THE INTERNATIONAL JOURNAL OF HUMANITIES & SOCIAL STUDIES

Climate Change in Zimbabwe: Perceptions of Smallholder Farmers in Mangwe District

Nevel Tshuma
Institute of Development Studies of National University of Science and Technology (IDS-NUST), Zimbabwe
Talent Mathuthu
Institute of Development Studies of National University of Science and Technology (IDS-NUST), Zimbabwe

Abstract:
Agriculture forms the bases of livelihoods for many rural folks in Zimbabwe. Rain-fed agriculture has been adversely affected by climate change. This paper raises the importance of considering the smallholder farmers' perception on climate change as it affects their decision making when adopting adaptation strategies. The study was carried out in Mangwe and it showed that farmers perceived climate to have changed over the past two decades, as indicated by erratic rainfall patterns, decrease in rainfall amounts, increase in temperatures, seasonal shifts and increased frequency and magnitude of extreme weather events. These changes have grossly affected agricultural productivity in both crops and livestock. Evidence from climate data buttresses the farmers' perceptions as they show a decline in rainfall amount and temperature increase over the past decades. The study further shows that majority of farmers do not clearly understand the major causes of climate change.

Keywords: *Climate change, Smallholder farmers, Perceptions, Mangwe district, Temperature, Rainfall*

1. Introduction

Climate change has emerged as a major global crisis of the 21st century because of its past, present and projected environmental and socio-economic impacts. Houghton *et al* (1990) describe climate change as a shift of climatic conditions in a directional incremental mode, with values of climatic elements changing significantly. 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) causing long-term changes in global climatic conditions. The fierce debate on climate change attributes the phenomenon to natural forces and processes while humans have also been implicated as support for the Anthropogenic Global Warming Theory mounts.

Studies have revealed that climate change will have long lasting negative effects for populations and their environment in most parts of the world. Human health, food security, economic activities, physical infrastructure and natural resources will be greatly undermined by the phenomenon (UNDP, 2007). In most parts of Africa; climate change will result in increased temperature (Tadross *et al*, 2005), erratic rainfall, sea level rise, increased intensity and frequency of extreme weather events such as floods and droughts (Mushita and Thompson, 2013). This is expected to result in environmental degradation, increased water stress and decrease in agricultural production which will result in livelihood insecurity and food insecurity. Africa will be affected by climate change far more than other regions because of its heavy dependence on rain-fed agriculture, lack of technology (Sokona and Denton, 2001) and due to widespread poverty, limited coping and adaptive capacity and a highly variable climate; factors which are understood to exacerbate vulnerability (Madzwamuse, 2010a).

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

The experience of the changing climate has brought about varied perceptions amongst smallholder farmers regarding the nature, causes and effects of climate change. According to Slegers (2008), perceptions refer to a range of beliefs, judgments and attitudes.

The objective of this paper is to identify and examine smallholder farmers' perceptions on climate change in Mangwe district of Zimbabwe, a drought prone area. The study of farmers' perceptions is a participatory approach which attempts to understand climate change from the perspective of farmers. Understanding farmers' perceptions is possibly an important ingredient crucial for policy formulation and design of interventional programs.

Several studies have been undertaken on farmers' perceptions of climate change in many regions of Africa for instance by Maddison (2006) in eleven different African countries, Acquah de Graft (2011) in Ghana and Gbetibouo (2009) in South Africa. In Zimbabwe similar studies have been conducted by Nhemachena and Hassan (2007), Chikodzi *et al* (2012) and by Moyo *et al* (2012) among others. Crucial information emerges from these studies regarding how farmers understand climate change and how they respond to the phenomenon. Most of these studies were however undertaken at macro-level. The realisation that areas are heterogeneous and have different climatic conditions, ecosystems, resources, institutions and social factors such as culture and traditions raises the need to undertake site-specific research in order to capture the micro-level aspects on farmers' perceptions of climate change. This is largely because perceptions are diverse and dynamic, often being influenced by such factors as culture, norms, education, religion, access to information and historical experiences amongst others which are unique to a particular area (Prager and Posthumus, 2010). The study will thus compliment other studies on climate change perceptions by rural smallholder farmers by providing an insight into the perceptions and level of awareness of climate change amongst farmers in marginal and drought prone areas.

A growing body of research on climate change has accorded importance to peoples' perceptions on the phenomenon. This is because of the consensus amongst scholars that perceptions are an important factor that influences adoption of response measures such as adaptation. Smithers and Smit (2009) assert that environmental perceptions are among key elements influencing adoption of adaptation strategies. Similarly, Deressa *et al* (2011) and Maddison (2006) contend that the process of adaptation to climate change involves two steps which include firstly understanding that the climate is changing or has changed and secondly responding through adaptation. These assertions infer that the ability to respond effectively to climate change partly lies with recognition by farmers that the current changes are more than just climate variability but are long-term and are envisaged to have detrimental effects on agriculture. Decisions taken by farmers on how to respond to climate change are often influenced by how they understand climate change. According to Bryant *et al* (2001), it is these perceptions on climate change that are translated into agricultural decisions. It is thus important to understand how locals conceptualize the phenomenon of climate change as perceptions are an important part of the response process.

2. Materials and Methods

2.1. Study Site

The study was conducted in Mangwe district of Matabeleland South province located south-west Zimbabwe between May 2013 and December 2013. Matabeleland South province is part of the upper Limpopo Basin stretching for 515 km from Plumtree to Chituripasi and is prone to droughts (Msarurwa and Lunga, 2012). Mangwe district borders with Botswana to the west, with Bulilima district to the north and Matobo district to the east. The district consists of 17 wards with 11 wards displaying characteristics of agro-ecological region IV and the remaining 6 wards falling under agro-ecological region V. The study covered 2 wards namely Mphoengs (ward 5) and Sanzukwi (ward 6) out of 17 wards in the district.

Mangwe district falls under agro-ecological regions IV and V which are characterised by low and erratic rainfall. The district receives average rainfall of 500mm per annum while temperatures reach 40 ºC during summer and an average of 13 ºC during winter. (Practical Action not dated). The study focused on areas that fall in agro-ecological region V.

Agricultural output is relatively low in the area. Vincent and Thomas (1960) note that areas in region V are suitable for extensive farming such as cattle farming or game ranching. These farming activities are practised in Sanzukwi and Mphoengs wards which were under study.

2.2. Sampling Design

This study followed a multi-stage sampling procedure to select 40 households practising smallholder farming. In the first stage, convenience sampling was used to select Mangwe district because it was accessible to the researchers and also that it is one of the driest areas of the country and is prone to drought. In the second stage, random sampling was used to select 2 wards out of 11 wards in Mangwe district that have characteristics of agro-ecological region V. Mphoengs and Sanzukwi wards which are both communal wards were thus selected. Random sampling was also used to select 2 villages from each of the wards. Sanzukwi ward has 6 villages and Matshongwana South and Mkhubazi were selected for the study. Mphoengs ward has 5 villages and Matsota South and Bulu 1 villages were selected for the study. In the third stage, a total of 40 households were drawn from the selected villages using the snowballing sampling method. Respondents that participated in the Focused Group Discussions (FGDs) comprised farmers, lead farmers, paraprofessionals in agriculture and kraal heads and were also selected using the snowballing technique. Key informants such as the community leadership, AGRITEX officers, Veterinary officer, Mangwe Farmers Association Representative and staff of NGOs operating in the area of study were identified for interviews.

2.3. Data Collection Methods

Primary data was collected from 40 smallholder farmers using open-ended questionnaires. It included data on farmers' demographics, perceptions and experiences of climate change. Key informant interviews were used to collect data from key figures in the community such as traditional leadership, AGRITEX and Veterinary officers, Mangwe Farmers Association and NGO staff. These interviews collected data on climate trends, agricultural activities, livelihoods, agriculture related interventions

as well as perceptions and opinions of farmers on climate change. FGDs were conducted to solicit information on farmers' perceptions and experiences of climate change. A timeline was produced and it captured data on historical climate experiences and observations, effects of climatic hazards, community based coping strategies and interventions by various institutions.

3. Results and Discussion

3.1. Social Characteristics of Farmers

Findings show that smallholder farmers, particularly the targeted household heads, are of different ages with youths constituting only a small proportion while more than 80% are the elderly of above 50 years. The age of farmers was an important factor as it was the older farmers who narrated how climatic conditions had changed over decades pointing to reduced rainfall and increased temperatures as the most noticeable changes. The older farmers clearly indicated that the experienced changes were more than just seasonal variations. Demographic data shows that, the majority of smallholder farmers in the area are female making up to 63% while men make up 37%. Indications were that majority of men had migrated to South Africa and Botswana in search of employment. It was of interest to note that even in male-headed households, discussions revealed that women performed bulk of the agricultural activities and men were largely involved in decision making.

The community displayed average literacy levels as results indicated that a total of 56% had either attended primary education up to standard 3 or completed primary education. The numbers of educated farmers however diminished with higher levels of education such as tertiary stage. Education like experience in farming also plays a fundamental role in understanding the differences between seasonal variability and climate change, accessing information and understanding concepts related to climate change.

3.2. Perceptions and Awareness of Climate Change

The research revealed that smallholder farmers have different levels of awareness and knowledge of climate and also have varied perceptions on the phenomenon. The respondents were asked on what they perceived as proxy indicators of changes in climate conditions. Rainfall and temperature patterns emerged as the key indicators of climate change. The respondents outlined the drastic changes in rainfall patterns over past decades as a strong case in point for a changing climate. A total of 82% of the farmers reported that over the years the amount of rainfall received has significantly reduced as shown in fig 1. This is consistent with ZMSD (2011) statistics which show that average rainfall in Mangwe has decreased over the years. Research findings confirm the findings by Moyo (2012) in a similar study in two other dry districts of Zimbabwe (Hwange and Masvingo). Moyo (2012) argues that the perceptions of the farmers are in agreement with the climatological records in the districts.

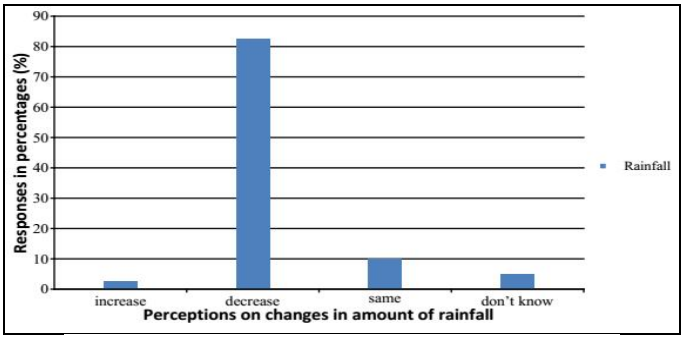

Figure 1: Perceptions on changes in amount of rainfall

Respondents further reported that heavy down pours which used to characterise the peak of rainy season where now rare. Their duration has drastically reduced to few minutes. The continuous rains lasting for hours known as "*imvimbi*" in local language were now scarce. This is signified by the low levels of water in static water sources while many rivers no longer flow as they used to do. A total of 10% of the farmers reported that they had not noticed any changes in the amount of rainfall while 5% had no knowledge of the changes.

3.3. Seasonal Calendar and Noted Changes

One way of determining climatic changes that have occurred within the community was to analyse their seasonal calendar. The outcome of oral history on seasonal calendar showed that most farmers perceived seasons to have changed citing such changes as timing of first and last rains, length of summer and winter and timing of farming activities. A total of 88% of the respondents acknowledged seasonal shifts as shown in fig 2. Most farmers indicated that the rainfall season used to start at the beginning of October and end in April but as from the 1990s onwards, the rainfall season began mid-December and ended beginning of March. Some farmers specifically cited that the first rains, which are called *insewula* in local language, were received at the beginning of October but had changed to late November and sometimes early December. Also the rains that assist in the decay of crop residue in the fields known in local language as *imbolisamahlanga* normally fell in July or August but now came late or did not come at all. The farmers also pointed out that their planting season has moved forward from October to late November or early December.

From the seasonal calendar, it is clear that the farmers perceive climate to be changing. Some farmers professed ignorance on seasonal shifts.

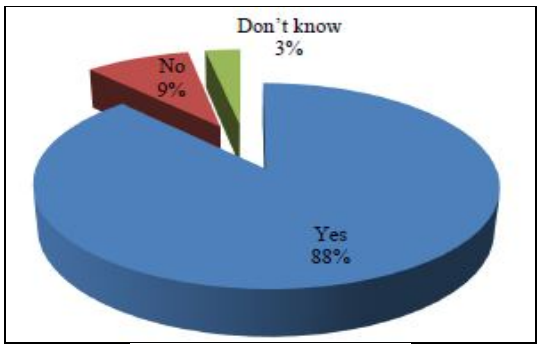

Figure 2: Seasonal changes

3.4. Temperature

Temperature was perceived to have increased by 80% of the farmers as shown in fig 3. This was reported to have led to hotter summers and warmer winters. The respondents cited that due to increase in temperature some local indicators of cold weather were no longer occurring. This includes mist and images seen in clouds on cold days known in local language as *amajangalijimu.* The ZMSD (2011) report further buttress this argument by showing an increase in temperature in the area since 1980s. A total of 10% of the farmers indicated that they were not aware of any changes in the temperature while 8% displayed no knowledge on the changes. It is worth noting that the respondents who did not notice the changes in temperature where mostly youthful. This is in line with the findings by Madison (2007) in his study on perceptions and adaptation in five selected African countries; when he observed that the more experienced and the older the agriculturalists the more likely they are to claim that temperatures have increased and less likely to claim that there has been no change.

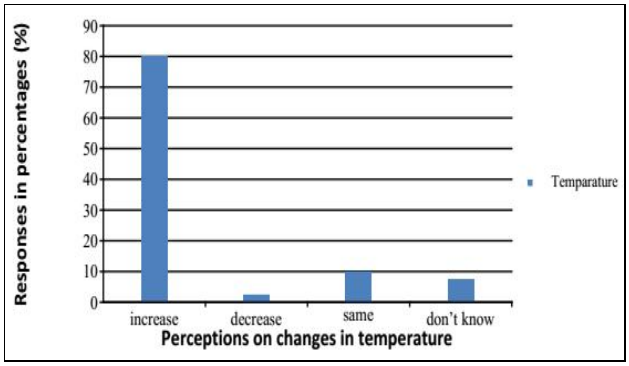

Figure 3: Perceptions on changes in temperature

According to the respondents, changes in rainfall patterns and Temperature were a clear indication of changes in climate although they could not term it climate change.

3.5. Perceptions of Incidence of Climatic Hazards

To further ascertain the perceptions of farmers on climate change, respondents were asked on the types of natural hazards they associated with climate change. Respondents pointed to droughts, floods and storms noting that significant changes in occurrence of these natural hazards had been experienced in the past two decades. A total of 85% of the respondents perceived droughts to have increased in frequency and severity as shown in fig 4. The respondents argued that the occurrence of droughts was more often than in previous years and they had become more severe in recent years. A total of 35% of the farmers noted that floods had increased over the years while 42% pointed out that they had seen no changes in floods which are a rare phenomenon in the area. Violent storms were also noted to have increased and farmers attributed them to the increase in temperatures.

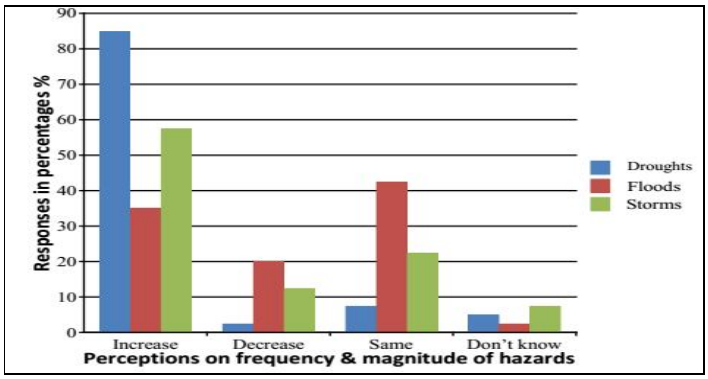

Figure 4: Perceptions on frequency and magnitude of hazards

The timeline of Mangwe district presented in table 1 was obtained through key informant interviews and FGDs and it attest to the perceived increase in frequency of climatic hazards in the area.

The trends in the timeline indicate that before the 1990s, severe droughts used to occur at a 10 year interval while in recent years records show severe recurrent droughts. This is consistent with findings by Practical Action (undated) which notes the changed intervals of droughts and further states that farmers often reported some droughts that were not recorded by ZMSD while they omitted some droughts that were on records. This has been cited as due to the difference between perceptions of drought by communities and scientific meteorological parameters. Droughts were reported to have had devastating effects which included crop failure, livestock death consequently leading to hunger, malnutrition, reduced income and ultimately poverty. Food and income shortages saw many farmers dispose their assets and as a result stripping some assets that are important for livelihoods. Various interventional programs set to improve access to food, water and improve agricultural production have been undertaken in the district over decades. These include Food relief by government in the 1990s, Food aid from World Vision and ORAP between 2002 and 2012, drilling of boreholes and supply of drought resistant seed varieties by government and NGOs.

While floods were said to have been experienced in 2000 due to the effects of cyclone Eline, there was consensus that the phenomenon is not as common as droughts in the area. The cyclone had detrimental effects; sweeping away infrastructure, crops, harvest, livestock and damaging water sources.

YEAR	DISASTER	EFFECTS /RESPONSES
1946/47	Drought	Crop failure, water shortages, food shortages, livestock death
1967/68	Drought	Crop failure, water shortages, food shortages, livestock death
1972/73	Drought	Crop failure, water shortages, food shortages, livestock death
1982	Drought	Crop failure, water shortages, food shortages, livestock death
1992	Drought	Crop failure, severe food shortage, people ate yellow maize, relief grazing migration to Marula and, Food for Work by government
1994/5	Drought	Crop failure, water shortages, food shortages, livestock death, Drought relief by government
2000	Floods (Cyclone Eline)	Infrastructure and crops destroyed, dams burst
2001/2	Drought	Crop failure, food shortages, food aid from World Vision began
2002-09	Drought	Crop failure, food shortages, food aid from World Vision continued, relief grazing migration to Marula and *emilageni*
2011-12	Drought	Crop failure, food shortages, food aid from ORAP , relief grazing migration to Marula and *emilageni*

Table 1: Timeline of climate related hazards
Source: Survey 2013

3.6. Indigenous Weather and Climate Forecasting

Findings revealed that locals had indigenous ways of forecasting weather and climatic conditions as shown in table 2. Farmers expressed how these local indicators had been helpful in preparation for farming activities. Indications were however that over the years climate change had undermined this component of indigenous knowledge as some indicators had become unreliable. Such an instance is the appearance of the corona around the moon which in yesteryears signified good rains but had of late reportedly become unreliable appearing even in the driest years.

Condition	Local indicator
Drought	When the acacia tree (isinga) bears many fruits, umkhaya tree has white flowers, corona around the sun
Coming of rains	Swallows fly around, cuckoo (insingizi) sings, rain bird (inkanku) sings
Good rains	Corona around the moon, presence of swallows, idolo lenkonyane tree has flowers
Beginning of winter	Setting of the clustered stars (isilimela)
Dry spell	Warm temperature in winter, no singing of rain birds

Table 2: Indigenous weather and climate forecasting
Source: Survey 2013

3.7. Perceived Causes of Changes in Climatic Conditions

Farmers displayed varied perceptions on causes of changes in climatic conditions as depicted in fig 5. A significant number of farmers who constitute 45% reported that the noticed changes in climatic conditions were due to natural forces and it was beyond anyone's control to stop the changes. This group of farmers highlighted that it was important for people to embrace the natural changes and learn to live with them as no one knew what changes would be experienced in future.

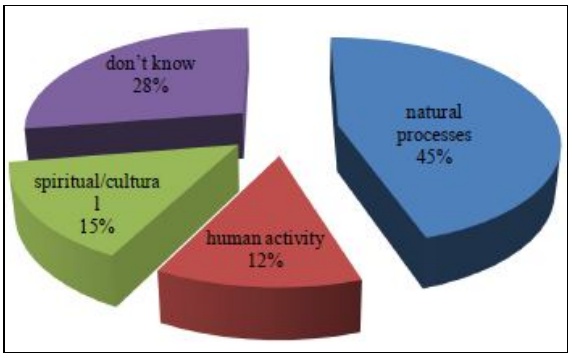

Figure 5: Perceived causes of changes in climatic conditions

A total of 12% of farmers indicated that the climatic changes were due to human activity. Activities cited as behind the changes include veld fires, deforestation, modernisation, technological advancement and as well as wars and conflicts. Other farmers (15%) attributed the climatic changes to spiritual and cultural issues. Issues identified included the wrath of God and that lack of rains and natural disasters were punishment from God for not following his commandments. Respondents also added that these changes signalled the end of times as written in the bible.

A key cultural issue raised was the mismanagement of Njelele; the rainmaking shrine situated in the adjacent district of Matobo. Farmers reported that the visits to the shrine, rituals and ceremonies were no longer done properly while visits by people with hidden agendas had defiled the sacred shrine. Also along cultural lines, farmers pointed out that the amount of rainfall had reduced because people were killing each other and killing animals leaving remains uncovered in the bush. They highlighted that the cultural practice, known in local language as *tjamwi* normally done before the rainy season to cleanse the bush by gathering and burning animal carcasses, hides, nests of a bird called *uthekwane* and other remains had not been done correctly over years and had been out-rightly neglected in some areas. A total of 28% of the respondents said they had no idea what was causing the noted changes.

Age and level of education emerged as important factors in understanding causes of climate change. The young and educated farmers displayed better understanding of factors that cause climate change such as emission of carbons. This is probably due to their increased access to information from media and better understanding of technical concepts.

While farmers were conscious of changes in climatic conditions in their environment, they had no information on the technicalities of the phenomenon of climate change. When respondents were asked if they knew what climate change was,

majority of them (88%) reported that they had no idea about the phenomenon of climate change. This group of farmers comprised mainly the elderly and less educated. Only a total of 12% of the farmers reported that they knew about climate change from reading books and newspapers, some from listening to radios and watching television. This demonstrates the importance of age and level of education in understanding climate change issues.

3.8. Climate Change and Livelihoods

Majority of farmers reported that mixed farming particularly livestock keeping remained an important source of livelihood in the area. This is consistent with previous studies carried out by Gandure (2005) in Bulilima and Mangwe which established that the main livelihood strategy in both districts was selling of livestock as crop production often failed. Findings revealed that smallholder farmers supplemented their income through alternative livelihood strategies such as gold panning, remittances, formal and informal business. Farmers reported that their livelihoods particularly mixed farming was under threat because of the changes in climatic conditions. The changes were believed by farmers to have had negative impacts on mixed farming as shown in table 3.

Effects of climate change	**Effects on crop production**	**Effects on livestock production**
Reduced rainfall	-decreased soil moisture hence crop failure -ultimately reduced yields	-water shortages -poor grazing areas -death of livestock and ultimately reduced production
Higher temperatures	-increased transpiration hence wilting of crops -decreased soil moisture -ultimately reduced yield	-increased evaporation in water sources hence water shortages -wilting of pastures and shrubs -poor health or death of livestock
Increased magnitude, frequency and incidence of droughts	-inadequate rains hence reduced soil moisture causing crop failure -high temperatures hence increased transpiration causing wilting, reduced yields	-water shortages -poor grazing areas -poor health and death of livestock and ultimately reduced production
Pests and Diseases	-spread of evasive weeds, crop destroying worms, locusts, quela birds hence crop destruction -ultimately crop failure	-spread of livestock diseases and infestation of pests causing poor health and death of livestock -spread of poisonous shrubs that kill livestock

Table 3: Perceived effects of climate change on crops farming and livestock production
Source: Survey 2013

Farmers stated that the effects of climate change had undermined their access to food and income especially that they mainly depend on farming for food requirements and sale of surplus. The erratic rains, high temperatures and recurrent droughts led to crop failure and consequently reduced yields while in view of livestock it led to poor grazing areas and water shortages and consequently livestock death. This greatly affected their way of life limiting access to income used to access other basic needs, causing malnutrition, hunger, diseases and in worst cases death while farming assets were eroded through selling during droughts as families struggled to raise funds for other needs. This substantiates findings by IPCC (2001) which stated that climate change in the form of higher temperature, reduced rainfall and increase rainfall variability reduces crop yield and threatens livelihoods and food security.

4. Conclusion

Agriculture and particularly smallholder farming remains vulnerable to climate change posing a threat to food security and livelihood security. Zimbabwe is already feeling the pinch of climate change with agriculture bearing the most burden as it is a climate sensitive sector. Rural populations whose bread and butter come mainly from farming have been severely affected by climate change plunging many into hunger and poverty. While climate change is a global phenomenon; the experiences, opinions and views of the phenomenon are diverse and vary with geographic areas. This study identified and examined smallholder farmers' perceptions of climate change in Mangwe district of Zimbabwe. Majority of farmers were found to be conscious of climatic changes around them ranging from changed rainfall and temperature regimes, seasonal shifts to intensifying natural hazards, their effects on farming though the technical understanding of climate change is still considerably low. This corroborates with findings by Moyo *et al* (2012) and Chikodzi *et al* (2012) in studies undertaken in Zimbabwe which found out that the understanding of climate change issues amongst farmers was still low. The most common causes of climate change cited by

farmers were natural forces, human activities, cultural and religious beliefs. Previous studies on climate change in Zimbabwe have underscored the dire need to facilitate training, information provision and awareness campaigns on climate change for smallholder farmers in order to bridge the gap of limited knowledge about the phenomenon. It is thus imperative that relevant government departments and NGOs mainstream climate change issues in their programming if efforts of attaining sustainable livelihoods and food security even in face of climate change are to be fruitful.

5. References

1. FAO, 2006. The state of food insecurity in the world (2006): Eradicating Hunger - Taking Stock Ten Years after the World Food summit. FAO, Rome
2. Gandure, S. (2005). Coping with and adapting to drought in Zimbabwe. Unpublished PhD thesis. University of Witwatersrand, South Africa
3. Gbetibouo, G.A. (2009). Understanding farmers' perceptions and adaptations to climate change and variability: The case of the Limpopo Basin, South Africa. Discussion Paper No. 00849. South Africa Environment and Production Technology Division. IFPRI.
4. Houghton JT, Jenkins GJ, Ephraums JJ (eds). (1990). Climate change: the IPCC scientific assessments. Cambridge University Press, New York
5. IPCC. (2007). Climate change: Impacts, adaptation and vulnerability. Cambridge University Press
6. IPCC.(2001), Summary for Policymakers. Climate Change 2001: Impacts, Adaptation, and Vulnerability. A report of Working Group II of the IPCC. Geneva
7. Levina, E. (2006). Domestic Policy Framework for adaptation to climate change in the water sector part 11. Lessons learnt from Mexico, India, Argentina and Zimbabwe. OECD, Paris
8. Maddison, D, (2006). The perception and adaptation to climate change in Africa. CEEPA
9. Madzwamuse, M., (2010a). Climate Governance in Africa: Adaptation Strategies and Institutions. Heinrich Boll Stiftung
10. Madzwamuse, M.(2010b). Drowning voices: The climate change discourse in South Africa. Heinrich Boll Stiftung
11. 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 to Climatology Evidence, African Crop Science Journal, Vol. 20, Issue Supplement s2, pp. 317 –335
12. Musarurwa C and Lunga W. (2012). Climate change mitigation and adaptation threats and challenges to livelihoods in Zimbabwe Vol 1, No.2 . Asian Journal of Social sciences and Humanities. Leean and Luna International. Japan
13. Practical Action. (not dated). Coping with drought: Research findings from Bulilima and Mangwe districts, Matabeleland South, Zimbabwe. Practical Action
14. Prager, K., & Posthumus, H. (2010). Socio-Economic Factors Influencing Farmers' Adoption of Soil Conservation Practices in Europe. In T. L. Napier (Ed.), Human Dimensions of Soil and Water Conservation (pp. 203-223): Nova science publishers.
15. Sokona, Y and Denton, F.(2001).Climate change impacts: Can Africa cope with the challenges? Climate Policy 1(1), 117–123.
16. Vincent, V. and Thomas, R.G. 1960). An agricultural survey of Southern Rhodesia: Part I: agro-ecological survey. Government Printer, Salisbury