximum utilization of available social capital, indigenous knowledge and natural assets (DFID, 2000). Embracing social capital and indigenous knowledge systems at a downscaled farming level improves resilience (Putman, 2000). Local initiatives are the mainstay in fostering autonomous and planned adaptation against idiosyncratic and covariate shocks and stresses for smallholder farmers (Moser, 2008). Smallholder farmers with adaptive capacity have improved livelihoods chances.

This study examines the role of social capital and indigenous knowledge in sustaining smallholder farmers' coping and adaptive capacity against with climate change risks and hazards. The study scrutinized the role of social relationships and collectivism in fostering local farmers' adaptive capacity. The importance of social capital and indigenous knowledge in adaptation is analyzed in relation to availability of livelihood assets. Lastly, the chapter will draw conclusions on the challenges of social capital and indigenous knowledge in adaptation and resilience building.

7.2 Materials and methods

Both probabilistic and non-probabilistic sampling techniques were used to select respondents. Three wards in Bikita, ward 20, 21 and 24, were purposefully selected for this study. Wards 20 and 21 are found in agro-ecological region IV (four) with semi-arid characteristics. These two wards have similar soil types, tree species and other topographic characteristics. Ward 24 which is found in agro-ecological region V (five) has arid characteristics. The reason for inclusion of ward 24 was to give a cross comparison on adaptation strategies used by farmers with different rainfall patterns. The study squared off indigenous knowledge and adaptive strategies used in the three wards against the background that ward 24 are product of resettlement. Combining the three wards provided rich ground for comparing similarities and differences considering differences in background of farmers and ecological characteristics.

After purposive selection of wards, the names of all villages in each ward were recorded as provided by the ward councilors, village headmen and extension service officers. Ward 20 had 45 villages, ward 21 had 26 villages and ward 24 had 15 villages. Despite the three wards having different number of villages, three participating villages were randomly selected from each ward. The decision of selecting three villages in each ward was based on two reasons. Firstly, all farmers in the three wards have similar cropping systems, similar soil types and vegetation and secondly financial limitations. Lack of adequate research resources limited the numbers of participating villages and households. Furthermore, similarities in soils types and vegetation also represent similarities in indigenous knowledge seasonal forecasting indicators and this pushed me to reduce the need for more villages.

From the selected villages, households in each of the three selected villages of each ward were listed. From the listed households, ten households were selected from each village making a total of thirty participants from each ward. Selection of ten households per village was influenced by financial challenges, similarities in cropping behaviors and similarities in soil types, tree species and other topographic characteristics. The process of purposive selection and random selection of participants was repeated across other two wards. All the selected participants selected in this category answered the questionnaires. Three research assistants in helped in administering questionnaires. The study was conducted in six months.

On focus group discussion (FGD) both men and women were selected as participants who were drawn from the household lists prepared for those that participated in the questionnaire. Three focus group sessions were purposely done in each of the selected villages. Each focus group discussion had twelve participants of which six were male and the six were females. Participants were randomly selected. The rigorous process of selecting focus group discussion participants was repeated across all the three wards. Different key informants were selected based on their positions and knowledge they possess in farming and smallholder farmers' vulnerability and adaptation to climate change disasters. Table 7.1 summarizes the breakdown of purposively selected key informants.

Table 7.1: Summary of key informants

<p>Three extension services officers – they were selected from the three wards. They provided information how they link with local farmers in adapting to climate change impacts. They also pointed out how they work with local institutions in improving local farmers’ adaptive capacity.</p>
<p>One CARE International programs officer- the programs officer operating in the three wards revealed the linking capital they have with local farmers and how they help them with coping, adapting and building their resilience against climate change impacts.</p>
<p>Nine village heads –the heads were drawn from all the participating villages. They provided information on social capital and its role in reducing local farmers’ vulnerability to disasters.</p>
<p>Three ward councilors –the ward councilors were selected from the three participating wards. They reflected invaluable information on how they link with local institutions in adapting to climate change impacts.</p>
<p>Six community gardens chairpersons –they were selected from ward 20 and 21 were community gardens are common. Six participants emerge from six selected villages. They provided information on the benefits and challenges of community gardens in adaptation.</p>

7.3 Study area

Bikita is one of the seven administrative districts in Masvingo province in Zimbabwe (Figure 7.1). The other six districts are Zaka, Gutu, Mwenezi, Chiredzi, Chivi and Masvingo urban. Bikita District is located 80 km east of Masvingo city and 377.9 km from Harare. It lies about 656 meters above sea level. Bikita district is dominated by the Karanga people of the Duma totem. The Karanga people depend on mixed subsistent farming.

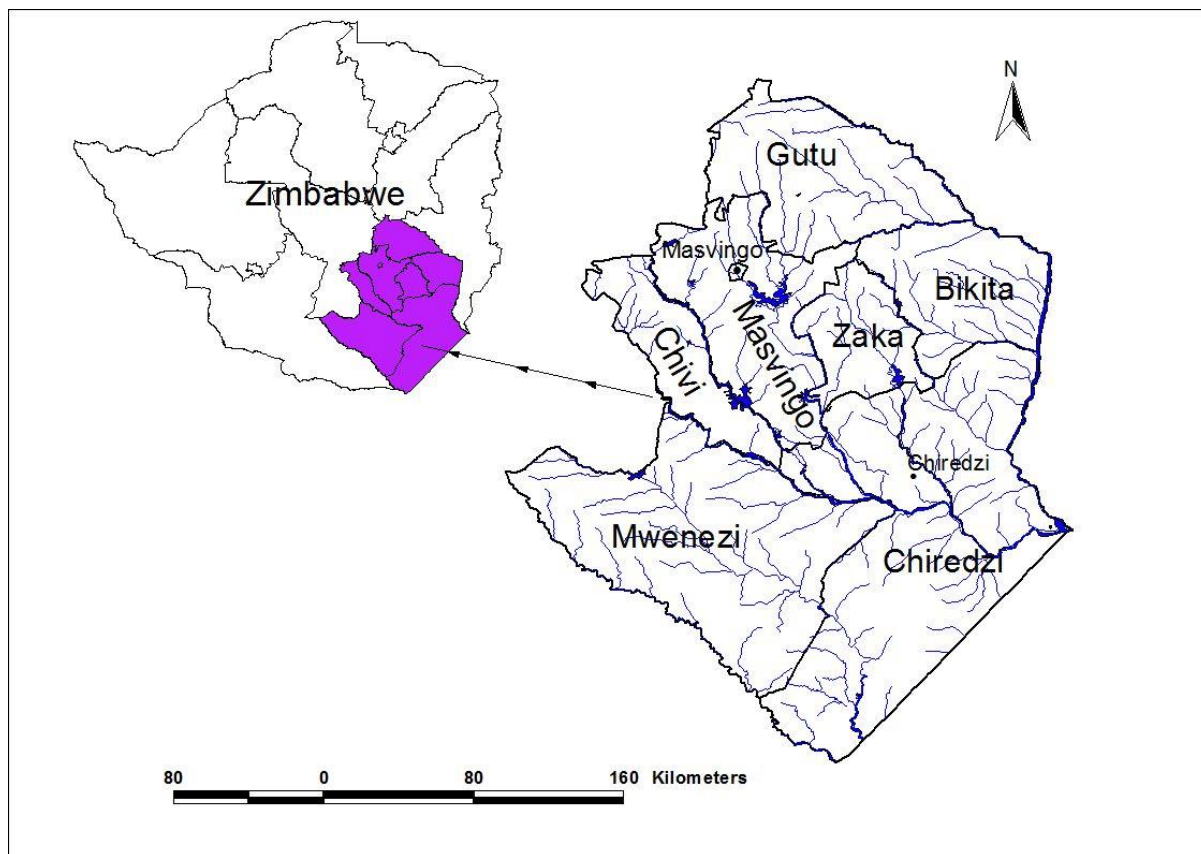


Figure 7.1: Map of Bikita district. Extracted from Chikodzi et al (2013).

Most parts of Bikita are found in arid and semi-arid belt with poor topographic characteristics. Most farmers' dependence on rain fed agriculture increase their vulnerability to perennial to droughts. Farmers grow small grains such as rapoko, millet and sorghum. Growing small grains is an adaptive strategy against harsh seasonal conditions. Harsh conditions limit cultivation of maize, the staple cereal. Apart from small grains, groundnuts are cultivated for commercial reasons despite serious market challenges. Domestic animals such as cattle, donkeys, goats and sheep are common. Domestic animals save two main functions. Firstly, bigger livestock such as cattle and donkeys are used as source of draught power. Secondly, they are used as safety nets during disasters. Farmers sell domestic animals in coping with disasters such as droughts. Apart from selling livestock in coping with disasters, majority of vulnerable farmers depend on food aid from local institutions. The main food donors are NGOs and government's Ministry of Labor Social Welfare. Furthermore, local farmers adapt to disasters through migration to big cities and working in irrigated commercial farms in Chipangayi, Chipinge, Middle Sabi, and Birchneough.

7.4 Results

7.4.1 Bonding, linking and bridging capital in ward 24

Data gathered through questionnaires revealed that bonding capital is low amongst smallholder farmers compared to bridging and linking capital. This trend existed for long period. A historical trace from 1990s up to 2015 shows a significance difference between linking capital and bonding and bridging social capitals ($P \leq 0.05$). A detailed trend on the flow of social capitals is shown on Figure 7.1.

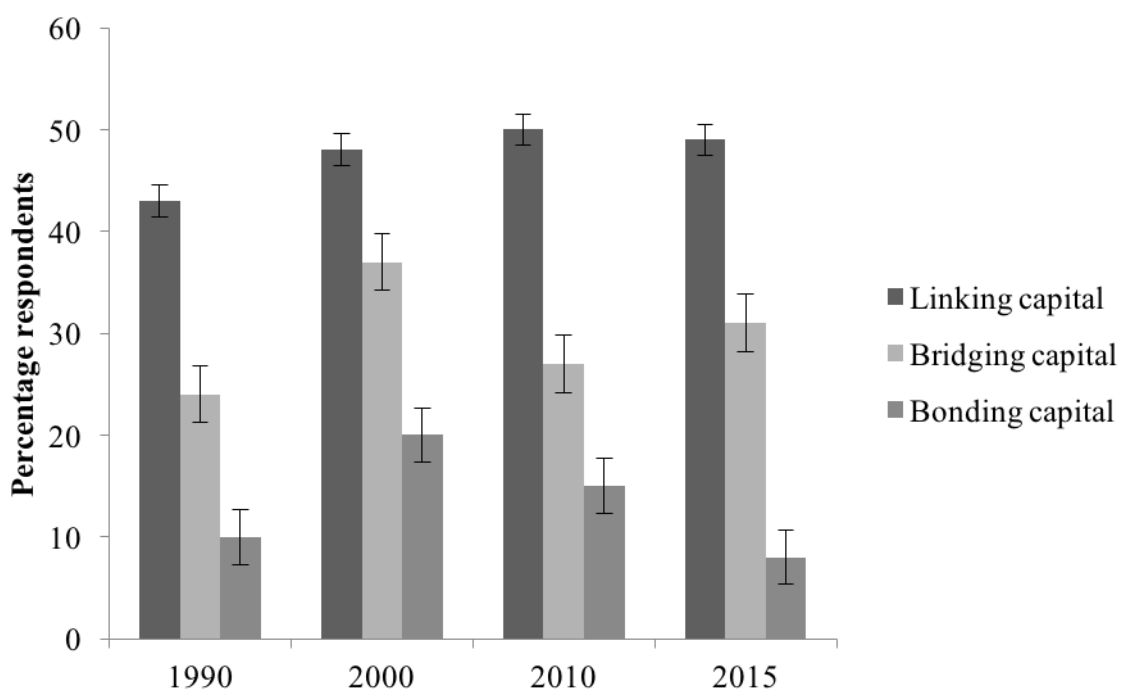


Figure 7.2: Trends of social capital in ward 24. Source: Field work questionnaires, 2016

Local farmers in ward 24 explained that linking capital is more dominant than bonding and bridging capital. Participants in the focus group discussion confirmed that poor bonding capital is caused by two factors. Firstly, they acknowledged that ward 24 is constituted by people from different socio-demographic backgrounds. All the smallholder farmers were brought together through the resettlement project undertaken by the government in the early 1980s. Local farmers acknowledged that the resettled farmers are facing challenges in getting together in solving livelihoods disasters. They also expressed that low bonding capital is worsened by the political violence which happened between ZANU PF and MDC supporters

in 2008. The stalemate in election results lead to the outbreak of conflicts and violence which increased polarization of relations and mistrust amongst themselves.

Focus group discussion with farmers further revealed that despite increasing droughts, social relations between them remained low. They expressed that for coping with droughts they depended on food aid from CARE International, SAT and PLAN International in collaboration with Ministry of Social Welfare. Participants to the discussion acknowledged that food aid from NGOs was not enough for their adaptation. Weak social relations were causing serious problems on the selection and distribution of aid to vulnerable beneficiaries. Lastly, on bridging capital, local farmers survive by migrating and working for food in neighboring irrigation schemes in Birchneough, Chipangayi and Middle Sabi.

7.4.2 Social capital nexus adaptive strategies amongst smallholder farmers

Data gathered through key informant interviews and focus group discussion revealed many challenges caused by low bonding capital. Focus group discussions with local farmers revealed that in 2014, CARE International introduced a project of rearing high breed goats. Local farmers confirmed that the project put them in groups of ten farmers and were given five goats which they should keep and later sell the off-springs for survival. They acknowledged that CARE International was aiming to reduce vulnerability through empowering them with high quality goats. After rearing the high breed goats, farmers were expected to supplement their income. Focus group participants expressed that the project of goat rearing failed due to conflicts and mistrust amongst local farmers.

On the same note, information from two key informants confirmed the collapse of the high breed goat project introduced by CARE International. The local extension services officer and the programs officer from CARE International narrated challenges which they experienced in implementing this project. Box 7.1 below highlights views from the selected key informants on the high breed goat project in ward 24.

Box 7.1: Reflections from key informants on high breed goat projects

Extension service officer – CARE International consulted us on the self-help projects they may help our vulnerable farmers with and due to dryness of the area we advised them to introduce goat projects. Goats are more resilient than cattle and other domestic animals in this area. However, the project failed due to social problems with the local farmers.

Programs officer from CARE – after our pilot study and consultation with the extension services departments, we agreed that introducing high breed goat project was ideal for local farmers as an adaptation to failing rain fed farming. We put local farmers in groups of ten and they would co-operate keeping them before selling the off-springs. The project failed because of both weak social relations and political factors. Local farmers failed to co-operate because of differences in political belonging and differences in their historical origins. We hoped they would supplement their income for self-sustenance but all our efforts fall away due to lack of grassroots co-operation.

Apart from the hybrid goat's project, participants in the focus group discussions confirmed that CARE international introduced community gardens for women. Female participants in the group discussions indicated that the project failed succeed due to two reasons. The first reason was that of scarce water reservoirs in ward 24. Absence of water resources from water sources such as boreholes, rivers and aquifers derailed their potential of community gardens. Secondly, they mentioned that weak social relations also derailed the potential of success of community gardening.

On a different note, focus group discussion and key informants indicated that men have their own adaptive strategies which are based on social capital. Focus group discussions highlighted that unemployed men in the area form small groups ranging between five and ten collaborate for poaching in the neighboring Devure Range. Members from the poaching groups confirmed that collaboration helped them in killing large prey such as zebras, buffaloes and wild beasts. They also confirmed that groups help them in fighting dangerous wild animals such as lions as well as game wardens (game rangers) when they come in conduct with them. The pointed out that they use distinct names of referring to their wild prey to avoid being caught by police officers. They call wild meat '*zebhedheki*' so as reduce being caught by police officers. On the same issue of social groups in poaching, the researcher identified two group leaders of a poaching syndicate and they confirmed what was said in the group discussion. They also

pointed out that poaching is a life-threatening strategy but due to poverty and droughts they have no option for survival.

7.4.3 Indigenous knowledge adaptive strategies

Information gathered through questionnaires, focus group discussions and key informant interviews depicted that local farmers do not rely much on indigenous strategies in adapting to challenges threatening their agro-livelihoods. The study failed to identify local or traditional associations which could help them in fighting climate change risks and hazards. Nevertheless, some elderly respondents from the focus group discussion narrated existence of *zunde ramambo* (chief's granary) some few years ago. They pointed out that *zunde ramambo* disappeared in ward 24 after the death of Chief Budzi who used to coerce local farmers to work together and store harvests at his homestead. The stored food worked as safety nets for vulnerable and poor households and orphans. Participants in the focus group discussions showed that chieftainship wrangles after the death of Chief Budzi led to the collapse of farming groups. Local farmers also confirmed that severe droughts also influenced the disappearance of farm groups.

7.4.4 Collective projects and encountered challenges in ward 20 and 21

Data gathered from sampled villages in ward 20 and 21 showed that smallholder farmers have strong bonding, bridging and linking capital. Focus group discussions and key informant interviews showed that there are collective efforts in many farm and social groups found in Nebarwe, Mutsinzwa and Gate Maranganyika villages of ward 20. Focus group discussions revealed that success of social group is facilitated by similar socio-demographic characteristics of smallholder farmers. The successful community gardens and Fushai projects were introduced and supported by CARE International and SAT. Detailed explanation of various social capitals found in ward 20 and 21 are shown in the Table 7.2.

Table 7.2: Types of social capital in ward 20 and 21

Social capital	Associations and activities involved
Bonding capital	Local farmers have strong bonding relations which witnessed in successful community gardening projects, Fushai (small scale credit schemes), burial societies, participating in food for assets projects (FFA), farm groups (e.g. in <i>majangano</i> , <i>majaka</i> and <i>humwe</i>), and collective performance of rain making ceremonies.
Bridging capital	Sharing of water and pastures between different villages, depending on closer irrigated areas such as Middle Sabi, Chipangayi, Chipinge and Birchneough for food. Also travelling to towns, cities and outside Zimbabwe as an adaptive strategy.
Linking capital	Farmers have good links with NGOs (CARE International, SAT, PLAN and Ministry of Social Welfare).

Source: Field work focus group discussions and key informant interviews, 2016

Information gathered through questionnaires confirmed existence of vibrant social in the sampled villages in Bikita. The information showed the various levels of frequency and significance of social capital in supporting various adaptive strategies employed by local farmers. Figure 7.2 highlights a detailed view of adaptive strategies employed by men and women in smallholder farming.

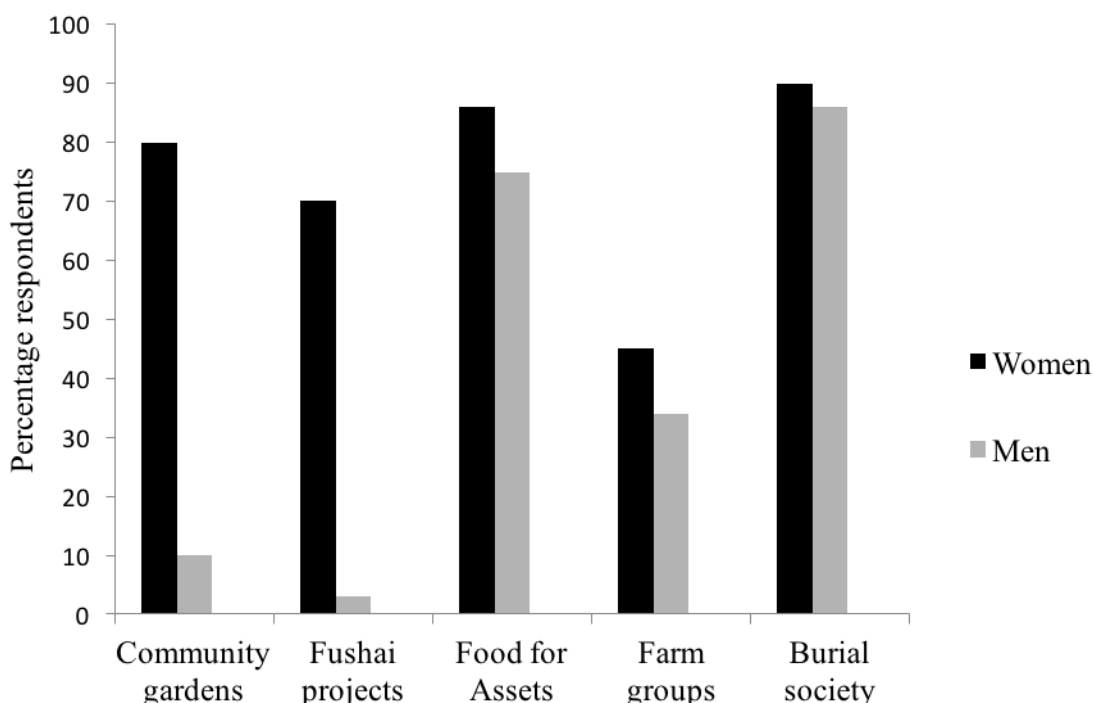


Figure 7.3: Social groups and adaptation. Source: Fieldwork questionnaires, 2016

Detailed information on adaptive strategies used by local farmers was harnessed through the use of focus group discussion and key informant interviews. Key informants (three community garden chairpersons and CARE International programs officers) explained various processes, success and challenges which are experienced in the gardening projects. Box 7.2 shows a detailed explanation on gardening projects.

Box 7.2: Key informants' explanations on the gardening projects

Views of gardens chairpersons - Harvests obtained from the gardens such as tomatoes, cabbages and others sold and some for consumption. They noted that returns are petty but they help them as an alternative to dry land farming. They also raised the issue that women complained about being overburdened by gardens on top of domestic duties.

CARE International programs officer - the officer confirmed that community gardens were going well due to availability of water resources and good social relations amongst women. Despite good harvests, local farmers have difficulties in accessing better markets for their produce and they end up getting far less than expected. These uncertainties are major stumbling blocks to the full realization of sustainable outputs from gardening initiatives.

Apart from community gardens, focus group discussion and key informant interviews revealed that there are other projects such as food for assets (FFA) which were brought by local institutions. Participants in the focus group discussions revealed that CARE International and PLAN International introduced small dam projects in their areas. CARE International monitor people who participate in damming projects and they are given food in return. Local farmers concurred that small damming projects left them tangible physical assets at the same time giving them food to cope with hunger. Majority of sampled participants agreed that a small dam is helping them in harvesting water for gardening projects and water for livestock during dry seasons. One key informant from CARE International (programs officer) confirmed that small damming project was going well amongst men and women in ward 20 and 21. He acknowledged the use of indigenous social groups undertaking the projects.

Women also confirmed participating in is small scale credit groups known as Fushai projects. They acknowledge receiving the idea and training of managing Fushai scheme from CARE International officers. Participants in the credit schemes explained that they formed small groups and they agreed amounts of money on monthly bases. Women join groups depending

on their level of earning. Women without much money join groups which contribute between \$1 and \$5 per month. From the focus group discussions, it was expressed that those with more money join groups which contribute as much as \$20 per month. Participating women invest money in various activities such buying and selling goods, lending and brewing and selling traditional beer in order generate interest. After the interests, the participating members buy and share goods or money depending on their agreement. Some women confirmed that the money is helpful in supplementing other benefits they get from farming and gardening. In the discussions, some women complained that some women with more money who join groups of those with less money were creating problems. Women with less money felt being dominated by those with money in making decisions. They pointed out that this scenario was creating conflicts in Fushai associations.

Lastly, focus group discussions and key informant interviews highlighted that local farmers participate in burial societies. Burial societies are based at village level in ward 20 and 21. Participants in the focus group discussions confirmed that men and women equally participate in burial societies compared to other associations in their wards. Every household in the village pay an agreed nominal fee every month which they will use as a safety net during time of bereavement. In order to supplement the burial funds, the chairperson and treasury engage in borrowing and lending the money to increase interests. Information on burial societies was confirmed by village heads and treasures from the burial societies which were found in sampled villages. They expressed that the money is helpful especially during untimely or unplanned death.

7.4.5 Indigenous associations in ward 20 and 21

Respondents who participated in the focus group discussions pointed out they depend on indigenous associations for coping with challenges affecting their farming activities. They explained that in farming they maintained indigenous strategies of farming such as *majangano* (collective ploughing), *humwe* (collective harvesting), *majaka* (brewing beer for collective thrashing of rapoko, millet and sorghum) and *mukweverera* (rain making ceremonies). Farm groups such as *humwe* and others work like a family because they pool labor together in all farming and harvesting activities. One elderly respondent in the focus group discussion highlighted that pooling labor together helps then in maximizing gains especially in goods seasons and even those with less rains. Local farmers expressed that they perform

mukweverera rituals at the beginning of every farming season. They attributed the success of executing the rain making rituals to good social relations which exist amongst them.

7.5 Discussion

7.5.1 Fragmented bonding, bridging and absence of indigenous responses

Local farming communities with poor social capital are vulnerable to disasters. Vulnerable communities have low adaptive capacity. Communities with poor social capital are vulnerable in the context of incremental climatic change impacts. Absence of critical livelihoods capitals exacerbates poor farmer's low adaptive capacity against climate change risks and hazards. As noted in ward 24 of Bikita, local farmers' exposure to precarious ecological conditions reduced their adaptive and resilience potential in the absence of strong social capital.

Communities with strong social bonding are well prepared to face disasters with minimal outside intervention (Putman, 2000). In smallholder farming communities, vulnerable categories with strong horizontal and vertical connections are better positioned to communicate and deal with disasters such as droughts and diseases. In some cases, local farmers can share weather and seasonal information which empowers them in planning and decision making in farming livelihoods.

Local farmers with good social relations can unite in various local arrangements which give them self-sustaining coping and adaptive strategies. As noted in ward 24 poor social capital has impacted negatively on local arrangements such as rain making ceremonies, '*zunde ramambo*' (chief's granary), inter alia. Fragmented social capital in many cases denies vulnerable communities the ability to embrace other critical capitals such as human capital which help them in putting collective actions. Communities with weak social unions have low adaptive capacity against culminating disasters (DFID, 2000). As noted from ward 24, most vulnerable farmers in this condition end up depending on food aid instead of their local initiatives which makes them to deal with the disasters on their own.

As noted elsewhere, bonding capital is a critical asset but needs to be well combined with bridging and linking capital (Putman, 2000). Gugerty and Kremer (2008) emphasized the

point that communal farming groups in Kenya and Rwanda failed to yield positive results due to absence of linking capital. A combination of all these capitals provides fertile grounds for local and enthusiastic participation of local farmers. As noted in ward 20 and 21, compact social relations amongst farmers facilitated acceptability of many outside intervention strategies. Successes of intervention are buttressed consensual use of valuable livelihood assets by the locals. Good social relations can also by-pass barriers which may emerge from political tensions as witnessed in ward 24. In such conditions, success of projects such as community gardens and small-scale projects are attributed to cohesive social relations amongst local farmers.

Farmers who depend on food aid are more vulnerable to climate change disasters because they have low adaptive initiatives. As has been noted elsewhere, food aid can also be a source of social conflicts hence exacerbates vulnerability and low adaptive capacity. As noted in ward 24, food aid is further widening the already fragile social relations. Preferential treatment on sharing of food aid is widening social gaps hence increasing the scale of vulnerability. Pretty (2003) expressed the vulnerable smallholder communities with fragmented relations are not able to spread risks and hazards amongst themselves. Disintegration thwarts the potential of solving risks and threats from a unified standpoint.

Smallholder farming communities with strong bonding and linking capitals have more capacity to cope and adapt to disasters (Putman, 2000; Coleman, 1990). As noted from the study, local institutions offer a wide range of intervention coping and adapting strategies. Those communities with poor bonding capital end up falling in the dependence syndrome. To the contrary, local farmers with good bridging and bonding capital are less vulnerable to climate change shocks and stresses. In ward 20 and 21 success of FFA projects is bestowed upon good horizontal and vertical relations amongst local farmers. Di Gregoria et al (2012) highlighted that local farmers who are rich in social capital are capable of building sustainable adaptive solutions on present and future trends.

In support of the above arguments Njuki et al (2008) expressed that linking capital is there to complete the missing components in the social capital and adaptation discourse. These arguments defy the popular views which romanticize the value of linking capital as critical in adaptation on its own. Romanticizing linking capital in adaptation to climate change impacts is tantamount of regarding vulnerable local farmers as blank slates. Other independent factors

are so inhibitive to the success of linking capital. As observed in ward 24, presence of local institutions did not guarantee the success of interventions strategies such as goat projects. In overall all the three social capitals needs to be present so that local farmers are in a good position to deal with disasters such as droughts.

In social capital and adaptation, there are also some independent variables which can retard the good sights of collectivism. As noted in ward 20 and 21, mixing people of different social classes is detrimental to effective functioning of bonding, bridging and linking capitals in adaptation. As witnessed in the small-scale credit schemes mixing of rich and poor women created problems which thwarted the collective minds in adaptation. Poor women complained that they are being exploited by rich women. Presence of the rich women in small scale credit scheme groups has weakened the poor in planning and decision making regarding the use of money among others issues. Arguing from this standpoint, Adger (2003) noted that in many collective projects, the poor become weak and invisible in determining vital decisions regarding the direction of the project. In many cases this has resulted in the fall of collective motions of adaptation.

Existence of repelling conflicts amongst group members is not unique to ward 20 and 21. Research proved that they have been observed elsewhere. Gugerty and Kremer (2008) confirmed that in rural Kenya, small scale credit projects have been bulldozed by affluent women yet disregarding the deserving vulnerable women. Likewise, in ward 20 and 21, the well protracted Fushai project which was supposed to benefit drought prone female farmers become riddled with conflicts and competition. Issues of social class and belonging led to further fragmentation of these social groups. This has affected the potential of inclusive community participation and solidarity. The main outcome was horizontal social fragmentation in the society.

Using this scenario as an example, one can subscribe to Pretty (2003)'s observations which concluded that community based social associations do not always guarantee successful results. Sometimes, it can be a source of divisions and antagonism amongst the members. Existence of social divisions precluded community associations from coping and adapting to climate change shocks and stresses. Associations riddled with fragmentation fail transfer climate change shocks and stresses from an individual member to the whole community.

Farming communities which maximize social capital are more resilient than those with fragmented social relations.

7.5 Conclusion

From the study, it has been observed that social capital is a critical component in coping, adapting and building resilience of vulnerable farmers in ward in Bikita. It was noted that communities without compact three social capitals are not in a better position to adapt and cope with climate change disasters. Linking capital is not on its own important in coping disasters but needs to be combined with bonding and bridging capital. Romanticizing the role of linking capital has been rendered obsolete as far as provision of sustainable livelihoods strategies. Attempts to collectively put people together by NGOs have failed due to political and socio-demographic differences in some areas.

Absence of bonding capital has rendered adaptation problematic. Vulnerable farmers' reliance on food handouts enable farmers to cope with droughts but not improving their adaptive capacity. Though social cohesion is problematic amongst villagers, combining it with indigenous knowledge is projected guarantee sustainable coping strategies. Combining social capital and indigenous knowledge form the solid grounds for sustainable adaptation amongst smallholder farmers. All in all, it can be concluded that all smallholder farmers with poor social capital and indigenous knowledge cannot adapt to climate change impacts. Combining the social capital and indigenous knowledge is critical for poor and vulnerable smallholder farmers.

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CHAPTER 8

THE ROLE OF LOCAL INSTITUTIONS AND INDIGENOUS KNOWLEDGE BUILDING RESILIENCE AND ADAPTIVE CAPACITY AMONGST SMALLHOLDER FARMERS

Abstract

This chapter examined the role of local institutions in building coping and adaptive capacity of vulnerable smallholder farmers against climate change impacts. It also scrutinizes local institutions' use of indigenous knowledge in the processes of building local farmers' resilience and adaptive capacity. Data was collected using questionnaires, focus group discussion and key informant interviews. Results showed that local institutions are helping vulnerable farmers with various coping and adapting strategies. NGOs are more active and critical in reducing local farmers' vulnerability than the public institutions. Active NGOs are biased towards food aid hence making less in building vulnerable farmers' resilience and adaptive capacity against climate change risks and hazards. There are also other critical factors such politics, economy, poor social capital and poor topographic characteristics which are inhibiting them from implementing sustainable adaptive strategies. In intervention, local institutions do not encourage the use of indigenous knowledge in adaptation. Lastly, existing civic groups and indigenous associations are not improving adaptive capacity due severity of climate change disasters. Albeit shortcomings associated with local institutions in Bikita, they are functional in supporting human livelihoods when the government is failing to support its people.

Key works: local institutions, NGOs', resilience, adaptation, indigenous knowledge

8.1 Introduction

Climate change and variability impacts are multiplying complex threats to humanity in the global world (IPCC, 2007). The impacts and their effects are increasing pressure on human livelihoods activities. Most vulnerable groups to climate change risks and hazards are poor smallholder farmers and have low adaptive capacity (Adger, 2006; IPCC, 2006). Majority of vulnerable smallholder farmers are found in the global South (IPCC, 2007). Vulnerability is mainly caused by over dependence on rain fed subsistent agriculture. Other contributing factors to low adaptive capacity are the absence of livelihoods assets, sound climate change adaptation policies and vibrant local institutions (Adger, 2006).

Smallholder farmers' dependence on rain fed agriculture with minimal technology makes them permanent climate change refugees (Denton, 2000). Statistics confirmed that 80% of the arable global land is less mechanized and farmers depend on manual labor (FAOSTAT, 2005). Poverty makes it difficult for smallholder farmers to buy modern technologies which enhance their farm based livelihoods (Mogoi, et al, 2010). Absence of modern technologies expose

majority of smallholder farmers to serious food insecurities. Food insecurity is among the top negative factors which thwarts the potential of resilience and adaptation (IPCC, 2007; AGRA, 2014).

Despite smallholder farmers' poverty and vulnerability to climate change disasters, adaptation is possible at local level (Adger, 2006; Agrawal, 2008). Local institutions and indigenous knowledge are two mainstay keys to local farmers' adaptation against climate change risks and disasters (Nhemachena and Hassan, 2007). Local institutions' intervention on local farmers' adaptation is fundamental in bringing missing ingredients for sustainable planned and autonomous adaptation (Agrawal, 2008). Sustainable adaptation strategies are fostered by livelihood diversification, migration, market exchange, pooling and storage (Kurukulasuriya and Mendelson, 2006; Agrawal, 2008). These strategies are critical reducing vulnerability of farmers against extreme climate change risks and hazards.

This chapter examined the role of various local institutions in strengthening smallholder farmers' coping strategies, adaptive capacity and resilient practices against climate change risks and hazards. The study started by identifying various typologies of local institutions which are active in sampled wards and villages in Bikita. Secondly, it interrogated the acceptability and sustainability of various intervention initiatives they implement in reducing smallholder farmers' vulnerability to climate change risk and hazards. Lastly, it evaluated the interphase and compatibility of local institutions' intervention initiatives with the local people's attitudes, indigenous knowledge, experience and available resources.

8.2 Materials and methods

Both probabilistic and non-probabilistic sampling techniques were used to select respondents. Three wards in Bikita, ward 20, 21 and 24, were purposefully selected for this study. Wards 20 and 21 are found in agro-ecological region IV (four) with semi-arid characteristics. These two wards have similar soil types, tree species and other topographic characteristics. Ward 24 which is found in agro-ecological region V (five) has arid characteristics. The reason for inclusion of ward 24 was to give a cross comparison on adaptation strategies used by farmers with different rainfall patterns. The study squared off indigenous knowledge and adaptive strategies used in the three wards against the background that ward 24 are product of

resettlement. Combining the three wards provided rich ground for comparing similarities and differences considering differences in background of farmers and ecological characteristics.

After purposive selection of wards, the names of all villages in each ward were recorded as provided by the ward councilors, village headmen and extension service officers. Ward 20 had 45 villages, ward 21 had 26 villages and ward 24 had 15 villages. Despite the three wards having different number of villages, three participating villages were randomly selected from each ward. The decision of selecting three villages in each ward was based on two reasons. Firstly, all farmers in the three wards have similar cropping systems, similar soil types and vegetation and secondly financial limitations. Lack of adequate research resources limited the numbers of participating villages and households. Furthermore, similarities in soils types and vegetation also represent similarities in indigenous knowledge seasonal forecasting indicators and this pushed me to reduce the need for more villages.

From the selected villages, households in each of the three selected villages of each ward were listed. From the listed households, ten households were selected from each village making a total of thirty participants from each ward. Selection of ten households per village was influenced by financial challenges, similarities in cropping behaviors and similarities in soil types, tree species and other topographic characteristics. The process of purposive selection and random selection of participants was repeated across other two wards. All the selected participants selected in this category answered the questionnaires. Three research assistants in helped in administering questionnaires. The study was carried out in six months.

On focus group discussion (FGD) both men and women were selected as participants who were drawn from the household lists prepared for those that participated in the questionnaire. Three focus group sessions were purposely done in each of the selected villages. Each focus group discussion had twelve participants of which six were male and the six were females. Participants were randomly selected. The rigorous process of selecting focus group discussion participants was repeated across all the three wards. Different key informants were selected based on their positions and knowledge they possess in farming and smallholder farmers' vulnerability and adaptation to climate change disasters. Table 8.1 below shows different key informants and their duties in building local farmers' resilience and adaptation.

Table 8.1: Key informants

Three ward councilors – councilors from ward 20, 21 and 24 were selected. They provided information on how they work with local institutions in helping vulnerable local farmers to adapt
One officer from Ministry of Social Welfare officer – the officer explained how they co-operate with other local institutions in building local farmers’ resilience and adaptive capacity
Three program officers – three program officers were drawn from SAT, CARE International and PLAN International. The informants work in the three wards and they provided information on how they work and give help to vulnerable local farmers.

8.3 Study area

Bikita is one of the seven administrative districts in Masvingo province in Zimbabwe (Figure 8.1). The other six districts are Zaka, Gutu, Mwenezi, Chiredzi, Chivi and Masvingo urban. Bikita District is located 80 km east of Masvingo city and 377.9 km from Harare. It lies about 656 meters above sea level. Bikita district is dominated by the Karanga people of the Duma totem. The Karanga people depend on mixed subsistent farming.

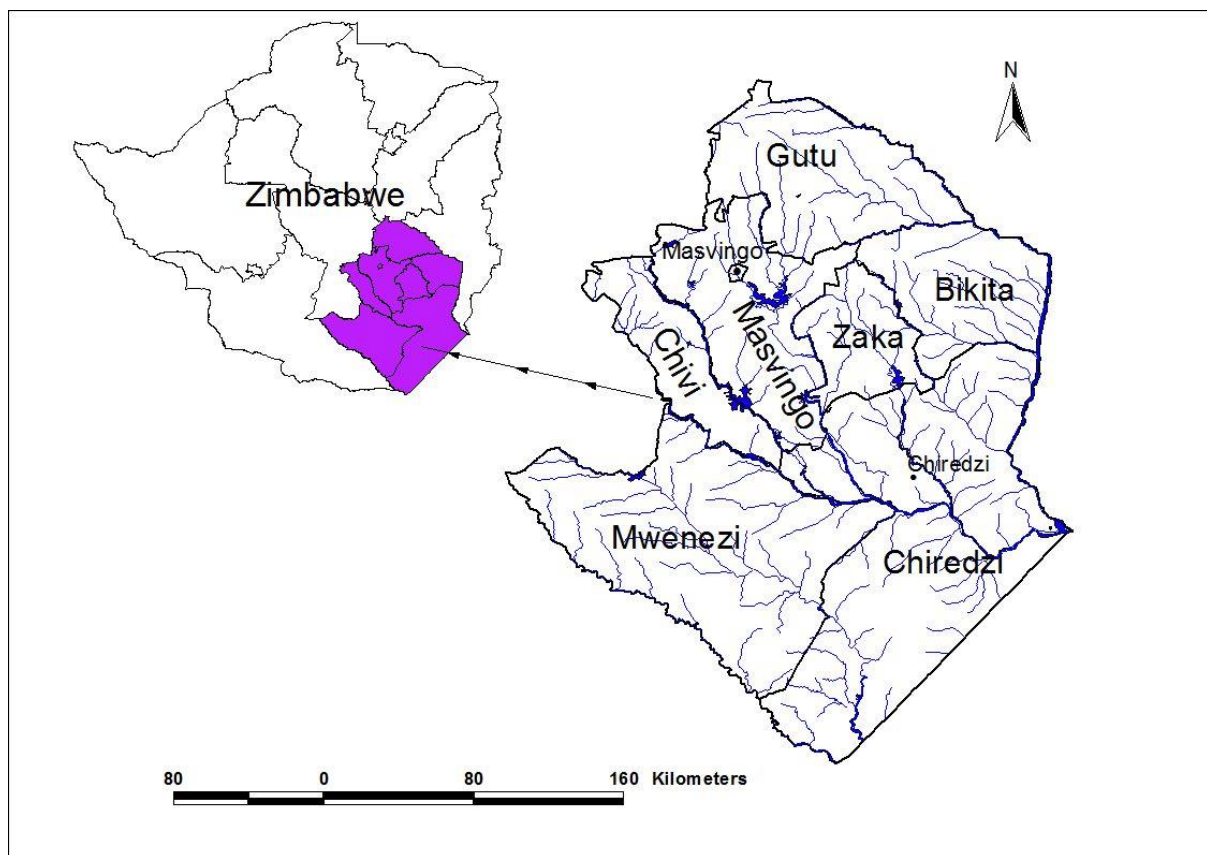


Figure 8.1: Map of Bikita district. Extracted from Chikodzi et al (2013).

Most parts of Bikita are found in arid and semi-arid belt with poor topographic characteristics. Most farmers' dependence on rain fed agriculture increase their vulnerability to perennial to droughts. Farmers grow small grains such as rapoko, millet and sorghum. Growing small grains is an adaptive strategy against harsh seasonal conditions. Harsh conditions limit cultivation of maize, the staple cereal. Apart from small grains, groundnuts are cultivated for commercial reasons despite serious market challenges. Domestic animals such as cattle, donkeys, goats and sheep are common. Domestic animals save two main functions. Firstly, bigger livestock such as cattle and donkeys are used as source of draught power. Secondly, they are used as safety nets during disasters. Farmers sell domestic animals in coping with disasters such as droughts. Apart from selling livestock in coping with disasters, majority of vulnerable farmers depend on food aid from local institutions. The main food donors are NGOs and government's Ministry of Labor Social Welfare. Furthermore, local farmers adapt to disasters through migration to big cities and working in irrigated commercial farms in Chipangayi, Chipinge, Middle Sabi, and Birchneough.

8.4 Results

8.4.1 Local institutions in ward 24

Information obtained from the study show majority of smallholder farmers in ward 24 are vulnerable climate change risks and hazards. Data gathered using questionnaires, key informant interviews and focus group discussion pointed that there are various local institutions which work in the area reducing local farmers' vulnerability to climate change disasters. Information obtained through focus group discussions (Figure 8.1) revealed that in the 1990s there were few NGOs because climate change impacts were not severe as they are in 2015.

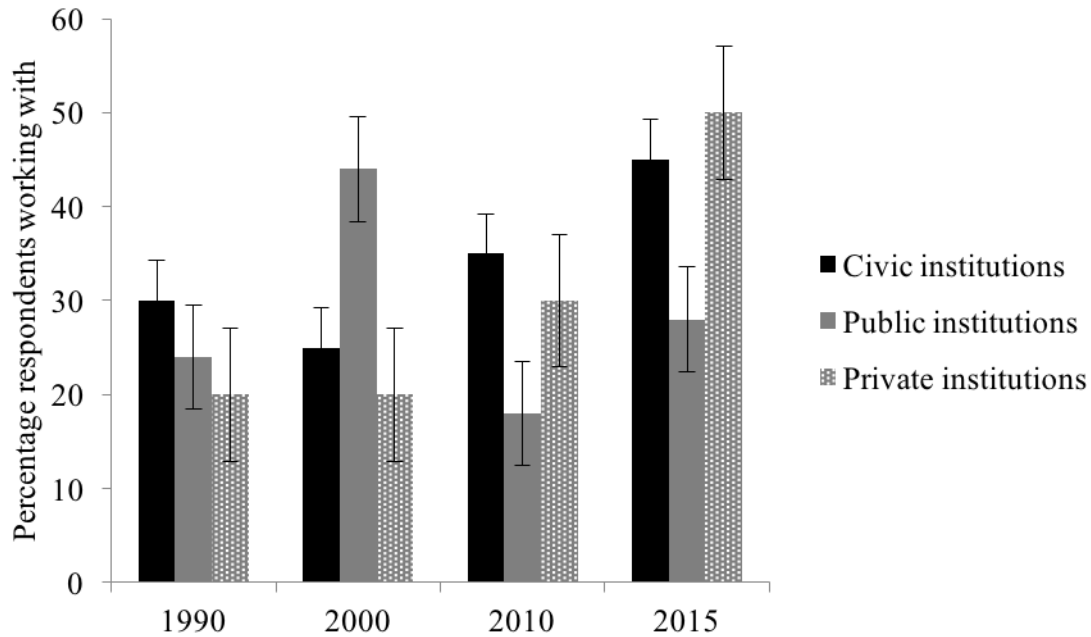


Figure 8.2: Local institutions in Bikita district. Source: Field work questionnaires 2016

Participants in the focus group discussions agreed that around 2000, public institutions were more active than the private and civic institutions. They explained that government institutions such as the AGRTEX (Agricultural Extension Services) and Ministry of Agriculture were common in giving farming expertise and seeds to smallholder farmers. In the post 2000 era, smallholder farmers concurred that the economic recession forced the government to withdraw from their responsibilities of helping vulnerable farmers. Respondents to the study highlighted that the failure by government in providing them with help during disasters force them to seek help from NGOs through their local leadership. On the same issue a key informant from extension services confirmed that the government’s incapacity paved way for the coming in of NGOs in helping vulnerable smallholder farmers.

8.4.2 Palliative care from private institutions in ward 24

Respondents in the focus group discussions acknowledged receiving help from CARE International, SAT (Sustainable Agricultural Trust), PLAN International and Ministry of Social Welfare and Services. They expressed that the help did not give them power for self-sustenance. It was highlighted that in most cases they are given food instead of technology, financial aid and information which will help them in adapting to disasters. Some respondents also revealed that majority of beneficiaries of food aid are becoming too much dependent on it instead of them working for their future adaptation.

Three key informants from CARE, SAT and PLAN opposed information from focus group discussion on local institutions' failure to help farmers with adaptive strategies. Key informants pointed out that there are many factors which inhibit them from implementing sustainable solutions in ward 24. Box 8.1 below gives a summary of points raised by three key informants.

Box 8.1: Reflections on local institutions' intervention programs

Topographic characteristic – they expressed that ward 24 is arid and have unfertile soils and poor rainfall amounts. These characteristics reduce their influence on types of adaptive strategies which they should implement. As a result, suitable adaptive strategies in the area need a lot of money which the donor community cannot fund when the local government has failed.

Poor social capital – they cited that bad social relationships amongst local farmers are among the reasons which limited their interest in implementing sustainable projects to improve local farmers' adaptation. They further indicated that mistrust and conflicts amongst the smallholder farmers led to the failure of initiatives such as the high breed goat project, community gardening, burial society and small-scale credit schemes.

Political interference – they cited that political interference from the ruling party (ZANU PF) also caused them to stop some of their long-term projects which were targeted to improve local farmers' adaptive capacity against climate change disasters. It was pointed that political interference ended up causing conflicts and violence and they decided to give food aid only to vulnerable households rather investing in future projects. Furthermore, they cited that ZANU PF's interference in food distribution was also affecting the process of transparent distribution of food aid to deserving vulnerable households.

8.4.3 Civic institutions and adaptation

Apart from the failure of NGOs in implementing sustainable adaptive initiatives, some focus group respondents concurred that poor social relationships, politics and poor topographic characteristics were negatively affecting full operation of civic associations. They expressed that political tensions and poor social capital is negatively affecting operation of indigenous local institutions such as *zunde ramambo* (chief's granary) *nhimbe*, *majaka* and *majangano* (all different types farming co-operative). Participants to the study agreed that local co-operation is helpful for them before they accept help from outsiders. Nevertheless, they

indicated that NGOs and local farmers are no longer depending much on indigenous knowledge in adapting to climate change risks and hazards.

8.4.4 Operation of local institutions in ward 20 and 21

Smallholder farmers in ward 20 and 21 concurred that NGOs are helpful in improving their adaptive capacity against climate change risks and hazards. Through focus group discussions, it was noted that CARE International introduced small scale projects through the ENSURE program. Participants in ward 20 expressed that the ENSURE program introduced various small-scale projects under the name of Food For Assets (FFA). In FFA, farmers built small dams, repairing roads among other projects depending on the area's natural assets. Small dams harvest water to supplement water in rivers and wells. They explained that harvested water in small dams was critical for livestock consumption and to irrigation of community gardens. A key informant from CARE confirmed local farmers' participation in small damming projects. He also highlighted that many local farmers are benefiting from small dams as a supplement to rain water.

Albeit positive stories of damming project in Ziwacha village, the results drawn from Nyadanda village in ward 21 showed a different outlook. Data gathered using focus group discussions revealed that the Nyadanda damming project was riddled with conflicts. Some members complained that they benefit less than those close to the dam. They pointed that their participation was not their own need but they were coerced by food at the same time helping others to benefit more than them. Some respondents also cited that the FFA projects are discriminatory to vulnerable groups. Elderly, young children, disabled and the sick were cited as the main victims who excluded from getting the food due to their incapacity to participate in dam construction. Majority of farmers expressed that positive benefits of damming projects and road repairing outweigh complains from underprivileged few individuals.

Apart from the damming projects, community gardens are another successful initiative embraced by the local farmers particularly women. Smallholder farmers confirmed receiving financial aid, expertise and technology for gardening from CARE. One key informant from CARE (programs officer) expressed that they collaborate with government's extension services department in the gardening projects. Smallholder farmers also acknowledged implementing conservation farming which was brought by SAT. Focus group discussions revealed that they are encouraged to embrace digging covering for the absence of draught

power. Some farmers embraced this strategy citing that it resonates with their traditional way of farming known as *chibhakera* (the digging technique). Despite the fact that conservation farming is considered as good, elderly farmers complained about the absence of human labor to help them with the digging and collection of humus from the forest. A key informant from SAT confirmed that they motivate the beneficiaries through provision free farming implements such as seeds, fertilizers, hoes and expertise.

Similarly, in gardening projects, CARE International introduced the Fushai (small scale credit scheme) amongst women. Through focus group discussion, it emerged that various groups of women collectively pool their financial resources for investment. The rotating schemes and borrowing with interest. The earned money helps them with an extra income to cope with drought and other household needs such as food, school fees, cutlery and clothing. Though some respondents pointed out those benefits from small scale projects are not enough others depend on them during droughts.

8.4.4 Government and climate change vulnerability reduction strategies

Information gathered through key informant interviews highlighted that NGOs have serious clear climate change policies and strategies cripple their operations. Key informants from CARE, SAT, Ministry of Social Welfare and PLAN expressed that their intervention strategies are not coordinated with those of other institutions and the government. They concurred that they end up duplicating roles yet failing to improve local farmers' adaptive capacity. Key informants from the NGOs confirmed receiving little help from the government and its other departments. In support of these sentiments, local farmers pointed that extension services workers are few and difficult to find especially in ward 20 and 21. Local farmers lamented that the absence of extension officers make them to remain behind with current seasonal and climate change information.

Apart from absence of extension services workers, local farmers also pointed malfunctioning of government's District Development Fund (DDF) in maintaining and repair damaged roads. Roads are useful in networking and accessibility. Farmers complained that lack of road networks negatively affects their connection with other communities. Bad roads also preclude them from receiving help such as food aid from NGOS. On other platform, local farmers complained that the failure by Ministry of Health and Child Welfare to build and maintain clinics and hospitals increases their vulnerability to diseases.

8.4.5 Indigenous institutions and adaptation to climate change disasters

Focus group discussions confirmed the presence of indigenous civic institutions though they are no longer as efficient as before. Smallholder farmers expressed that the civic institutions are helpful in sustaining their agro-based livelihoods. The commonly noted local associations are farm groups which are *zunde ramambo* (chief's granary), *jangano* (farming co-operative) and *jaka* (thrashing co-operatives) and *humwe* (farming groups). Elderly respondents pointed out that indigenous farm groups are critical in pooling labor and expertise together. Participants in the study agreed that farm groups help in saving their time and maximizing their opportunities in good seasons. On the same note, local farmers indicated that indigenous farm groups are threatened by extreme seasonal uncertainty and extreme climatic conditions. They further highlighted that other rituals such as *mukweverera* (rain making rituals) are losing their ground due to adverse climatic conditions and other factors.

8.5 Discussion

Local institutions are considered as an important capital for resilience and adaptation (Agrawal, 2008). Local institutions are hailed as providers of many missing capitals for adaptation such as financial assistance and technocrats inter alia. Nevertheless, the role of local institutions can be successful with the presence of natural and physical assets. Local farmers' ownership of these assets or lack of it thereof marks the potential of adaptation or maladaptation. Communities with poor resources are vulnerable to various climate change and variability impacts. For example, poor topographic characteristics in ward 24 directed most local institutions to concentrate much on food aid. Concentration on food aid limits the implementation of sustainable resilient and adaptive strategies.

While food aid is credited as a form of relief, there some challenges associated with it. Critical thinking revealed that majority of food aid beneficiaries end up succumbing in the dependence syndrome. Local farmers with dependence syndrome end up giving up on farming or innovating strategies for self-sustenance in farming. Similar cases of dependence on food aid due to limited natural assets and bad seasonal conditions are not only unique to villages of ward 24. Pasteur (2011) expressed that cases has been recorded in farming communities of Bulima and Mangwe districts of Matabeleland. Apart from creating dependence syndrome,

some critics pointed out the unsustainability of food handouts from local institutions. In some cases, vulnerable farmers face serious food insecurity challenges when donor agents withdraw for rendering their services.

In the Zimbabwean history, proliferation of local institutions increased in recent years due incremental trends of negative climate change impacts. As noted from the study, good farming conditions and economic welfare reduced the need for local institutions particularly from the private sector. Nevertheless, perennial disasters such as droughts facilitated the need for external intervention. The economic meltdown also forced the government to seek external donors to help vulnerable and poor smallholder farmers. These factors witnessed the increase of private institutions in agro-based livelihoods. Despite shortcomings associated with private local institutions they help many poor farmers who are vulnerable to perennial droughts.

In communities endowed with natural, physical and social capital the role of local institutions is critical. In intervention, local institutions can engage in more sustainable strategies apart from food aid. As noted in ward 20 and 21, successful intervention strategies from NGOs are facilitated by the presence of natural, social and physical capital. Presence of natural assets helped local farmers to engage in sustainable adaptive and resilient strategies. The success interventions of local institutions push away the government from its direct mandate in providing relief and help to the local farmers in need. It can be deduced that local institutions' successful interventions are determined by various factors such as social capital, politics, economy inter alia. Nevertheless, communities endowed with natural assets but having poor linking capital with local institutions are vulnerable to climate change disasters (Njuki et al, 2008; Ellis, 2000). Vulnerable communities have low adaptive capacity.

Social capital is a critical component to the success of institutional intervention. Poor bonding capital have the potential of thwarting the projected targets of reducing vulnerability to climate change shocks and stresses. As witnessed in ward 24 weak bonding capital negatively affected the success of adaptive initiatives from NGOs. The collapsing of high breed goat projects is attributed to the local farmers' weak social relations. Social conflicts affected the potential of community gardens as an adaptive strategy against failing rain-fed farming. Observed scenarios in ward 24 of Bikita contradict positive benefits expressed by Ellis (2000) on institutional intervention. While it is agreeable that local institutions create an intimate relationship between locals and their resources, the vice versa can be true. Conflicting factors

reduces local farmers' adaptive capacity and the potential of building resilience. In Kenya, various social classes have negatively affected positive goals introduced by local institutions in attempts of building local farmers' resilience and adaptive capacity (Gugerty and Kremier, 2008). It is noticeable that weak bonding capital affects the rhythm of co-operation hence resulting in the collapse of intervention strategies. The collapse of collective motions is detrimental to institutional goals of sustainable adaptation.

Another factor which impedes the functions of local institutions is politics. Unstable political conditions are detrimental to the success of intervention strategies brought in by local institutions. As observed in Bikita, bad political relationships negatively affected the success of intervention strategies from CARE, SAT and PLAN International in ward 24. Local farmers with unstable political relations are vulnerable to multiple climate change disasters. Vulnerability is caused by the absence of grassroots unity on adaptive strategies. There is also need for good relationships between the private and public institutions. Negative political relationship between them is detrimental to full operation of institutions. Elsewhere Chhetri et al (2011) discovered that conflicts between government institutions in Mali and Senegal have derailed projected adaptive strategies by the local institutions. Conflicts increased withdrawal of local institutions and this caused the loss of human capital (inform of expertise, information and knowledge) and financial capital which improve adaptive capacity.

Intervention of local institutions can sometimes be positive. In ward 20 and 21, good social capital and natural and physical capital enabled local farmers to reduce vulnerability through self-help initiatives. With the help local institutions, projects such as Fushai and community gardens reduced vulnerability especially amongst women. Local institutions such as NGOs take central roles in facilitating coping and resilience strategies amongst local farmers (Vincent, 2010). Successful stories of NGO intervention have been noted in Zambia and Mozambique. Private institutions in these countries provide critical adaptive initiatives covering gaps left by inept caused by the governments (Vincent, 2010).

Private institutions have been used by government as vehicles for reducing tension and fostering adaptation of vulnerable groups. In Kenya, the government's agreement in letting Practical Action play a brokering relationship between the conflicting pastoralists resulted in positive outcome (Pasteur, 2011). The strategy of letting them sharing their natural assets (grazing pastures) helped much in reducing vulnerability to droughts and loss of livestock by

some pastoralists. The smooth relationship between local farmers and local institutions strengthen adaptive capacity of vulnerable farming communities.

The role of local institutions in improving adaptation capacity through the use of indigenous knowledge has been observed in Bikita. Successful stories of institutional intervention in ward 20 and 21 were based on social capital and the communitarian view of solving problems. Community associations in community gardens and Fushai local farmers in building solidarity in fighting climate change disasters. As noted elsewhere the success of indigenous association groups needs to be supported by other formal groups for them to strengthen their role in livelihoods initiatives. The mutual relationship between the Sukuma people and the Ministry of National Recreation and Tourism in Tanzania helped much in the management and restoration of the once degraded environment (Agrawal, 2008). The revival of the *ngitiliti* (indigenous Swahili word for closure) reinforced the local farmers' and it led to the success of the project. Combining formal (public and private) and informal institutions (civic) is an important force behind sustainable adaptation. Successful cases of pooling labor resources have been witnessed in projects like FFA in ward 20 and 21.

8.6 Conclusion

It has been noted that selected farming communities in Bikita are vulnerable to a wide range of both climate and non-climatic disasters. There are a number of both formal and informal institutions which are operating in selected wards of Bikita in attempt to reduce vulnerability through various coping and adaptive strategies. The active institutions in the selected wards are private institutions. Despite their numbers, their methods of operation have been affected in their attempt to empower locals with adaptation and resilience strategies to deal with current and future climatic threats.

Three main problems were observed as impediments to full operation of NGOs. They include weak social capital, politics and poor topographic characteristics in some areas. On politics, emergence of polarized political views is detrimental to the full co-operation amongst vulnerable local farmers and also the NGOs themselves. Prevalence of political conflicts worsened the already fragile social capital which is important in informing cohesive adaptive energies. Most NGOs are duplicating roles such as food aid whilst failing to diversify their strategies which empower local farmers for self-reliance even when reacting to future

uncertainties. Also noted is the fact that some few attempts for self-reliance like FFA have been rolled but due to limited financial, physical and natural assets derailed attempts of building strong resilience to climate change impacts. The full operation of civic institutions in resilience building is slowly falling due to weak social capital and extreme climatic conditions. It concluded that, there is need for government's commitment in creating conducive environment which enables all local institutions to function properly in improving livelihoods of vulnerable groups.

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CHAPTER 9

CONCLUSIONS AND RECOMMENDATIONS

9.1 Overview of the study

This study unravels agro-dependent smallholder farmers' vulnerability to increasing climate change risks and hazards. Central to local farmers' vulnerability and capacity to adapt is access to weather and seasonal information. Seasonal information is obtained from the scientific seasonal forecasting and indigenous knowledge indicators. Access to weather and seasonal events is critical in informing decision making, planning and devising of adaptive strategies. Smallholder farmers' access to scientific seasonal information is problematic due to limited technology and assets. Limited access to technology creates challenges on scientific seasonal forecasting in the provision of seasonal information. Use of indigenous indicators is more appropriate though there are also some challenges which militate against their role in seasonal forecasting. This study examined the role played indigenous indicators in seasonal forecasting and how local farmers use the information for adaptation. In the process, the study evaluated the challenges associated with indigenous knowledge indicators in seasonal forecasting and adaptation. Lastly, the study evaluated the strength and weaknesses of integrating indigenous knowledge and scientific seasonal forecasting as an adaptive strategy of accessing dependable weather and seasonal information.

9.2 Main findings

Results obtained from the study identified various indigenous indicators and their role in seasonal forecasting. Though indigenous indicators are readily available, majority of local farmers do not totally depend on them. In most cases local farmers use both scientific forecasting and indigenous forecasting in farming. Though scientific seasonal forecasting is more popular and less complicated than indigenous indicators it has its own shortcomings. Shortcomings of scientific forecasting emerge communication breakdown (confusing forecasting jargon), lack of access to information gadgets such as radios and televisions, and minimum help from the extension services department. A combination of all these aspects infringed much local farmers' access to weather and seasonal information. Access to seasonal information strengthens local farmers' decision making and adaptation.

Alternatively, smallholder farmers have plenty of natural, social and human capital to strengthen their resilience. Central to the capitals is indigenous knowledge systems. Indigenous knowledge systems are an integral asset which they use in accessing seasonal forecasting information. Access to seasonal information provides adaptation strategies for vulnerable local farmers. Knowledge on indigenous indicators is common amongst the elderly farmers compared to youth and younger generations. Young generations' lack of knowledge on indigenous is causing its disappearance. Indigenous knowledge's disappearance is caused by factors such Christianity, education, collapse of traditional leadership and climate change impacts. The collapse of traditional leadership poses serious threats to preservation and transmission of indigenous knowledge. This affects the execution of important traditional rain making ceremonies. Absence of gatekeepers opened floodgates for loss of local knowledge.

Education and Christianity are also threatening the dependence indigenous indicators in predicting and adapting to seasonal uncertainties. Prevalence of scientific approaches in adapting to climate change problems are also influenced by climate change and the lack of documentation of indigenous knowledge systems. Lack of documentation is contributing much to the loss of invaluable knowledge. On the other note, adverse effects of climate of change and variability are also contributing to the loss of indigenous knowledge. Harsh seasonal impacts such insufficient rains and frequent heat waves are reducing the efficiency of some indigenous forecasting indicators. Reliance on indigenous indicators is dwindling due to unreliability of some indigenous indicators in seasonal forecasting.

From the study is noted that local farmers are vulnerable to complex climate change impacts. Local farmers' non-usage of indigenous knowledge in adaptation worsened their vulnerability particularly women. Smallholder farmers' lack of seasonal information and important livelihoods assets weakens their potential for adaptation. In such scenario, local farmers needs outside intervention in reducing vulnerability. External intervention emerges from NGOs and some government departments. The local institutions are mobilizing local farmers together, bringing new ideas, technology and important information needed in adapting to climate change shocks and stresses. Local institutions are diverse coping and adaptation strategies in responding to disasters such as droughts. Local institutions' intervention is affected by factors such as poor topographic characteristics, poor social capital, economy and politics. Villages with functioning social capital and good political relations are adapting well compared to others.

The study concludes that sustainable grassroots based adaptive strategies needs to be premised on indigenous knowledge. Success of indigenous knowledge in adaptation needs to be supported by climate change policies and other alternative adaptive strategy frameworks. Lack of policies which support indigenous knowledge systems are weakening of local farmers' adaptation. Countries with indigenous knowledge policies are doing well in supporting smallholder farmers' adaptation. Success of adaptation is supported by availability social capital and local institutions. All these factors are critical is strengthening local farmers' preparedness in fighting future uncertainties.

9.3 Recommendations

1. There is need for the government's meteorological department and extension services to work with local communities in provision of seasonal forecasting information.
2. The government should teach local farmers to document seasonal events and trends they get from indigenous indicators so as to create dependable seasonal information and farming calendars.
3. Government should create climate change policies which supports indigenous knowledge as an adaptive strategy amongst local farmers. Presence of policies which supports indigenous knowledge support the creation of self-help grassroots based adaptation strategies. Grassroots strategies reduce local people' expenses in obtaining seasonal forecasting information.
4. The government should include indigenous knowledge in the education curriculum. This work as strategy of safeguarding its existence and transmission to younger generations. Learning of local knowledge from young ages help in the restoration and preservation of indigenous in farming enterprise.

9.4 Future research

1. To interrogate children's vulnerability and available adaptive strategies – this will interrogate children's levels of vulnerability and available options for their adaptation.
2. To evaluate the importance of climate change policies and indigenous knowledge systems in adaptation and resilience building – this will interrogate how policies can support indigenous strategies of adaptation to climate change disasters.

3. To determine the contribution of traditional rainmaking ceremonies and Christian based rituals in influencing seasonal events – this will help local farmers in integrating different rituals as an adaptive strategy against climate change disasters.
4. To evaluate the role by various institutions in supporting adaptation and resilience building in rural livelihoods – this will unpack how local institutions can improve local farmers' adaptation by including local farmers' local knowledge and available capitals.

APPENDICES

APPENDIX 1: INDIGENOUS KNOWLEDGE SYSTEMS QUESTIONNAIRE

Introduction:

This questionnaire investigates how communities have interpreted climate change and weather patterns as they affect various aspects of their livelihoods. Whilst seasonal forecasts have been provided by the Meteorological services, these have been more widespread only recently ago but as communities have had their ways of measuring how seasons are going to unfold. These are the indicators which as communities have helped you predict the season and thus make choices on the types of crops to grow. It is therefore the thrust of this survey to get information on indicators used by communities to forecast seasons.

Name of interviewer.....

Name of Respondent.....

District.....Ward

1. Age.....

2. How long have you stayed in this area?

3. What crops do you intend to grow this season?

4. What are your reasons for choosing these crops?

5. What sort of indicators did you rely on to forecast performance of rainfall season?

Plants and/or vegetation (mite)

Animals (vertebrate, non-vertebrate, domestic, wild)

Atmospheric features)

6. Which trees in particular do/did you use in forecasting the season?

7. If the season was good, what are the phenological properties/characteristics observed on these trees)

8. If the season was bad what phenological characteristics did you observe on the trees?

9. Talking about animals, which animals/creatures did you use to forecast the season?

10. What was the behavior of these animals when a good season was expected?

11. In the event of a bad season, how did the animals behave?

12. Once the season started there are times when a dry spell would occur, what indicators helped you know a dry period was coming through?

13. At the end of the dry spell what would indicate the coming back of rains?

14. Have you checked on the indicators you use whether they are really good at forecasting the season?

15. If yes which indicators really gave good results?

16. Are the indicators you used in past years still as good today?

17. If you said no, can you explain what has changed on the indicators?

18. How did you get to know about these indicators?

19. Do you think the youth still use these indicators for seasonal forecasting? Give reasons

20. Do you use seasonal forecasts issued by the Meteorological Services Department?

Do you get the seasonal forecast in time and during the season do you get updates?

How do they hear or get to know of these forecasts (radio, newspapers, AEW, cell phone, hearsay etc)

21. Do you understand the seasonal forecasts issued by the MSD?

22. Have you ever analyzed to see if there is agreement between the forecasts given by MSD and your own forecasts using indigenous indicators?)

23. Name the areas of agreement if you said yes
24. Considering forecasts that are generated by the MSD, do you think you want to continue using your own ways of forecasting seasons or you want to shift to climate science?
25. Do you get the seasonal forecast in time and during the season do you get updates?)
26. Can you tell me what crops you would grow when a bad season was forecasted?
27. After growing these crops did you get good yields to help you survive the bad season
28. What agricultural measures would help you get some food during droughts?

ROLE OF RITUALS AND SPIRIT MEDIUMS IN CLIMATE CHANGE

What is a spirit medium?

Are there still spirit mediums in this area?

Yes / No. If your answer is YES explain

Also explain how do these spirit mediums work and disseminate their information to the people?

If your answer is NO what do you think is the reason for their non-existence?

What is called rain making ceremony / rituals?

6.1. Why or when is rain making ceremonies usually performed? How functional is the rain making rituals in influencing rain fall?

Who are the custodians of these rain making ceremonies?

Is there any relationship between spirit mediums in rain making ceremonies?

How important is the spirit mediums' role in rain making ceremonies?

How exactly are these rituals executed?

Is there any relationship between spirit mediums' work and that of MSD?

Which one is more reliable between spirit mediums and MSD in climate change?

SIYABONGA / TATENDA

APPENDIX 2: GENDER AND SOCIAL CAPITAL QUESTIONNAIRE

Introduction:

This questionnaire interrogates different impacts of climate change on gender and how it can be adapted. It also focuses on how social capital can be combined with indigenous as a way of building resilience to vagaries of climate change.

Name of interviewer.....

Name of Respondent.....

Ward

1. Age

2. Sex

3. How long have you stayed in this area?

4. Have you ever heard about climate change?

5. What have you observed changing?

6. How has the changes impacted on your farming?

7. How have these changes impacted on gender roles?

8. Who are the most affected and how?

9. How do the most affected react to these impacts?

10. What challenges do they face in adapting to impacts of changes in farming?

11. Do they use indigenous knowledge systems as part of their reactionary strategies?

12. Is there any help from the government or other private players in helping the affected?

13. Besides farming what other activities men and women do to survive and what challenges do they face?

14. Which gender is most affected by these non-farming activities?

Part 2- Social capital and indigenous knowledge.

15. In the face of climate change problems, do people form groups for fighting them?

16. If yes how do the groups emerge?

17. What are the activities they do in collective action?

18. How important are these social networks?

19. Are these social networks linked with our indigenous knowledge systems?

20. Where exactly is the link / what activities being used?

21. Apart from indigenous knowledge, are there relationships with local government, NGOs or other institutions?

22. What are the constraining factors to collective action?

23. What are the enabling factors to collective action?

ZIKOMU KWAMBILI. TATENDA ZVIKURU. SIYABONGA

APPENDIX 3: QUESTIONNAIRES FOR VULNERABILITY AND ADAPTATION IN BIKITA

- What are the most important livelihoods resources to different groups within the community
- What challenges are facing with these resources in adapting to effects of climate change?
- What other coping strategies are you currently employing when responding climate change shocks and stresses
- Are there other social, political or economic factors which make particular people within the community more vulnerable than others?
- Do these vulnerable groups have any influence over these factors?
- Are households employing climate-resilient agricultural practices?
- Do houses have diversified livelihood strategies? Do these include non-agricultural strategies?
- Are people managing risk by planning for and investing in the future?
- What are the biggest climate-related hazards faced? Non-climate related hazards?
- How are hazards likely to change over time as a result of climate change
- Do households have protected reserves of food and agricultural inputs
- Do households have secure shelter?
- Do household have important infrastructure like clinics, schools and roads networks?
- Are key assets protected from hazards?
- Do people have access to early warnings for climate hazards?
- Do people have the mobility to escape danger in the event of climate hazards?
- Are social and economic safety nets available to households?
- Are financial and extension services available to households
- Are there any policies which support the vulnerable groups?

APPENDIX 4: VULNERABILITY ASSESSMENT FOR BIKITA

Objective: to identify local vulnerabilities that assist in communities developing adaptive knowledge and capacity

Summary of tool

Selection of enumerators/team members

Identification of risks and vulnerabilities with team members/enumerators

Methods

Identification of local hazards/risk assessment (climatic and non-climatic risks)

Assessment of local vulnerabilities/vulnerability assessment

Information for the vulnerability maps

Once risks have been selected:

The group discusses scenarios where the risks occur – date, intensity, season, weather conditions etc, in order to determine the shape of the risk and what will be affected by its impact at the particular time and place where it occurs

A domino effect can be written where the events or risks can trigger another, making the effect more pronounced

Enough detail to provide information about boundaries of risk zones

Risk zones should be estimated with the best available knowledge and techniques

Determine things within the risk zones that will be considered vulnerable.

Vulnerable sites are where people live, work, visit, and where farming, forestry, grazing etc, prevail

The baseline data collected for vulnerability map is the basis for decisions about adaptation decisions

Priority risk identification

Increased incidence of drought

	Risk level	Severity	Frequency
Water shortage			
Low crop yields			
Loss of income			
Spread of invasive species			
Biodiversity loss			

Assessment will be done for each of the major affected crops grown in the area.

Tools

1	Institutional analysis	Identification of key groups and interactions that determine how institutions operate
2	Brainstorming	Construction of matrices and lists of ideas, knowledge and perceptions
3	Consultation of stakeholders	Construction of individuals or groups affected by the decisions or processes
4	Oral histories	Use of the knowledge provide by the groups to construct analogues of strategies and future effects
5	Expert judgment	Technical evaluation of specific problems in the field
6	Vulnerability indicators	Compilation and mapping of data and knowledge to construct multistage/level indicators

7	Macro-economic models, cost benefit analysis	Economic and social valorization of the impacts, options and responses
8	Vulnerability profiles	Mapping and analysis of indicators for different groups
9	Risk analysis	Introduction and analysis of uncertainty in decisions
10	Focus groups	Selected groups of stakeholders who analyze options for dealing with certain issues

Application of methods with appropriate tools

Indication of risk

To analyze risk of drought

Risk analysis (tool 9);

Oral histories (tool 4);

Expert judgment (tool 5);

Brainstorming (tool 2);

Focus groups (tool 10)

To assess damage to natural resources and environment

Expert judgment (tool 5);

Consultation of stakeholders (tool 3);

To identify areas at high risk (drought/impacts)

Vulnerability profiles (tool 8);

Expert judgment (tool 5)

To show evidence of deforestation

Photographs;

Expert judgment (tool 5)

To evaluate risk of food insecurity

Stakeholder consultation (tool 3);

Focus group discussion (tool 10);

Expert judgment (tool 5)

To show impact of climate change and variability

Vulnerability assessment

To show evidence of rainfall reduction over the years

Vulnerability indicators and mapping (tool 6);

Vulnerability profiles (tool 8)

To show evidence of vulnerability of agriculture

Vulnerability indicators (tool 6);

Expert judgment (tool 5)

To show evidence of the delay in rainfall

Vulnerability indicators and mapping (tool 6);

Vulnerability profiles (tool 8)

To show evidence of the vulnerability of agriculture to drought

Vulnerability indicators (tool 6);

Expert judgment (tool 5)

APPENDIX 5: QUESTIONNAIRE ON INSTITUTIONS

Do local institutions have scaled down resilient projections available to the locals?
 What institutions (government and non-government) are involved in research, planning, and implementation of adaptation strategies to the local communities?
 If so what are they doing in supporting the locals in adapting to climate change and variability
 Do these local institutions have access to information on current and future climate risks?
 Do they have local plans or policies that support climate resilient livelihoods?
 What are the most important institutions in facilitating or constraining adaptation?
 Do local institutions (governmental & non-governmental) have the capacity to monitor and analyse information on current and future climate risks
 Do these institutions have mechanisms in place to disseminate this information to the beneficiaries?
 Do the government / or public institutions have policies supporting preservation and reliance on indigenous in
 Forecasting
 Adaptation
 10. Do private and civic institutions have policies that encourage usage of indigenous strategies in adapting to climate hazards?
 If they are there, mention them
 11. If not why are they not having indigenous driven policies in their intervention?
 Semi-Structured Questionnaire-guide for focused group discussion

Country: _____ District: _____

Institution: _____

1. Prevalent hazards, risks and risk drivers in Bikita District

In your opinion...

What would be your 3 priority hazards? Why?

Hazard 1:

Category	Comment
Hazard	
Who is most vulnerable?	
Why are they vulnerable?	
Where is highest vulnerability?	

Hazard 2:

Category	Comment
Hazard	
Who is most vulnerable?	
Why are they vulnerable?	
Where is highest vulnerability?	

Hazard 3:

Category	Comment
Hazard	

Who is most vulnerable?	
Why are they vulnerable?	
Where is highest vulnerability?	

Are there sectors/services with internal shortcomings that increase the likelihood of a localised or more widespread disaster ... if so, which ones?
 Are there risk and vulnerability mapping exercises?
 If so, who does them?
 When was the last exercise done?

DO SAME FOR RISKS

2. Information on capacities of government agencies, essential services and management practices
 To address these threats what are your organisation's strengths?
 What major risk assessments, related to your area of work, have been undertaken in the 5 years?
 How do you monitor rural/urban water shortage risk?
 Tell me about the adequacy of your district water storage
 What capacity do you have to respond to rural/urban water shortages?

Opinions of the 3 most significant disaster events since 2000
 Do you have a disasters' database or list of disasters? Where can I find this database?
 What are the 3 disasters since 2000 that stand out the most to you? Why do these disasters stand out? (economic, livelihood/infrastructural loss... etc)

Disaster Name	Type	Year	Spatial Extent	No. affected	Reason why significant

Top ranked disaster since 2000
 What happened? How many people were affected? Etc.
 What factors escalated the impacts of the disaster?
 What management practices were effective?
 What factors stabilised/deescalated the impacts of the disaster?
 Speak about the effectiveness of the early warning systems
 Were there any warning signals that were missed?
 Were there any escalating risk factors that were ignored?
 If an event of this magnitude were to occur again, what would happen?
 Other institutional Qs
 How effective do you feel regional collaboration on disaster risk is?
 What are the strengths of these?
 What are the weaknesses?
 Give an example
 At what point is an emergency situation declared as a national disaster?
 At what point do you appeal for international assistance?
 What is the protocol for mobilising international assistance?
 How effective do you feel the co-ordination of government, NGO's and humanitarian aid is?

How can this be strengthened?

What are the shortcomings?

Interviewee's opinions on projected future changes

In your opinion, what is likely to change in the future? Where, for whom, why, when?

How do you expect the risk profile to change?

What factors influence this change?

What do you feel the response of the population will be to these changes? Government's response ...constraining/enabling factors?

Do you feel your institution will be able to cope with/benefit from these changes?

APPENDIX 6: COMMUNITY/INSTITUTIONAL ADAPTATION FGD Guide

Brainstorming on community responses to climate change

How have communities responded to these changes and hazards? Have these responses been self-driven or driven by externals? In what way has this happened? Who has failed to respond and why (women, men, youths)? How have the households that have failed been assisted and by who? Remember to probe for all these issues

Change/Hazard	Response	Response driven by?

Institutional and stakeholder mapping, stakeholder analysis: brainstorming and Venn diagrams
This tool will map out stakeholder and institutional capacity in climate management.

(i.) A brainstorming session will list the stakeholders and institutions that have had a role to play in climate related hazards and CCA. Probe for the shortcomings and achievements of each stakeholder in detail as participants list services and role played

Institution/stakeholder	General services they provide	Role played by each in change and hazard response

It will be important to then establish the priority stakeholders identified through matrix scoring and ranking. Participants will outline the criteria for evaluating stakeholder activities e.g. timeliness, frequency etc

Institution/stakeholder	Timely intervention	Frequency of intervention	Sustainability of intervention	Score	Rank

(ii.) A Venn diagram will establish the interaction between communities and stakeholders and also among the stakeholders themselves in CCA. Also probe on trends in and inclusivity issues in stakeholder interventions including their impacts



Collective action

What brings people together for CCA and to what extent has this been effective? Who coordinates this?

