Climate variability and the adaptive capacity of the rural farmers: The case of Matobo District- Zimbabwe 2016 to 2017 rainy season.

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Abstract

This paper evaluates the adaptive capacity of rural farmers in the midst of climate variability in 2016 to 2017 rainy season in Matobo district. Climate variability has emerged as a major global crisis of the 21st century because of its past, present and projected environmental and socio-economic impacts. The shift in climatic conditions over the Sub-Saharan Region towards semi-arid to arid conditions has stemmed up a lot of concern as to whether Africa can adapt well to these climatic conditions. The past three decades have been characterized by an erratic rainfall pattern over Africa's sub-tropics and a significant decline in the amount of rainfall. This has resulted in droughts which have significantly affected agriculture and food production. Crops have failed to quickly adapt to these harsh climatic conditions. Research on the impacts of climate variability in Zimbabwe shows that the country's agricultural sector is already suffering from changing rainfall pattern. In as much climate variability is affecting everyone directly or indirectly, farmers worldwide are at the forefront. This is mainly because their livelihoods are mostly hit by ever changing climate variations. Some research have shown the adaptation strategies that farmers have employed as a result of variations in rainfall and temperatures patterns. Mostly in Matobo district, these variations of rainfall and temperature patterns are mainly low rainfall and high temperature for the past decades with the exception of year 2011 and 2012 which experienced moderate rainfall during the rainy season. As a result of these climatic conditions in the district of low rainfall and high temperature patterns that were easy predicated even by farmers, farmers had developed innovations with institutions to curb low

rains which were being experienced in the district. However, 2016 to 2017 rainy season posed a change in climatic conditions in the district. The district experienced heavy rains throughout the season. As a result of this climatic variation of 2016 to 2017 rainy season, this paper seek to evaluate how farmers in Matobo district were able to adapt to this change as they were mainly used to low rainfall patterns and have further developed adaptive strategies to curb low rains in the district. This papers will highlight the effects of high rainfall patterns on farmers crops, the adaptive capacity of farmers to high rainfall of 2016 to 2017 rainy season and asses the role of institutions towards the adaptive capacity of farmers.

Key words: Adaptive capacity, climate variability, climate change and rainy season.

1.1Introduction

Climate variability has emerged as a major global crisis of the 21st century because of its past, present and projected environmental and socio-economic impacts (IPCC, 2007). Climate variability refers to the climatic parameter of region varying from its long-term mean. Every year in specific time period, the climate of location is different. Some years have average rainfall, some have average or above average rainfall (IPCC, 2007). Climate variability will certainly have an effect on the future sustainable development of much of our planet's resources such as those relating to biodiversity, water, forests, land and oceans as well as in relation to various sectoral activities like agriculture, forestry and biodiversity (WMO, 1992).

The reality facing the world is that the world has become warmer with the earth's surface temperature having risen by more than 0.7 ºC since the 1800s (IPCC, 2007). Studies done by Karim, (1996); Watson (1996); Kelly and Adger, (2000); O'Brien, (2000); Leichenko, (2000) and Bohle, (2001) state that climate variability is taking place with impacts on people's livelihoods. Agriculture has proved to be most vulnerable to that effect, spanning from high temperatures that are being experienced in most parts of the globe, which has seen a remarkable reduction in crop yields and a drastic decline in food production over the past two decades (Feyissa, 2007). This happens notwithstanding the fact that livelihoods in developing countries rely on agriculture, and that seventy percent of the world's poor live in rural areas, where

agriculture is their main source of income (Nelson et al, 2009). In most parts of Africa too, particularly in the Sub-Saharan region, climate variability has exerted enormous pressure on farming, the mainstay of rural livelihoods (UNDP Human Development Report, 2006). Climate projections in Southern Africa suggest that variability is likely to increase in the future and extreme weather events might become more frequent (Tadross et al., 2005).This scenario again arguably plunges populations into food insecurity, hunger, ill-health, limited access to income and ultimately poverty (Watson et al., 1996).

Moreover, in Zimbabwe 70% of the population derives the bulk of food requirements and income from subsistence farming in rural areas (Levina, 2006). The heightening of climate variability has had substantial negative effects also on agriculture (IPCC, 2007) and this has raised the food and livelihood insecurity alarm in Zimbabwe and the entire world. The negative influence of climate variability on agriculture in Zimbabwe has culminated into a hydra whose effects have choked the country's economic growth (Bohle, 1994).

Matobo district is in National region 4 and 5. This area is mainly characterized and experiences low rainfall and high temperatures. The area experiences a semi-arid climate as it is subject to periodic seasonal droughts and severe dry spells during the rainy season (Meteorological Services Department, 2013). The rainy season occurs from November to March (Ndlovu, 2010). As a result, rural farmers have adopted adaptive strategies for their livelihoods to curb these climatic conditions of high temperatures and low rainfall (FAO, 2012). Studies by (Moyo 2012), Ncube, 2016) clearly indicate that from 2005 to 2015 excluding 2011 and 2012 shows that the district has been experiencing low rains as further highlighted in Figure 1.1.

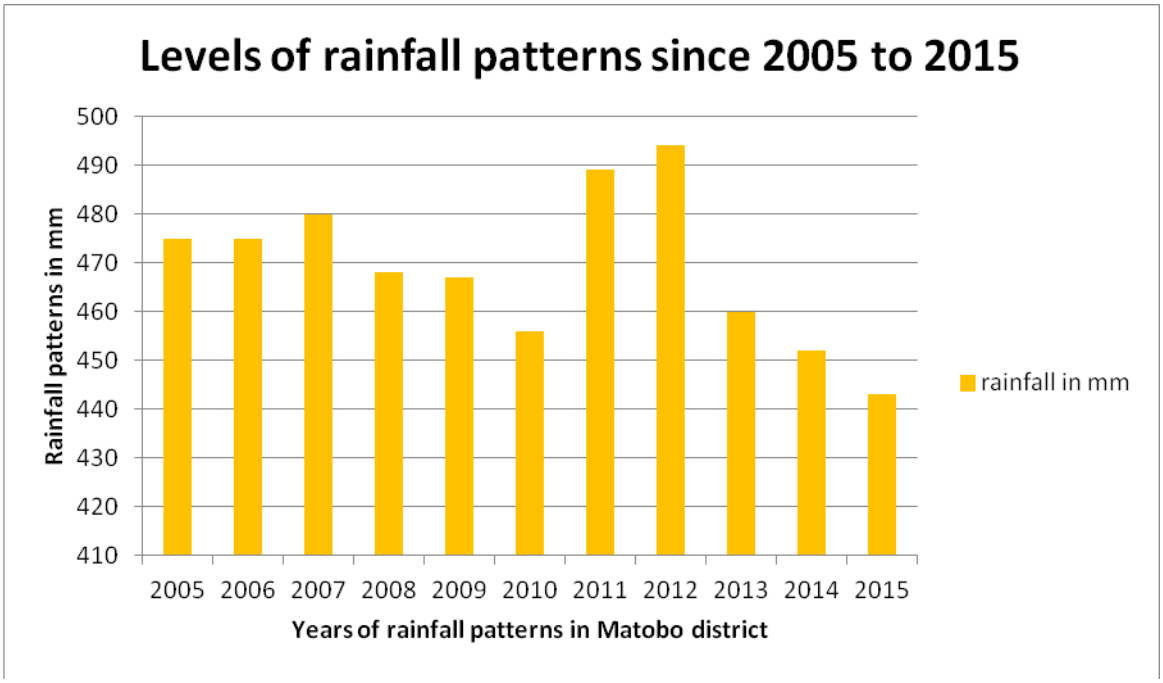

Figure 1.1: Levels of rainfall patterns in Matobo district since 2005 to 2015

Source: Meteorological services in Kezi (2016)

Studies by (Moyo, 2012, FAO, 2012) clearly highlight that institutions and farmers from the district have derived various mechanisms or adaptive strategies to curb low rainfall patterns. These adaptive strategies include planting of drought resistant crops, diversification of crops, use of manure, delayed planting and opening of small gardens (FAO, 2012). A study by (Ncube, 2016) further evaluated the sustainability of these adaptive strategies that are being employed in the midst of low rainfall.

The gap which motivated the researcher to carry out this study was that in 2016 to 2017 rainy season, the district faced a change as far as climate variability is concerned. The district experienced heavy rains throughout the season. Since the farmers from the district have been mostly used to low rainfall patterns and even adopted various adaptive strategies to overcome low rainfall. As a result, this study seeks to evaluate the adaptive capacity of farmers in Matobo district to heavy rainfall of 2016 to 2017 rainy season.

2.1 Main body of manuscript

2.2 Conceptualizing climate variability

There have been debates surrounding the subject of climate variability and climate change. According to (IPCC, 2007) climate variability refers to the climatic parameter of region varying from its long-term mean. Every year in specific time period, the climate of a location is different. Some years have below average rainfall, some have average or above average rainfall (IPCC, 2007). On the other hand, Tadross*et al*, 2005 refer to climate variability as variations in the mean state and other climate statistics (standard deviations, the occurrence of extremes, etc.) on all temporal and spatial scales beyond those of individual weather events. Variability may result from natural internal processes within the climate system (internal variability) or from variations in natural or anthropogenic external forces (external variability). Climate change on the hand is defined as a change in climate over time, whether due to natural variability or as a result of human activity (IPCC, 2007). This usage differs from that employed in the United Nations Framework Convention on Climate Change (UNFCCC, 2007), which defines climate change as a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.

What the ongoing debates on climate change and climate variability reveal is that climate variability refers to variations and inconsistencies in the mean state and other climate statistics whereas climate change refers to any change in climate over time, whether due to natural variability or anthropogenic forces (Khanal, 2009). Climate change happens after a long period of time and the change is permanent while climate variability happens for a short period and it is temporal (IPCC, 2007). Climate variability effects are temporary for instance, change in the average annual rainfall of Rajshahi in north western Bangladesh is 1 494 mm. The amount of rainfall may change next year either by decreasing or increasing (Goddard, 2010). Climate change is the slow change in the composition of the global atmosphere, which is caused directly and indirectly by various human activities in addition to natural climate variability over time (Koehler-Munro & Goddard, 2010).

This study looks at climate variation in terms of rainfall patterns in the area of Matobo district. Moreover, Khanal (2009) and Goddard, 2010) state that climate variability has affected peoples activities globally. Therefore this study evaluate the adaptive capacity of farmers in the midst of

high rainfall of 2016 to 2017 rainy season. In dealing with climate variation, it is highlighted to the respondents that climate variability in this study looks at variations in rainfall.

2.3 Understanding adaptive capacity

Anthropologists and cultural ecologists discuss adaptive capacity as the flexibility with which individuals and communities or populations adapt to environmental changes (Regin and Lewin, 2000; Campbell and Sayer, 2003; Bodley, 2012). Adaptive capacity is the processes by which individuals or social systems learn, alter and improve means of subsistence when faced with perturbation and add this new means to their cultural repertoire (Matutinovic, 2002; Ayres, 2008; Bodley, 2012).

The terms resilience and adaptive capacity are also sometimes used interchangeably (Walker et al., 2004).The term adaptive capacity has multiple meanings: the capacity of the system to absorb disturbance without changing its stability (Gunderson and Holling, 2002); a system‘s capacity to absorb and reorganize while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks (Walker et al. 2004)

The adaptive capacity inherent in a system represents the set of resources available for adaptation, as well as the ability or capacity of that system to use these resources effectively in the pursuit of adaptation (Gunderson and Holling, 2002). It is possible to differentiate between adaptive potential, a theoretical upper boundary of responses based on global expertise and anticipated developments within the planning horizon of the assessment, and adaptive capacity that is constrained by existing information, technology and resources of the system under consideration (UNDP, 2005).

According to Barnett (2001) and Downing *et al.*, (1989) adaptation measures in agriculture are irrigation management, change in cropping pattern, diversification of crops, and introduction of drought resistant varieties. In areas of China, many historical adaptations in agriculture (e.g., relocating production or employing irrigation) are no longer available as population pressures increase on limited land and water resources (Fang and Liu, 1992; Cai and Smit, 1996). In Kenya, effective smallholder response to climate effects has shifted from traditional planting strategies to employment diversification (Downing *et al.*, 1989).

El Shaeret al., (1996); Rayner and Malone (1998) outline various types of adaptation that can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation. Adaptive capacity is the potential or ability of a system, region, or community to adapt to the effects or impacts of climate change(Burton, 1996; Smith et al., 1996; Parry et al., 1998; Smit et al., 1999). The expression of adaptive capacity as actions that lead to adaptation can serve to enhance a system's coping capacity and increase its coping range thereby reducing its vulnerability to climate hazards. Ability to adapt clearly depends on the state of development (Berke, 1995; Munasinghe, 1998). As Ribotet al. (1996) illustrated, underdevelopment fundamentally constrains adaptive capacity, especially because of a lack of resources to hedge against extreme but expected events.

Studies by (Regin and Lewin, 2000; Campbell and Sayer, 2003; Bodley, 2012) point out that adaptive capacity is the flexibility with which individuals and communities or populations adapt to environmental changes. In this study, adaptive capacity means actions taken by farmers or institutions to overcome the impacts of high rainfall patterns. Morestill studies by (Regin and Lewin, 2000; Campbell and Sayer, 2003; Bodley, 2012) noted that people adapt because of environmental changes. However this study looks at how farmers of Matobo district adapted due to high rainfall experienced in 2016 to 2017 rainy season. Studies by (Gunderson and Holling, 2002) posit that the adaptive capacity inherent in a system represents the set of resources available for adaptation, as well as the ability or capacity of that system to use these resources effectively in the pursuit of adaptation. This study seek to highlight the resources the farmers of Matobo district had for adaptation. A study by (Ribotet al. 1996) illustrated, underdevelopment fundamentally constrains adaptive capacity, especially because of a lack of resources to hedge against extreme but expected events. This study will highlight the challenges the farmers had with the issue of resources and how effectively did they use the resources when it came to adaptive capacity.

Studies by (Barnett (2001) and Downing *et al.*, (1989) adaptive capacity measures in agriculture are irrigation management, change in cropping pattern, diversification of crops, and introduction of drought resistant varieties. The gap that this study seek to address is that these adaptive capacity measures pointed out by (Barnett (2001) and Downing *et al.*, (1989) are mainly adaptive capacity actions done by farmers to deal with low rainfall patterns and high temperatures. This

study however seeks to address the adaptive capacity measures employed by Matobo farmers in dealing with high rainfall patterns of 2016 to 2017 rainy season. These scholars are also highlighting these adaptive capacity measures from a general and broad point of view. This study seek to be specific on the adaptive capacity measures employed by the farmers of Matobo from a micro level point of view.

2.4 Theoretical framework

This study made use of the Local Adaptive Capacity Framework (LAF) by Lindsey Jones, Eva Ludi and Simon Levine (2010) linking it with the Sustainable Livelihoods Framework (SLF) by Scoones (1998). The Local Adaptive Capacity (LAF) framework identifies five distinct yet inter-related characteristics that are conducive to adaptive capacity. These are: the asset base, institutions and entitlements, knowledge and information, innovation, and flexible forward-looking decision-making (Ostrom, 2005). These characteristics determine the degree to which a community is resilient and responsive to changes in the external environment (IPCC, 2007). There are interdepended on each other.

The first characteristic in the LAF is the asset base. The ability of a community to cope with and respond to climate effects depends heavily on access to, and control over, key assets (Daze et al., 2009). Typically, it is the poorest that are most vulnerable to the impacts of climate variability and wider developmental pressures, in large part because of their lack of, or restricted access to, key assets and capitals. Assets include both tangible capitals (natural, physical and financial) as well as intangible ones (human and social) (Prowse and Scott, 2008).

The relationship between assets and adaptive capacity is complex. Lack of availability and access to appropriate resources may significantly limit the ability of a system to cope with the effects of climate variability and wider development pressures. Equally, an effective asset base depends on the extent to which components within the system are substitutable in the case of disruption or degradation of one component. As a result, asset diversity, and the ability to access assets that are in some sense surplus and interchangeable, may each be as important as simple ‘asset abundance’ (Ospina and Heeks, 2010). In view of the above characteristic, this study seeks to highlight how assets owned by farmers in Matobo district have helped them to adapt well to high rainfall patterns.

The SLF by Scoones (1998) identifies these assets as:

- **Natural assets**: land, water, trees, genetic resources, livestock, soil fertility
- **Physical assets**: agricultural inputs, business equipment, houses, consumer durables, vehicles and transportation, water supply and sanitation facilities, and communications infrastructure
- **Human assets**: education, skills, knowledge, information, health, nutrition, time, labor
- **Financial assets:** savings, credit, and inflows
- **Social assets:** membership in organizations and groups, social and professional networks
- **Political assets**: citizenship, enfranchisement, and effective participation in governance

Assets are important for the poor because they can help them cope better with shocks, including climate shocks and the longer term impacts of climate extremes. In the context of climate variability, access to and control of assets can be particularly important for the poor, where assets such as secure land and water rights, agricultural technologies, livestock, knowledge, and social capital can help individuals and households adapt to increasing variability of production (Bebbington 1999; Moser 2007; Sen 1997; Sherraden, 1991). This study therefore will further map out the assets that the farmers of Matobo district have in curbing high rainfall patterns in the district

The second characteristic in the LAF is institutions and entitlements. Institutions are the 'rules' that govern belief systems, behavior and organizational structure (Ostrom, 2005). Communities with well-developed social institutions are typically better able to respond to a changing environment than those with less effective institutional arrangements. Defining a 'well-developed' institution is, however, problematic and subjective. Access to and control of assets is mediated through institutions and entitlements, or claims. At the community level these are generally 'informal' local-level institutions or rules, and may include: land tenure rules, such as claims to common property resources; the ways in which farmers share knowledge; family, clan and church networks through which assets are shared; and 'rules' (unwritten) governing the rights of women (Adger, N., Brooks, N. and Kelly, M. (2004).

Given that entitlements to 'elements of adaptive capacity are socially differentiated along the lines of age, ethnicity, class, religion and gender' (Adger et al., 2007), it is often thought that institutions that ensure equitable opportunities to access resources are likely to promote adaptive capacity within a community (Saleemul (2009). Institutions cannot, however, be measured solely according to asset distribution. Dimensions such as participation in decision-making; how institutions empower or disempower people; and the extent to which individuals, groups and communities have the right to be heard may prove key in determining both the degree to which a community is able to adapt (Jones, L. (2010). This study therefore will further look at the role of various institutions that is the government and Non-Governmental Organizations roles in Matobo district towards asserts distribution among farmers. The study will further assess the role of institutions towards empowering the Matobo district farmers on issues of decision making when it comes to adaptive capacity.

Knowledge and information is the third characteristic of LAF. Communities are often more likely to cope with change if they have appropriate knowledge about potential future threats, as well as an understanding of how to adapt to them. With this in mind, successful adaptation will require: understanding of likely future change and its complexity, knowledge about adaptation options, the ability to assess options, and the capacity to implement suitable interventions (Frankhauser and Tol, 1997). Knowledge can also play a role in ensuring local empowerment and raising awareness of the needs of particular groups within a community (Ospina and Heeks, 2010). Therefore, the way in which a system generates, collects, analyses and disseminates knowledge is an important determinant of adaptive capacity with obvious links with the institutional context and the governance of knowledge.

Local generation and exchange of information is again often classed as 'informal', and contrasts with more 'formal' information provided by external and/or state actors. Communities need systems that can both optimize 'informal' knowledge generation and sharing, and maximize their uptake and use of external, 'formal' knowledge sources. In many contexts, adaptation will require effective services from outside the community itself to support the use of information (IPCC, 2007). These services include quality education, the generation of information and

expertise on climate or agriculture and much more effective communication of that information than has often been the case (Nagy, 2003).

Adaptation to any hazard, including climate variability, does not depend on information only about the hazard itself. A community's ability to know where to find and use new crop species or to apply for financing to fund investment in agricultural change are as important as knowing the weather forecast, and how the climate is expected to change in the future. Similarly, an important aspect is general awareness-raising and capacity-building of stakeholders to inform adaptation decisions (McGray, 2009). This study seeks to highlight the role of institutions in disseminating information and knowledge to the farmers in the district and it further seek to measure the extent how the information was relevant to the farmers towards their adaptive capacity. Studies by (Ospina and Heeks, 2010) note that knowledge can also play a role in ensuring local empowerment and raising awareness of the needs of particular groups within a community. Therefore this study will further highlight the extent how the institutions rose the awareness of high rainfall in 2016 to 2017 among Matobo district farmers and how empowered were they.

Innovation a key characteristic of adaptive capacity relates to the system's ability to foster innovation and support new practices (Smith et al., 2003). As social and environmental changes continue, communities will need to alter existing practices, resources and behaviors, or in some cases adopt new ones. Experimentation, innovation and adoption as part of the learning process are essential in ensuring the system's ability to cope with and respond to changing circumstances. Moreover, innovation is crucial to enable a system to remain dynamic and functioning though at the local level the willingness and capacity to foster innovation (and to accept failure) vary greatly. It is important to recognize that this is not only about 'high tech' and large-scale innovation, but also micro-level initiatives, as many of the actions taken to adapt to changing shocks and trends will be done spontaneously or autonomously at the local level (Wongtschowski et al., 2009). Such local innovations are often not recognized in the face of more technological or infrastructural innovations though care should be taken not to 'over romanticize' traditional local practices. This study seeks to outline and assess the role of institutions in ensuring new innovations in Matobo district as means of withstanding the shock of climate variability. The study by (Wongtschowski et al., 2009) looks at 'high tech' and 'large

scale' innovations. This study will look at the innovations done at that district as means of dealing with climate variability in 2016 to 2017 rainy season.

Flexible forward looking decision making and governance is the last characteristic of the LAF. A system's capacity to anticipate change and incorporate relevant initiatives into future planning and governance is an important aspect of adaptive capacity. Informed decision-making, transparency and prioritization are key elements of adaptive governance. Decision-making and governance that is flexible, collaborative and learning-based may be responsive, adaptive and better able to cope with evolving circumstances. This recognizes the importance of dynamic organizations, and the institutions, entitlements and assets they control in response to shock and changing trends (Smith et al., 2003). Moreover, decision-making systems can gain from being flexible enough to include new information and knowledge regarding changing environmental, social and political conditions. Supporting the capacities of formal organizations to deal with a range of shocks and trends, and to coordinate response options, may help to ensure that communities deal better with the impacts of climate change and wider development pressures (Tompkins and Adger, 2004). An important part of this is ensuring that such organizations learn and are forward-looking in nature, anticipate future weaknesses and vulnerabilities and create opportunities for appropriate adaptive actions. Taking a longer-term approach within governance and decision-making is crucial in order to prevent maladaptive interventions (Ayers and Huq, 2009). This study will assess the role of institutions in Matobo district in assisting farmers with information, decision making, knowledge and future opportunities in dealing with high rainfall.

2.5Methodology

Inductive approach was used in this study to evaluate the adaptive capacity of rural farmers in the midst of high rainfall in Matobo district during the 2016 to 2017 rainy season. A mixed research approach was taken and this involved the use of open ended interviews, use of focused group discussions (FGDs) and general observations to obtain the relevant information on the adaptive capacity of farmers in the midst of high rainfall in 2016 to 2017 rainy season. The area covered in the study is Matobo district and it has 24 wards. The researcher used convenient sampling technic in selecting the district because the researcher has hands on approach during data collection and the researcher has full knowledge of the district as her schooling and home is

from that district. The researcher used simple random sampling technic in selecting the wards. The reason why the researcher used this method of sampling was because the wards are far apart therefore it was convenient for the researcher to use this method and in this district every household practiced farming. This method was a reliable means of collecting data. Data was collected from youths, women and men who are farmers. The researcher used purposive sampling in sampling the key informants and these include Ministry of Water and Climate, Ministry of Agriculture and Mechanization, and NGO managers or field officers in the district. Other relevant information pertaining to this study was obtained through documentary research from the Intergovernmental Panel on Climate Change (IPCC). Relevant literature from books, academic papers, journals, newspapers and the internet was also used. Statistical figures, graphs and tables were used to interpret and further explain the facts on adaptive capacity of farmers to high rainfall in the district.

2.7 Findings and discussions

Research findings and discussions of results are presented in this section. Research findings are tabulated in graphs, pie charts and table forms. This section gives an insight into the rainfall patterns in the district, it further reveals crops that were planted by farmers, it ranks various crops that were affected by rain and various crops that produced more yields during the rainy season of 2016 to 2017. Finally it gives an insight to the adaptive capacity of the farmers of Matobo district to high rainfall patterns during 2016 to 2017 rain season and highlighting the role of institutions towards the adaptive capacity of farmers in Matobo district. The findings of the study are discussed within the context of debates in already existing literature on a similar subject and the study made use of the Local Adaptive capacity Framework (LAF) by Lindsey Jones, Eva Ludi and Simon Levine (2010) to further analyze data on the adaptive capacity of famers of Matobo district during the 2016 to 2017 rainy season.

2.8 Rainfall patterns during 2016 to 2017 rainy season in Matobo district

Ninety five percent of the farmers in the district pointed out that there were high rainfall pattern in the district during 2016 to 2017 rainy season. Three percent of the farmers noted that there were moderate rains and two percent posited that they were low rainfall pattern in the district as reflected by Figure 2.8.1

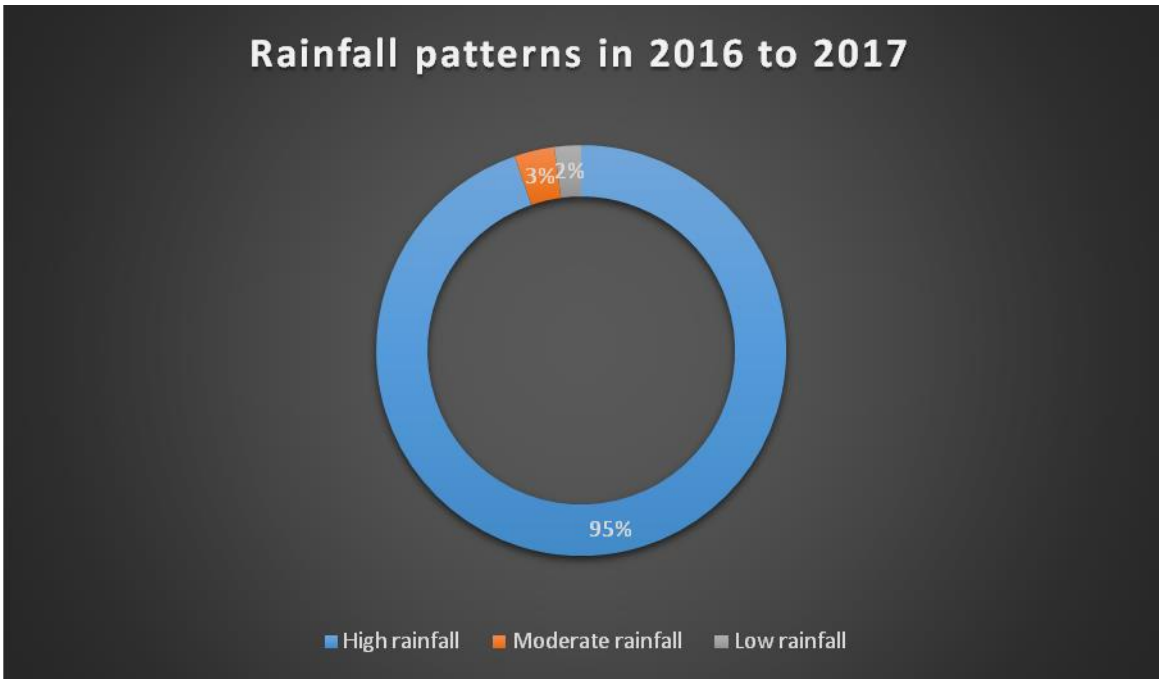

Figure 2.8.1: Rainfall pattern in 2016 to 2017 at Matobo district.
Source: Own fieldwork (2017)

High rainfall pattern in 2016 to 2017 rainy season emerged as the key indicators of climate variability. One farmer during the FGDs reported that in the last 10 years the amount of rainfall received has significantly reduced but last year the rains have been so much. This is consistent with Meteorological services (2016) data which show that in 2016 to 2017 rainy season experienced high rains. Most farmers stated that there were floods in their fields because of much rains. Mrs C Ncube a farmer from Malindi village in Matobo said
"*abekungangenekiemasinimingenxayamanziabemile. Bekutotaemasinini*".

She said that we were no longer able to get into the fields because there was water. It was sinking. The Ministry of Water and Climate field officer pointed out that the amount of rain that was in this area in 2016 to 2017 rainy season was too much. Figure 2.8.2 clearly highlights the amounts of water that was in fields of farmers of Matobo district in 2016 to 2017.

Figure 2.8.2 Evidence of crops floating in water at Matobo district in 2016 to 2017 rainy season.

Source: by Annamary Ncube Field Observations in Kezi, 4th of January 2017

2.9 Crops planted by farmers during the 2016 to 2017 rainy seasons

Table 2.9 shows various crops planted by farmers in the district. Fifty percent of the farmers pointed out that they planted maize. All farmers stated that they planted sorghum, millet, water melons and ground nuts. Ninety percent of the farmers noted that they planted round nuts and pumpkins. Sixty three percent of the farmers showed that they planted peas as evidenced in table 2.9

CROP	**PERCENTAGE %**

MAIZE	50%
SORGHUM AND MILLET	100%
GROUND NUTS	100%
ROUND NUTS	90%
WATER MELON	100%
PUMPKINS	90%
PEAS	63%

Table 2.9: Crops grown by farmers at Matobo district in 2016 to 2017 rainy season
Source: Own fieldwork (2016 to 2017)

Due to low rainfall and high temperatures that the farmers have been experiencing in the past years in Matobo district, farmers had employed a number of drought resistant strategies to overcome the problem of low rainfall and high temperatures in the district. The Organization of Rural Associations for Progress (2013) also noted that all households in Matobo district had shifted from planting maize to drought resistant crops such as millet and sorghum. Decreased rainfall and rising temperatures have affected the growth and production of crops such as maize that require high rainfall. Ministry of Agriculture and Mechanization field officer also stated that in the district due to low rainfall patterns, institutions which include government institutions and Non-Governmental Organizations have assisted and empowered farmers to plant drought resistant crops. Using the LAF by (Lindsey, 2010) shows that the institutions had innovations and strategies to their district before 2016 to 2107 rainy season. These innovations for adaptive capacity of farmers include the use of drought resistant crops.

2.10 Crops affected by high rainfall in 2016 to 2017 rainy season in Matobo district

Figure 2.10 highlights that sixty percent of farmers sorghum and millet was affected by high rains, farmers point out that 80% of their water melons were affected by water, fifty percent of peas were also affected by high rains and sixty five percent of their pumpkins also were affected by high rains in Matobo district in 2016 to 2017 rainy season.

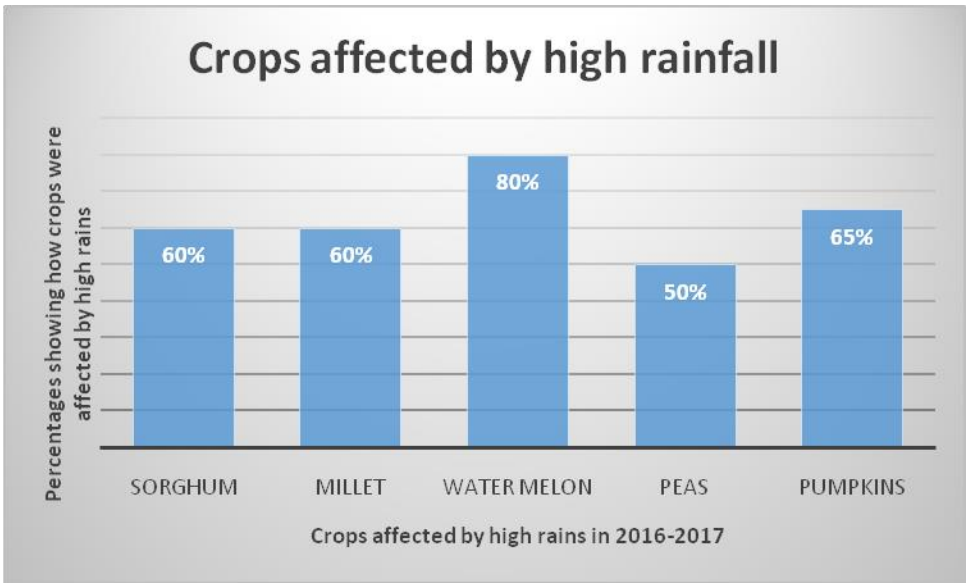

Figure2.10: Crops affected by rain in 2017 at Matobo district.
Source: Own fieldwork (2017)

From the graph, a number of crops were destroyed as a result of high rainfall in the district. Most of the crops that were destroyed were drought resistant crops especially sorghum, millet, pumpkins and water melons. MrMguni a farmer postulated during the interviews on the 12th of June 2017 that "amabele*ahleababomvuesasemancaneafangenxayezulualabalinengi".* He said millet and sorghum died still small because of too much rainfall.

His report concur with the report from Oxfam field officer who further pointed out that drought resistant crops were mostly affected by heavy rains in the district. As a result, the yields from sorghum and millet were low in the district as most farmers planted sorghum and millet. The AGRITEX field officer pointed out most farmers in the district did not have much yields because they were mostly and always prepared for low rainfalls and therefore as a result they plant drought resistant crops.

2.11 Crops which produced more yields in 2017 rainy season

Figure 2.11 shows that farmers who planted maize had great produce and the produce is at 98%. Farmers who grew sorghum and millet say these crops produced 45% of yields, farmers who planted peas say peas gave them 50% produce and farmers who planted water melons say water

melons gave them 20% of produce. Farmers who planted ground and round nuts say that the produce was at 55%. Farmers who planted pumpkins say pumpkins gave them 35% of produce.

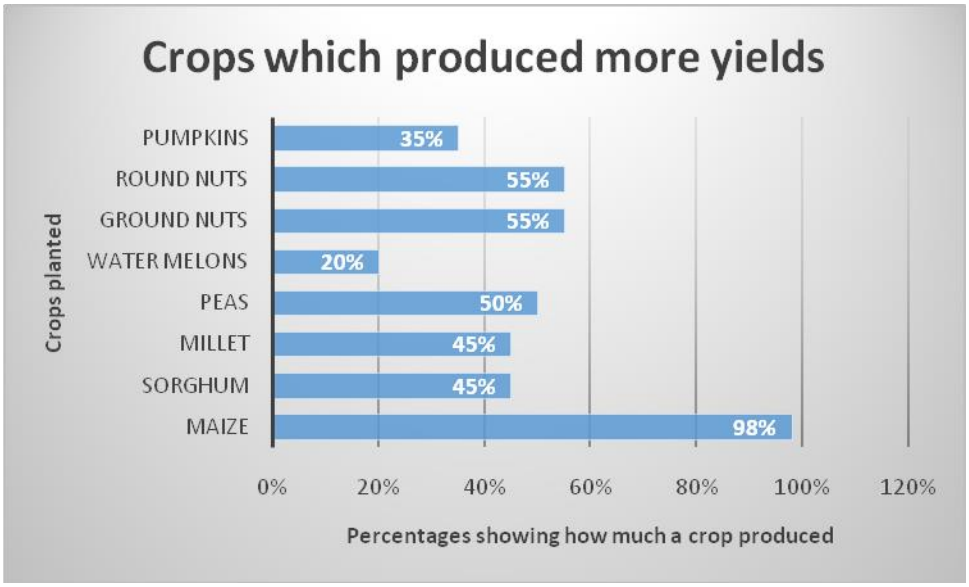

Figure2.11: Crops which produced more yields in 2017 at Matobo district.
Source: Own fieldwork (2017)

From the interviews conducted with the farmers, most farmers pointed out that many did not plant maize because of previous experiences that maize dies and not produce because of low rainfall and high temperatures. However in 2016 to 2017 there was much rain. MrNdlovu from Gohole ward in Matobo district noted that he planted more maize and he had more produce compared to sorghum and watermelons. Ministry of Agriculture and Mechanization officer noted that most farmers in this district plant a lot of crops to prevent total lose in their produce. As a result most farmers diversify their crops even though some did not produce much yields. According to Miguel (2008) crop diversification is an important strategy for managing production risk in small farming systems. Farmers agreed that diverse crops bring diverse benefits. This is because crop diversification reduces the chances of total crop failure. This result concurs with Hulme (1984) and Ruttenberg (1980) who established that diversification of traditional crop varieties and the farmers' skill for opting for small grains to minimize risks is an important adaptation strategy. Figure 2.11.1 reveals a farmer from Gohole in Matobo district who planted maize in his field.

Figure2.11.1: Evidence of maize crops producing more yields in Matobo district in 2017 rainy season.

Source: by Annamary Ncube, Field Observations in Gohole, 16 April 2017

2.12 Adaptive capacity of farmers in overcoming high rains in their field.

Figure 2.12shows that twenty five percentage of the farmers used fertilizers as a strategy of overcoming high rainfalls. Sixty five percent of farmers show that they made use of manure as a strategy, ten percent of the farmers employed the strategy of early planting and hundred percent of farmers used diversification of crops as a strategy.

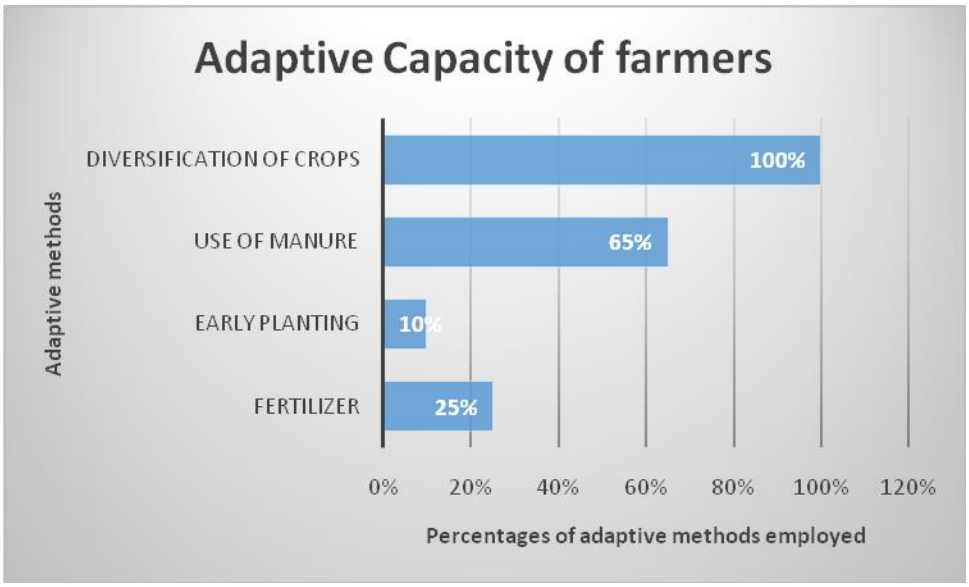

Figure2.12: Adaptive strategies employed by farmers in Matobo district in 2017 rainy season.

Source: Field Observations 16 April 2017

2.13 Use of fertilizer

Farmers in Matobo district pointed out most of their adaptation strategies were mainly for low rainfalls and high temperatures as that area is used to those climatic conditions. Most farmers from the FGDs noted that they did not have any mechanisms to deal with floods in their fields as it surprised them and were not ready for such rains and this affected their crops resulting in low produce. MrsMoyo from Madwaleni ward in Matobo district stated that I had planted a lot of sorghum and millet in my field. Most of the crops died because of much water and I had to buy fertilizer to help in draining the water. But the fertilizer was not much as I did not have money to buy more fertilizer so most of my crops died of water. Using the Sustainable livelihood framework of Scoones (1998) and Local Adaptive capacity Framework by Lindsey Jones, Eva Ludi and Simon Levine (2010), they pointed out that the adaptive capacity of people is compromised because of lack of financial assets. Most farmers posited that there did not have money to buy fertilizers as they had not prepared for heavy rains. Ministry of Agriculture field officer posited that the government and NGOs specializing in farming usually gave farmers fertilizer but usually in low quantities as the district is known for low rainfall patterns, therefore

most farmers did not have fertilizers. Most farmers during interviews clearly pointed out that they lacked money to buy fertilizers as means to curb high levels of water in their fields.

2.14 Use of manure

Figure 2.12 shows clearly that sixty five percent farmers made use of manure. However most farmers noted that they used manure to curb low rains not to curb high rains. Most farmers agreed during the FGDs that before rain comes, they first put manure because their land is overused, there have will be increased soil erosion and loss of soil retention. The continuous use of land has resulted in the loss of the soil fertility. Therefore it is a method to increase soil fertility. Mr D Nkomo a farmer from kezi in Matobo district during an interview acknowledged that this strategy was not used for heavy rains but it was used for increasing soil fertility but however it greatly assisted them as it helped in the sinking of water. According to Rossen and Bierman 2005 use of manure increases soil organic matter improves soil structure and increase water holding capacity of coarse textured clay soils; it provides a slow release of nutrients, reduces wind and water erosion and promotes growth of earthworms and other beneficial soil organisms.

However, from FGDs conducted, men farmers pointed out that this strategy is a difficult strategy for female headed farmers as it requires a lot of energy and more labor. This is because they will need to take the manure from the kraal which mostly it is far from the fields but this strategy has helped in bringing produce because the soil will be nutritious and sink water. Therefore in households were farmers are mostly females this strategy was not applied and it affected their crops.

2.15 Early planting

The Oxfam field officer pin pointed that this strategy is not commonly practiced in Matobo looking at the rainfall patterns of previous years. He further argued that rains in this district usually come late so the grounds will be dry for planting. Instead people in this district practice delayed planting.

Mr Thebe a farmer from Madwaleni ward in Matobo district stated that he employed the strategy of early planting as he did not know on the predictions of rain. He noted that this strategy assisted him greatly because he had planted sorghum and millet and when heavy continuous rains came, these plants had already grown and were not affected by rain. Ministry of Agriculture and Mechanization field officer noted that most of the farmer's crops were destroyed because of delaying to plant. When the rain came in December 2016, it rained continuously and it affected our crops as there were still small asserted one farmer from kezi during an interview.

2.16 Diversification of crops

All farmers during interviews and FGDs clearly posited that they used diversification of crops as a strategy. Ministry of Agriculture and Mechanization asserted that crop diversification is the panacea to climate variability challenges. This strategy has proved to be successful with a number of respondents highlighting that they have moved to new crop varieties that are relatively drought resistant and hence can withstand the long dry spells that are rampant in the district. From an interview with the officer from the Ministry of Water and Climate he eluded that diversification of crops in Matobo district usually helped vulnerable farmers in securing food and at least some income, even in the case of extreme events. However, in 2016 to 2017 rainy season, most farmers during FGDs alluded to the point that most of the crops died because of much water which had flooded their fields. Miss Dube from Number 4 ward in Matobo district noted during an interview that most crops like peas, watermelons and pumpkins died in 2016 rain season because of too much water.

Responses from the fieldwork highlighted that farmers planted a range of crops such as water melons, roundnuts, ground nuts, maize, sorghum, pumpkins, and millet amongst a host of other crops.

2.17 The role of institutions in the adaptive capacity of farmers in 2016 to 2017 rainy season.

Table 2.17 clearly highlights that the role of institutions towards dissemination of information and knowledge to farmers during 2016 to 2017 rainy season was is at 35%. The role of new

innovations or strategies brought by institutions in curbing high rainfall of 2016-2017 is at 30% and the role of assets distribution and ownership is high towards male farmers.

Role of institution in Adaptive capacity of farmers in Matobo District	**The percentage showing how much the institutions fulfilled their role**
Dissemination of information and knowledge to farmers on 2016 to 2017 climatic conditions	**35%**
New innovations or strategies brought by institutions in curbing high rainfall of 2016-2017	**30%**
Assets distribution and ownership	**Mostly assets ownership are dominated by male farmers**

Table 2.17: The role of Institutions in Matobo district in 2016 to 2017 rainy season
Source: Own fieldwork (2016 to 2017)

2.18 Dissemination of information and knowledge to farmers on 2016 to 2017 climatic conditions

Using the LAF by Lindsey Jones, Eva Ludi and Simon Levine (2010), information and knowledge are essential characteristics for local adaptive capacity to be successful. Table 2.7 highlight that 35% of the institutions fulfilled the role of disseminating information and knowledge to the farmers on issues of climate variability in 2016. MrsMguni from Mahetshe ward in Matobo district alluded during an interview that on one came in 2016 to alert them on issues of high rainfall in the district. The farmers pointed out during FGDs that if only they were well informed that the rains were much in during the season, they would have planted more maize compared to sorghum and millet. Figure 4.4 highlight that those who planted maize got 98% of the produce. Ministry of Water and Climate filed officer postulated that the dissemination of information was not properly done in the district because of lack of resources for the ministry to alert every ward in the district. Therefore they only manage to disseminate the information to wards close to them.

2.19 New innovations or strategies by institutions

Table 2.7 clearly shows that the role of new innovations or strategies brought by institutions in curbing high rainfall of 2016-2017 is at 30%. From the FGDs with farmers, Mr L Ncube a farmer from Madwaleni ward in Matobo district pointed out that institutions especially NGOs greatly assisted us from years back with goods which include provision of food handouts during drought, provision of agricultural inputs and educating the farmers on climate variability issues. In an interview with the World Vision officer he postulated that NGOs' work in the district has been complementary to Government efforts. The Government of Zimbabwe remains the duty bearer in disasters even though every legal persona is mandated to respond in disasters according to the Civil Protection Act (Zimbabwe, 1989). The study found that NGOs were involved in various community projects that addressed on issues of climate variability. NGOs such World Vision were found to be constructing and rehabilitating irrigation schemes in the district to address the perennial water challenges from rain-fed agriculture. They facilitated seed availability to communities through organizing agricultural inputs and technology fairs. In an interview with Ministry of Agriculture and Mechanization field officer, he alluded that even in year 2016 just like in other years, the government institutions in the district with NGOs gave agricultural inputs to the farmers in the district and the inputs included drought resistant seeds of sorghum and millet and maize. He noted that even fertilizers were also distributed to the farmers even though it was not much. As a result, the drought resistant seeds distributed to the farmers in 2016 only produced 45% of their yields in 2017 as most of the crops were destroyed due to heavy rainfall in the district see figure 4.4. Using the LAF by Lindsey Jones, Eva Ludi and Simon Levine (2010) to evaluate the data, the institutions failed to bring new innovations and new strategies to the farmers as they continuously brought same innovations to the farmers while climate is changing every season.

2.20 Assets distribution and ownership

This is a challenge faced by female farmers in the district. Most female farmers have lack of access to credit facilities due to lack of title deeds. During an interview with the district officer from the Ministry of Agriculture and Mechanization, he noted that women farmers face difficulties because they lack financial assets. It is clear that most women farmers continue to

suffer from climate variability due to lack of access to credit facilities in preparing to and adjusting to climate impacts. These results are consistent with findings of Mudzonga (2011) who found that availability of credit enhances probability of women farmers to adapt strategies that reduce the negative impact of climate variability to her household. Women farmers pointed out during FGDs that they did not have money to but fertilizer as it was a necessary strategy for them during the rains of 2016 to 2017 see (figure 4.6). Mrs Ncube from Gohole ward in Matobo district noted that men are the one who have access to assets and men tend to use assets like money for their own pleasure.

According to Local Adaptive capacity Framework (LAF), the ability of a community to cope with and respond to climate effects depends heavily on access to, and control over, key assets (Daze et al., 2009). During an interview with Ministry of Agriculture and Mechanization officer argued that most assets which include land, money, skills, knowledge, agricultural inputs and savings are mostly owned by men in the district. However men farmers pointed out during FGDs that these assets that they have are not much in quantity. Mr Phiri a farmer in Matobo district gave an example and said the skills, knowledge and money that they say we have is not much. “The money is too little and it cannot buy even a bag of fertilizer as most of us here do not work but we relay on farming” posited MrSibindi during a FGDs. Men pointed out that even if they have assets, there are not enough for them to adapt to climate variability.

3.1 Conclusion

Climate variability is a global challenge that is affecting all parts of the world and Sub Saharan Africa is not an exception. Zimbabwe is amongst the countries that are being affected by climate variability due to their reliance on agriculture. Farmers are the most affected when it comes to climate variability as is the case with Matobo district farmers. Just as in 2012, Matobo district experienced heavy rains in 2016 to 2017 rainy season and as a result, most of their crops were destroyed by the heavy rains in the district. The destruction of farmer’s crops was mainly due to lack of assets, lack of knowledge and information and minimal role that the district institutions played in the district. This affected the adaptive capacity of farmers of Matobo district in 2016 to 2017 due to high rains which were experienced in the district.

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References

Adger, W. N.(2003). Social aspects of adaptive capacity. Climate change, Adaptive capacity and Development. In J. B. Smith, R. J. T. Klein and S. Huq (Eds.), Imperial College Press, London.
P.29–50.

Adger, N., Khan, S. and Brooks, N. (2003) *Measuring and enhancing adaptive capacity.* New York: UNDP (www.undp.org/cc/apf-outline.htm).

Agricultural, Technical and Extension Services Kezi (2016) *Report on Crop and Livestock Production in Kezi*, AGRITEX Kezi

Ali, A., (1999). Climate change impacts and adaptation assessment in Bangladesh. In: *National Assessment Results of Climate Change:Impacts and Responses: CR Special 6* [Mimura, N. (ed.)]. Inter-research, Oldendorf, Germany, pp. 109–116.

Ayers, Jessica M. and Huq, Saleemul (2009) 'Supporting Adaptation to Climate Change: What Role for Official Development Assistance?',*Development Policy Review* 27 (6): 675-692.

Bapna, M. and McGray, H. (2008) *Financing Adaptation: Opportunities for Innovation and Experimentation*. Washington, DC: World Resources Institute

Below, T.B., Mutabazi K.D., Kirschke D., Franke C., Sieber S., Siebert R. andTscherning K. level
(2011) "Can farmers' adaptation to climate change be explainedby socio-economic household-variables?" Global Environmental Change,22(2012) 223-235.

Below, T., Artner, A., Siebert, R. and Sieber, S. (2010) 'Micro-level Practices to Adaptto Climate
Change for African Small-scale Farmers', IFPRI Discussion Paper00953.

Bohle,H.G. Downing, T.E and Watts, M.J. 1994. Climate change and social vulnerability: Toward

a sociology and geography of food insecurity.*Global Environmental Change*, 4 (1), 37-48.

Creswell, J. (1998). *Research design: Qualitative, quantitative, and mixed methods approaches* (2nd ed.). Thousand Oaks, CA: Sage.

Deressa, T. (2008) *Measuring Ethiopian Farmers' Vulnerability to Climate Change Across Regional States*. IFPRI Discussion Paper 806. Washington, DC: International Food Policy Research Institute (www.ifpri.org/pubs/dp/IFPRIDP00806.pdf).

Ellis, F., &Mdoe, N. (2003)"Livelihoods and Rural Poverty Reduction in Tanzania", World Development Vol. 31, No. 8, pp. 1367-1384.

Food and Agriculture Organization, (2006). The state of food insecurity in the world (2006): Eradicating Hunger - Taking Stock Ten Years after the World Food summit. FAO, Rome

Food and Agriculture Organization (2000). *'Climate-smart Agriculture: Policies, Practices and Financing for food Security, Adaptation and Mitigation',* Technical input for The Hague Conference onAgriculture, Food Security and Climate Change. FAO. Rome, Oct–Nov 2000

IPCC (2007) *Climate Change Impacts Adaptation and Vulnerability*. Geneva: IPCC

IPCC.(2001), Summary for Policymakers. Climate Change 2001: Impacts, Adaptation, and Vulnerability. A report of Working Group II of the IPCC. Geneva

Moyo M., Mvumi B.M, Kunzekweguta M, Mazvimavi K, Craufurd P and Dorward.P (2012). Farmer Perceptions on Climate Change and Variability in Semi-Arid Zimbabwe in Relation toClimatology Evidence, African Crop Science Journal, Vol. 20, Issue Supplement s2, pp. 317 –335

Nelson, V., Meadows, K., Cannon, T., Morton, J., Martin, A., 2002, 'Uncertain predictions, invisible impacts, and the need to mainstream gender in climate change adaptations', Gender And Development 10(2), 51–59.

Scoones, I. (1998). Sustainable rural livelihoods: A framework for analysis. Brighton: IDS, University of Sussex.

Scoones, I. (1998).'Sustainable Rural Livelihoods: A Framework for Analysis', IDSWorking paper 72, Brighton, IDS.

United Nations Development Programme (UNDP 2009) Gender and climate change: Impact and adaptation. IRADe. Available online: http://www.csd-i.org/. Accessed on 4 July, 2014)

UNFCCC, 1990. Climate change: defined, variability, and adaptation in developing countries. Climate Change Secretariat (UNFCCC): Bonn, Germany.

UNFCCC, 2007. Climate change: Impacts, vulnerabilities and adaptation in developing countries.

Climate Change Secretariat (UNFCCC):Bonn, Germany

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