

# Climate change and agriculture: Coping strategies of rural households in the Xangani Community of Chiredzi District, Zimbabwe.

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## Abstract

*This study examines the impact of climate change on agriculture and the various strategies utilised by the Xangani community in Chiredzi District in Masvingo Province, Zimbabwe. The study sought to establish the effectiveness of the indigenous knowledge systems used by the Xangani people in rural Chiredzi. A mixed research design was utilised to interrogate climate change as a phenomenon whereby interviews and observations were utilised to collect data on how the communities respond to the negative impact of climate change to their livelihoods. A sample was drawn using purposive sampling technique. Such purposive sampling was intended to solicit detailed data from key informants. Relevant literature was reviewed to establish the trends and evolution of how the world has responded to climate change. The study revealed that climate change has affected agricultural output in both animal and crop production. Water scarcity and high temperatures were the two biggest climate change problems affecting the community. The community used both traditional and modern methods to supplement on water scarcity and food insecurity problems. Despite adoption of modern technologies, indigenous knowledge systems are still utilised though some of the technologies and crop seed types are no longer available in the mainstream seed shops. Conclusions to the study were that climate change is reshaping the lives of the Xangani communities including change of family structures through cross border migration, community wealth has been severely depleted. Recommendations include the importance of knowledge about climate change and cooperation in development of technologies between community and different institutions of development.*

**Keywords:** Climate change; Rural; Zimbabwe; Chiredzi; Agriculture

## 1. Introduction

Climate change is a global phenomenon which can be regarded as one of the most serious environmental issue that affects all countries in the world. The IPCC (2007) defines climate change as the change in the average or mean monthly temperature, precipitation and other and weather components that affects the production systems within a region over a specified season. The climate related hazards experienced in Zimbabwe include droughts that happen in every five to seven years according to Brown et al (2012). Droughts experienced in the southern part of Africa in the past ten decades were mostly related to El Nino (Brazier, 2015: 6). This implies that the cycle of droughts is influenced by a climate pattern called El Nino- Southern Oscillation which originates in the Pacific Ocean. Extreme temperatures cause heat waves during hot seasons and ground frosts during the cold seasons. Brown et al., (2012) notes that average temperature is likely to increase across the country by 1 to 3 degree Celsius coupled with a moderate decrease in the average rainfall.

This study examines how the rural households in the Xangani communities of Chiredzi district in the South East Lowveld of Zimbabwe are coping with climate change. The communities mainly rely on subsistence agriculture, anchored on crop production and animal husbandry. The GoZ-UNDP (2009) climate change assessment of



Chiredzi District noted that the area lies under agro-ecological region five where rainfall is one of the biggest physical constraints to agricultural production. The rainfall type occurs in a single season from November to March. It is between the two most low-lying areas in Zimbabwe that receives an annual rainfall amount that is below 650 mm. The area is characterised by periodic and seasonal droughts, severe dry spell during the rainy season. Brown et al., (2012) note that even drought tolerant crops like sorghum and millet are now providing very low yield output due to the prevailing climatic conditions. The temperatures have warmed up by approximately more than 0.6 degrees Celsius between 1966 and 2005 and this has affected severely the water balance with more evaporation due to temperature rise and reduced water bodies' replenishment due to low rainfall. Marufu and Manyanhaire (2011) note that climate change induced water stress is likely to worsen the current problem of declining agricultural productivity and output leading to a severe decline in economic productivity, food insecurity and poverty. Because of these climatic changes induced problems, the communities have become more vulnerable and poorer due to loss of their social and economic capital as people move out of the communities to look for better incomes and some households lose material assets and community wealth needed for their survival. The drop in amount and unpredictability of rainfall has largely depleted the natural environment capacity to sustain human, animal and plant life. The Xangani people in Chiredzi district are one of the marginalised, minority groups in the country that have benefited at a very minimum rate in terms of development due to the centre periphery approach of the macro development approach in Zimbabwe. They are among the worst affected people due to climate change and do not possess sufficient resources financially and in terms of public goods and infrastructure. Phiri et al., (2019) also notes that the communities survive on natural resources and have developed very strong spiritual, cultural and physical links to enhance their livelihoods that is anchored on their indigenous knowledge that forms the bedrock of what defines and sustain them as a people. However, IFAD (2007) is of the opinion that despite their knowledge, their contribution to national development is not realised much due to their status as a minority group who are in the peripheries of the country. Phiri et al (2019) notes that cattle occupy an important position in these rural areas and much of their livelihoods is centred on cattle rearing and crop production that has been affected by change in the rainfall patterns, lack of sufficient water reduction of animal feed due to drought. This study seeks to identify the various strategies utilised by the communities based on their indigenous knowledge systems and to find out how sustainable these mechanisms can be as well as finding out how best these mechanisms can be incorporated into the mainstream development strategies.

Literature shows that globally countries and other institutions of global governance develop long-term mitigation strategies for climate change at macro level through various forums and treaties such as the United Nations Framework Convention on Climate Change (UNFCCC), and the Kyoto Protocol. However, local communities develop short-term coping strategies that are specific to their environment, and easy to adapt to the phenomenon. Much of these strategies designed based on their indigenous knowledge systems are inherited from generation to generation and continue to be utilised on the same environment regardless of the changed circumstances due to changes on factors such as population growth, environmental depletion and changed weather patterns. Due to the complexity of climate change the United Nations Development Programme

(UNDP), (2016) postulates that the issues of climate change in Zimbabwe needs a coordinated knowledge and experience to help communities to adapt to the effects of climate change effectively. This study focuses on the two major aspects of agriculture, which are crop production and animal husbandry. These two aspects are dependent on the environment hence it is inherent that the environmental factor is included and its role is analysed in relation to climate change and the society. The study investigates the coping strategies utilised on crop production and animal husbandry and how does these contribute to the overall household coping strategies outside the agriculture aspects for example household incomes that are dependent on factors that are climate related but not a direct result of agriculture. Local value chain related incomes that may use inputs influenced by change in climate could be a source of problem that communities and individuals rely on.

## 1.2 Theoretical framework

Climate change is a global problem that affects the global public good and is fast becoming a key issue in global diplomacy (Siders, 2019). The idea and concept of globalisation shapes all the various global approaches as championed by global actors and institutions of global governance. The various international forums convened to discuss about the impact, causes of climate change shaped the responds of the various stakeholders and these include individual member states, regional bodies, nation states and specific communities (Ziervogel et al., 2006a). In view of this study, a two-sided theoretical perspective to the study is utilised to capture the global relations that shape ideas and how climate change affects agriculture, as well as to articulate on the causative factors and effects (Urama & Ozor, 2010). The first perspective is anchored on the World Systems theory to try to capture the international relations aspect and the globalisation of climate change and its effects on livelihoods and agriculture as a problem. Martinez (2001) notes that the theory shows the important power structure and hierarchy between the core and the periphery whereby the core are the rich and powerful countries that exploit and dominate the poor countries at the peripheries. This theory is relevant in that it helps the researcher debunk the global evolution process in addressing climate change and agriculture. The core exploit and extract natural resources from the periphery and these actions according to Martinez (2001) promote exploitation of the natural environment that affects agriculture. The World Systems theory reveals that the international division of labour creates a system of inequality between the core, semi periphery and peripheral countries. It shows the difference between the people who generate more greenhouse gases that causes global warming and climate change and the people who are most affected and hurt by global warming. In this regard, the centre according to the World Systems theory is the developed countries like the United States of America, Britain, France, and Japan, whereby cumulatively the USA has contributed about 25% of the global gas emission (IPCC, 2018). The Kyoto Protocol provided legally binding targets for developed nations to cut emissions by 5.2% but contrary to these provisions, the USA refused to sign the agreement (IPCC, 2018). The world systems theory factors in the concept of technology whereby high-end technology produces more greenhouse gases that promote climate change. It also reveals that the developed countries develop and design technologies used to improve agricultural production in developing countries though some of the technologies may be incompatible with the

environment. The changes in the climatic conditions affects periphery countries more who in periods of disastrous climatic phenomenon like droughts, these countries provide relief in form of food hand-outs through donor agency (Adger et al., 2008). These core countries come up with various adaptation strategies that may not be compatible to the environment of application. Providing aid to periphery countries act as a gesture of goodwill yet these countries are causing more harm. Reviewed literature from publications by United Nations Development Programme (2019) shows the relationship and contributions of the developed countries versus failure of developing countries in creating and funding adaptation strategies to climate change in relation to agriculture. The literature reveals a two-way dichotomous relationship whereby developed countries continue to pursue economic development through capital accumulation at the expense of protecting the environment. While on the other hand, they are the biggest funders of adaptation and coping mechanisms, which they fund through donor organisations according to UNDP (2015). Failure to protect the environment affects agricultural output in developing countries.

The second theoretical perspective looks at the development of the local coping strategies as a viable capacity development approach based on the local Indigenous Knowledge Systems. This theoretical perspective focuses more on small societies. The constructivism theoretical assumptions were found to be relevant in the study in establishing how people of a specific culture or society develop their own coping strategies through local relevant technologies. May (2001) argues that social science research is carried out from an interpretive paradigm thus; it focuses on the meanings ascribed by the people to various aspects of their lives. According to Creswell (2009), social constructivism is based on assumptions about reality, knowledge and learning. The argument is that reality is constructed through human activity. Thus, members of the world together create the properties of the world. Knowledge is a human product and it is socially and culturally constructed, thus assuming that individuals create meaning through how they interact with others and the environment they live in. These two assumptions are key in understanding human interaction in the development of local solutions to their problems. These two assumptions are critical in climate change adaptation as Creswell (2009) notes that they can be critical in the process of knowledge building in adaptation science and policy designing and implementation of climate change resilience.

To marry this theory to the study, by assuming that reality is constructed through human activity and members of the world together create the properties of the world, this line of thought is in resonance with literature on agriculture and designing of adaptation mechanisms as described and revealed by the global forums such as the Rio Summit of 1992 (Hanjra and Qureshi, 2010). Alauddin and Sarker (2014) argues that these world forums reveal that the world realised that climate change and its impact on the environment needed a concerted effort to tackle it regardless of member states' economic position and influence. Literature reveal the acknowledgement made by global actors in addressing the impact of climate change. It shows that funding for adaptation can have global benefits either directly or indirectly. This can be done through investing in research and development of drought and flood resistant crop varieties as mechanisms to address climate change related agriculture problems. To juxtapose the two theoretical perspectives, the world systems theory reveals how the world interact and the power dynamics involved in relation to solving global climate change related problems.

It shows that the developed world is more responsible in promoting climate change and its many challenges due to prioritisation of capital accumulation while they are the funders of adaptation programmes to developing countries and some do not honour the global treaties designed to curb climate change. Global institutions to a certain extent prescribe and design adaptation programmes and projects that are capital intensive and lack continuity due to their exogenous nature that makes them lack ownership hence become unsustainable with time.

The constructivism theory attends to the necessity of utilising local indigenous knowledge systems in the development of local adaptation and coping strategies that are less capital intensive and are endogenous. This includes local technologies used to address increase in agriculture output in the face of adverse weather conditions. Literature consulted on the local climate change strategy in the National Climate Change Strategy of Zimbabwe is congruent with the assumptions of the constructivism theory noted above. The two theories complete each other in that the world systems approach looks at the global cooperation and power dynamics in the formulation of adaptation strategies while the constructivism theory looks at the designing, generating and utility of the local knowledge in designing coping mechanisms and how this can be incorporated in the designing of sustainable strategies.

## **2. Materials and Methods**

This study follows a mixed research design and the researchers sort to examine how the Xangani communities deal with climate change as a phenomenon and how it affects their livelihoods. This makes it a social research based on the constructivist philosophical worldview. Creswell and Creswell (2018) asserts that social constructivists worldview approach believe that individuals seek to understand the world in which they live. They develop subjective meanings of their experiences. They seek to derive meanings of phenomenon depending on the lived experiences.

The researchers made use of interviews, secondary published sources and observation to collect data from the participants. Key informants like the Headmen, Chiefs, Teachers, political leaders, veterinary officers, and agriculture extension workers provided data for the study. Notebooks and audio recordings were utilised to collect qualitative data from the participants and the data is grouped into the two main aspects or categories under agriculture, which are animal husbandry and crop production. For example, on each household the data collected is sorted into themes, the themes from all the households interviewed is grouped, and the data is analysed based on a given aspect, that is either on crop production or animal husbandry. To contextualise the above statement, on each household interviewed data on livestock coping strategies, crops resilience strategies, alternative income-generating strategies employed besides those linked to agriculture, was collected and sorted as standalone themes from each household. The data from these themes was sorted into the broader themes of all the households in the sample for each strategy. This allows for easy analysis of the data and presentation.

## 2.1 Delimitation of the Study

This study was carried out in the in the Xangani communities in Chiredzi district in the province of Masvingo in Zimbabwe. The community consists of 20 substantive villages. The region is predominantly occupied by the Xangani community whose ancestry is of Mozambican and South Africa decent. To the west the district there is Mwenzezi district whose bigger area comprises of the new resettlement areas under the fast track land resettlement programme. There is perennial Mwenzezi River which passes through the region and is a major water resource found in the region. To the north of the region is a railway line a major link between Zimbabwe and Mozambique.

## 3 Results

### 3.1 Inadequate supply of water

Water shortage is one of the biggest problem affecting agriculture especially domestic animals in the Xangani community. Traditionally the Xangani people settled along rivers, springs and streams that could provide sufficient and quality water throughout the year. However, most if not all of the springs and streams dried up due to climate change and communities had to find other alternative ways to find water for themselves and their animals. Communities in Chiredzi district do not have dams so they rely on boreholes, wells and small reservoirs. The local authorities constructed these reservoirs by blocking streams to capture the flowing water during the rainy season.

However, the reservoirs cannot provide water for animals for more than two months due to siltation. Physical inspection and observations of these reservoirs showed that the small reservoirs are now very shallow and their capacity to hold water sustainably continue to diminish. Chiredzi District council through its water sanitisation programme drilled boreholes in communities and these boreholes wanted to increase the number of boreholes that were already in existence upon the attainment of independence. However, these boreholes are drying up and some are broken down. Livestock mortality is increasing due to water scarcity. Cattle are the most sensitive to water scarcity and need bigger quantities as compared to other animals like sheep and goats.

Coping mechanisms for water challenges found included, water supplementation to improve the quantities of water for animal consumption. Of the 30 people interviewed by the researchers, 20 people in the communities had wells drilled using family labour and resources and have access to better quality water. While the other 10 could only access water from the community boreholes who are sometimes broken down. These wells mostly provide sufficient water during rainy seasons and when the area receives sufficient rains. In addition, households move their cattle herds to villages that are closer to Mwenenzi River for easy access of water from the river. Data collected from the 10 households in non-riparian communities showed a common trend whereby households move their animals from September until the first rains to villages that are close to the river for better access to sufficient quantities of water during dry seasons. This approach is meant to reduce pressure on boreholes and that provide water for drinking and watering their small gardens. Moving cattle nearer to

permanent water sources is a measure that seek to promote recovering and replenishment of wells and boreholes using underground water.

### 3.2 Depletion of grazing areas and forage

Domestic animals in the Xangani communities rely on the natural grazing pastures. There are specific designated areas for animals grazing shared by all community members, and with a specific calendar, that regulates the conduct and time of animal grazing. The interview on the key informants generally indicated that the increase in the stock of animals and the persistent droughts affected the natural process of environment replenishment such that many of the pastures lost its nutritious perennial grasses that can stand harsh weather conditions and only vulnerable annual grasses remain. This reduced the ability of the environment to sustain animal life. Coping with this challenge includes rental of grazing areas mostly for cattle in the nearby small-scale farms of Mwenezi resettlement farms located on the western side of Chiredzi district. The individuals and households pay a certain amount of money to the owners of the small-scale farms for their animals to feed in the farms. Observations by the researchers during field study identified a common trend whereby households with smaller herds harvest stubble and other crop residue from the fields that is used as a stock feed during the dry season. As for households with bigger herds of cattle, the harvested stubble would be used only to oxen that provides draught power during the farming season. Traditionally stubble and crop residues were a strategy used specifically as supplement feeds for oxen to boost and increase draught power output.

The study revealed that local communities use *Neorautanenia brachypus* (N.brachypus) a tuber called *Pombwe* or *Zhombwe* in the Xangani language to supplement on cattle feeds. According to Murungweni et al (2012), *Neorautanenie brachypus* (Harms) is a medicinal feed that is used to help cattle to survive drought. It is prepared by digging the tuber up from underground and then peel off the outer layer and then cut into smaller pieces. The tubers are usually dug from the fields during the dry season when it is easy to identify them because its outer shrub with purple flowers tend to bloom earlier than any other plant. Traditionally the N. brachypus was a multipurpose tuber used for treating various ailments even among people. Data revealed that it was initially used for cattle dosing just before the rainy season. Cattle would drink water mixed with syrup made from the tuber. Interviewees noted that the use of the N. brachypus as cattle feeds supplement started during the 1992 drought that affected much of the livestock. Since farmers in these communities had large herds of cattle, they would select only a few cattle especially the health looking ones mostly oxen and feed them with the tubers. Households that utilised this strategy managed to come out of the drought with a reasonable size of the herd.

The respondents also resort to buying livestock feeds to supplement on the traditional forage and food is becoming a common practice mostly from participants who are closer to Chikombedzi Growth Point because the area is more cosmopolitan as compared to other villagers that are distant to the growth point. Findings from the interviews showed that some of the stock feeds are imported as remittances from South Africa especially in households with family members who work in South Africa. Of the interviewed households, findings were that families that buy food supplements for their cattle either had to sell some of the cattle and buy food for a selected part of the herd.



A very significant number of households engaged in downsizing their livestock by selling their cattle and goats as a way of maintaining a sizeable number that is easy to manage during severe weather conditions. When they suspect of impending bad season or drought, they sell part of their herd when they are still fetching better prices on the market. This strategy is similar to converting part of their livestock stock to money to maintain value. After the drought, these households buy new livestock replace their herd. Downsizing the herd in another sense is trying to avoid absolute losses through deaths because animal mortality will be high due to lack of sufficient forage and sufficient amount of water. Selling their stock allows them to raise money to buy feeds for the remaining part of their stock. Overall destocking in the community is done through utilisation of feedlots where cattle are put on zero grazing and fed to increase their value before they are put to the market. In most cases, some households just sell their livestock straight on the market before value addition.

### **3.3 Reduction of crop yield and food insecurity.**

Chiredzi district has experienced drastic reduction in crop yield due to several factors attributed to change of the climatic conditions and other factors. The area has experienced persistent droughts in the last two decades. Among some of the droughts that affected the district were the 2002- 2003 drought, 2004-2005, and the 2016-2017 El Nino induced drought. Growing of small grain crops is one of the on-farm strategies used by the communities. The interview with the Local Agritex officer indicated that communities are becoming more interested in growing small grain crops that was part of their livelihoods in the past. Small grain cereal crops are drought resistant; they develop mechanisms such deep, and fibrous roots systems that makes them do well in areas with low amount of rainfall that is below 300mm. Most households in the Xangani communities of Chiredzi district have reverted to growing of small grain crops mainly a variety of sorghum types. The most common types of crops planted are millet and red sorghum. Families interviewed revealed that the use of small grain cereal crops was a common practice in the early 1990s. Most families pointed out that they had moved away from farming the small grain cereal crops due to the influence of the agricultural extension workers and the Shona community whom they argued brought maize and that changed their staple food.

Households further revealed that they have been encouraged to grow short season seed varieties that mature faster with little amount of rainfall under very unpredictable weather conditions. Agricultural extension officer encouraged the community to grow short season varieties. Where possible they helped households to procure the seeds from the market or through the presidential input scheme that provides farm inputs to the people. Identified as short season maize seed varieties according to Zaranyika (2015) are SC301, a drought tolerant variety, SC727 that can provide about 18 tonnes per hectare, which is regarded as the potentially highest yield hybrid maize seed variety in Africa. Utilisation of short season varieties was a second option after the use of small grain crops such as sorghum, beans and groundnuts.

Households have small gardens where they do vegetable farming as a way of improving their food security. Households with wells have resorted to farming vegetables mainly cabbages, and other vegetable varieties and tomatoes for family consumption. In some households with better quantities of water from their wells, they produce these vegetables in bigger quantities, sufficient for family consumption and they sell surplus to the local



markets. Households with better incomes have installed solar powered submersible pumps imported mainly from South Africa to pump sufficient water for their gardens and livestock. Some of the vegetable farmers have vegetable stalls at Chikombedzi Growth Point where they sell their vegetables. Those who do not sell their vegetables or who fail to compete for customers they dry their vegetables for their family consumption during rainy season.

Severe and adverse weather conditions mostly drought and floods have caused a reduction of community wealth through livestock deaths, degradation of the arable, land reduction in crop yield output such that most households do not have surplus to sell and raise income to buy and replace damaged assets. Lack of sufficient assets and capital has affected aggregate agricultural yield output in the communities. These assets are in the form of draught power provided by donkeys and ox, fertile fields and agricultural technology like ploughs and hoes. To try to ameliorate such problems households in the community share or rent the needed assets with fellow villagers. The study revealed that the Xangani people thrive on the concept of social uplifting of the poor through sharing, lending and renting of community assets and wealth such as domestic animals and fields between the poor and those who are rich. Sharing and renting of assets is a way of capacity development on the side of the victims of a natural phenomenon. It seeks to replenish the lost capacity to produce and promote self-sustenance of the affected members of the community. Both the victims and those with better resources, out of compassion can initiate this process.

### **3.4 Overview of the findings and utility of the various strategies used by the communities**

The first aspect of paramount importance to note in the study was the centrality of the people and the human capital invested in them. This is in line with the observations made by the UNDP (2016) which notes that the people are at the centre of the climate change equation therefore any approach that seek to address climate change and development must focus more on people as key anthropogenic drivers of climate change. Revealed by the study was the lack of knowledge by the bigger number of the community members about what is climate change therefore much of their actions are not informed by deliberate actions derived from the knowledge of climate change. Those who have the knowledge about climate change seem to be lack of deliberate actions to address the issues to do with climate change and its various trimmings. Knowledge should form the basis from where the community take measures to make deliberate actions to change their livelihoods to suit and address the prevailing problems. Both knowledge on climate change and indigenous knowledge by the community are critical in addressing the community problems. Indigenous people are important actors in addressing their own problems. Dettinger and Earman (2007) notes that indigenous people must not be viewed only as victims of climate change but as useful actors in reducing climate change and its impact. He alludes that their collective knowledge of the land, the sky and the sea offer valuable insights and helps in complementing scientific data in tracing the changes undergone by the community due to climate change. This indigenous knowledge is important in shaping local adaptive strategies and in capacity development that focuses on the already existing mechanisms. Utilisation of the indigenous knowledge systems and the local approaches will promote bottom up approaches in addressing local development problems rather than pursuing the already existing top to bottom

approaches done by donors and government who simply provide the people with food rather than capacitating them to produce their own food. Thus, making the people mere recipients of development rather than being actors in developing their communities.

The study established that there is a substantial knowledge gap that needs to be addressed and it is this knowledge that will help to shape the community perceptions and shape the strategies employed by households. Key to note is the fact that the strategies utilised are not used as stand-alone strategies but they are utilised as combinations and in certain circumstances they are utilised simultaneously. Scientists and scholars, may write articles, do some research and publish work that explains climate change but the communities and villages fail to understand what is contained in the articles or let alone have access to these articles such that implementation of climate change programmes end up being top to bottom and elitist imposition of ideas to these communities.

The study identified that much of the strategies were formulated based on how the people exists in the community and this includes their traditional networks, community leadership, hierarchies, and their belief systems. Development practitioners can utilise these existing networks and systems already in place in developing appropriate technologies to promote local adaptive approaches. The most common aspect is the solidarity of the people in the community as depicted by the concept of *humwe*, *nhimbe* or *dava*. Muyambo (2015) refers to *humwe/dava* as an indigenous knowledge systems concept that is characterised by working together collectively as a community or a section within the community. The people come together to work to achieve a common goal. Mawere and Mubaya (2017) corroborate to the above school of thought noting that the concept of *humwe* is a collective work undertaken by members of the community in providing extra labour to help each other especially in farming activities and these include ploughing, weeding and harvesting. Other strategies like sharing of assets and other means of production like land, borrowing of cattle and seed sharing are all based on the spirit of *humwe/dava* and collectivism. Collective sharing of labour is used as a strategy to compensate for labour migration as young people are migrating to South Africa and Mozambique to look for new economic opportunities and compensate loss of income creating labour deficiency. Sharing of assets and seeds is derived from the indigenous knowledge systems developed by the tribe over a long period is meant to create an environment whereby nearly everyone has a means of production and can harvest sufficient food for survival.

Due to low amount of rainfall and high rates of evapotranspiration, the natural pastures in Chiredzi district have been severely depleted reducing its capacity to provide sufficient cattle feeds. The study showed that there was a very critical decline and shortage of forage in the grazing areas of the communities. The community indicated that the natural pastures have lost much of its perennial grasses that could easily replenish with little amount of rain and only left with annual grasses. The annual grasses cannot provide sufficient feed to domestic animals for the whole year especially to cattle. The natural pasture is deforested due to a number of factors such that it cannot meet the needs of the livestock. Moreover, land use change is exacerbating the problem of depletion of the quality and quantity of the natural pastures, as more land is taken up for residential and opening more space



for farming to compensate for reduction in crop yield. With increase of the population, more land being taken up for other uses, environmental depletion through soil erosion and removal of land cover is worsening each day. Insufficient rain and high temperatures affect the ability of the grass to grow. The UN (2007) argues that a combination of high temperatures, low precipitation and erratic rainfall are among the major limitations of livestock productivity because of their contributions to forage generation. The community came up with a number of strategies to address these challenges. The community use various approaches to supplement on livestock feeds. The most common livestock feed supplementation for cattle is the use of *N. brachypus* a tuber that provides food to cattle. It was initially used for cattle dosing until the 1991 to 1992 drought where it was converted to cattle feed. The tuber is mainly found in areas with black clay soils. Utilisation of *N. brachypus* as feeds for cattle shows the importance of the indigenous knowledge in tackling local climate change related challenges using the local resources. *N. brachypus* is one example of the locally available resources derived from the local knowledge and the use of the tuber developed and transformed overtime from medicinal use to cattle feed.

Households with better financial capital buy cattle feeds supplements from the livestock feeds dealers from the nearby town of Chiredzi and some import the feeds from South Africa. In most households, the above strategy is utilised together with other related approaches like the downsizing of the herds of their livestock and that is done through utilisation of feedlots constructed by development partners under Enhancing Community Resilience and Sustainability (ECRAS) projects that is funded by CARE led by a donor consortium. Cattle that is being prepared for sell on to the market are confined into feedlots for fattening so that they appreciate in terms of commercial value and then sold on to the market. Downsizing include selling part of the stock. This is tantamount to destocking, it reduces the number of cattle in a given area making it possible for the households to supplement feeds, and it reduces the population of domestic animals that feed on a designated natural pasture. Proper utilisation of the above strategy can be plausible and sustainable over time. The UN (2016) postulates that destocking can be a very successful drought strategy that allows communities to focus limited resources especially forage on the most important breeding stock that can be selected using specific traits and their performance. The most common strategy utilised by most households is stubble and crop residue harvesting. Crop residue harvesting depend on the availability of the residue that means the community can only harvest stubble after the planting season. Due to low amount of rainfall and during droughts utilisation of residue harvesting as a cattle feed supplement is highly impossible. Moreover, in the ecological region five households do not use fertilizers in their fields because crop residue and stubble decompose and make natural fertilizers. Thus, harvesting stubble will affect the soil nutrients and reduce on farm productivity.

Depletion of pastures, loss of forage and difficulties in accessing sufficient cattle feeds have affected the population and the quality of cattle that provide draught power during farming and servicing other domestic traction needs. Data showed that approximately ninety-five percent of the households depend on draught power when planting in their fields and only a very small number either own tractors or utilise tractors through hiring to plough their fields. Of the ninety five percent that used draught power, the bigger population use ox

draught power while the remaining use donkey draught power. Due to loss of forage and delay in rainfall, cattle mortality is increasing and in certain circumstances, loss of weight and late recovery curtail their ability to provide sufficient draught power for ploughing in time. The above scenarios coupled with the multipurpose nature of cattle including providing direct food like milk, vulnerability to theft, disposal for income, affects their utility of cattle as a reliable source of draught power, and households are now shifting towards utilisation of donkeys to provide draught power and traction.

Water scarcity is one of the biggest climate change related problems for both crop production and animal husbandry. For animal husbandry, the community used water supplementation strategies that include moving their animals to areas with permanent water sources like the Mwenezi River. Some households drilled their own wells and boreholes at their own homesteads. A number of problems were identified in relation to these strategies. Moving cattle close to the river was only applicable to villages that are closer to the river. Moreover, this approach crowded the river such that the river itself is affected. More cattle along the riverbanks affected the riparian grazing pastures leading to over grazing in the riverbanks. Use of wells as a source of water is affected by ground water depletion that is caused by sustained pumping of ground water over a long time. During dry seasons especially from September to October, most wells are drying up making it more difficult for communities to access sufficient amount of water. Competing needs were identified as another problem with water scarcity as people are coming up with more gardens for vegetable production. Thus, more water is needed for watering the gardens especially during the dry season.

Crop production in Chiredzi district is dependent on the natural rainfall and the rainfall is becoming more erratic, poorly distributed such that crop production continue to be reduced and the community is becoming more food insecure. For crop production, a number of strategies addressed the issue of insufficient rainfall especially when considering on farm agriculture. Households plant drought resistant small grain crops like millet, and red sorghum that can thrive in areas with high temperatures and low rainfall. Characteristics of most sorghum varieties makes them the most suitable crop. Sorghum has several attributes that make it suitable in drought and low rainfall prone areas. These include small leaf area per plant that reduces transpiration; it has a well-developed and finely branched root system that is good in absorbing water.

Short season seed varieties are the most favourable crops used in the communities because they stall the development of seed mostly during drought periods. They can accumulate salts and sugar that is essential in protecting the crop against water loss. Households that grow short season varieties and small grain crops were more food secure as compared to the non-growers of short season varieties. Hence, the utilisation of short season varieties proved to be a viable solution to the problem of erratic and low quantities of rainfall.

#### 4 Conclusions

Climate change is the biggest developmental problem in the Xangani communities in Chiredzi district. The Xangani people's livelihoods are heavily reliant on rain fed agriculture. Animal husbandry and crop production are the two major agricultural practices identified and much of the agriculture is carried out at subsistence level

utilising family resources. Climate change has caused a very big reduction in on agricultural productivity. Noted were a significant reduction in crop yield due to erratic and low rainfall amount. Reduction in crop yield affected food security at household level with most families relying on food relief mainly from donors like the World Food Programme and Plan International. This food relief intervention happens mainly during the dry seasons that is from August to February. Climatic factors that affected crop yield included but not limited to low amount of rainfall, very late rainfall and high temperatures that promotes higher rates of evapotranspiration in crops that affects the amount of moisture critical in the growth of crops.

The study showed that the use of small grain like the Gangala a red sorghum variety has been existence for many decades but the grain was now less preferred as a staple food as compared to maize. With better advocacy and support from development partners the red sorghum can be planted again and improve the harvest. Utilisation of small grain variety is a very relevant and sustainable strategy with no environmental problems.

The study revealed that there is less utilisation of the indigenous knowledge systems in the designing and implementation of development programmes and projects. Indigenous knowledge work well with capacity development since the focus of capacity development is building on the existing resources and knowledge possessed by the recipients of the development initiatives. Lack of involvement and consultation of community members in the provision of relief and aid to address climate change problems has created aid dependency. This was revealed by how the community sell farm inputs like fertilisers provided through government agencies and programmes like the presidential input scheme and buy other needs. The local fields do not need fertilisers and the people do not have knowledge of how the fertiliser works.

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