Vulnerability and Adaptation to Climate Change: A focus on Chiredzi District, Zimbabwe

Synthesis Report

Coping with Drought and Climate Change Project
Harare, Zimbabwe

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Summary

The growing exposure to natural hazards such as drought, floods and extreme temperatures and weather events associated with climate change will have devastating impacts on rural livelihoods in Chiredzi district where agriculture is the main source of livelihood. Historical climate data from 1966 to 2006, and downscaled climate change projections for the period 2045-2065 are used to assess the sensitivity of crop and livestock livelihood systems to climate change impacts using the IPCC (2001) framework for vulnerability assessment. Community participatory approaches were used to rank impacts and root causes, which formed the basis of identifying adaptation options for the livelihood systems. Results from the project reveal that most of Chiredzi district will become unsuitable for maize, sorghum and cotton production under the worst case climate change scenario. Both goats and cattle also show significant sensitivity to climate change under both the best and worst case scenarios. The inherent dryness of the district, increasing demand on water from a growing human population, heavy reliance on underground water which has led to significant saline –water intrusion, poor environmental management practices and institutional failures are some of the factors identified to be worsening the impacts of drought. Possible adaptation measures for rural farmers in Chiredzi district include, options such as improving water management practices(at field and basin levels), optimizing rainfed crop and livestock production, adopting and utilizing new technologies (such as irrigation), and changing crop types and location, migrating permanently away from the agricultural sector. Establishing dedicated Drought Management Boards could also be a viable long-term strategy for drought risk reduction. A key policy message from this study is that policymakers should promote dynamic adaptation, as it is unlikely that there will be one solution for all time.

1.0 Introduction

With about two thirds of the country comprising Arid and Semi-Arid Lands (ASAL), strengthening resilience and preparedness to impacts of climate variability and change related shocks are a priority for Zimbabwe. The growing exposure to natural hazards such as drought, floods and extreme temperatures and weather events due to changing climatic patterns has devastating impacts on the rural population whose livelihoods largely depend on rainfed agriculture. This synthesis report captures the main findings from the "Climate risk and Vulnerability Assessment" conducted by the GoZ-UNDP/GEF, "Coping with Drought and Climate Change" project in Chiredzi district (Fig. 1.1).

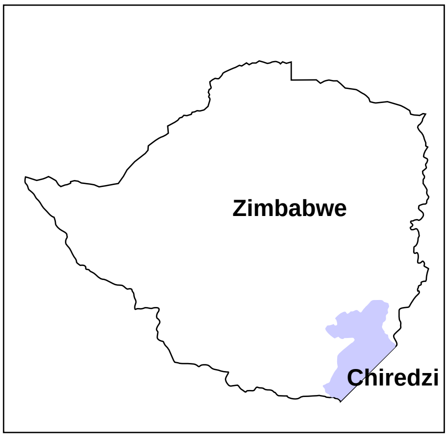

Figure 1.1 Chiredzi district location map

The aim of the report is to raise understanding of climate change vulnerability and adaptation options for agriculture based livelihoods.

The report has five sections. Section 1 is the introduction and background. The state of climate change is described in Section 2. Chiredzi district's climate sensitivity is outlined in Section 3. Sections 4 and 5 contain a description of the vulnerability and adaptation options for Chiredzi district respectively.

1.1 Background

Limited resources for adaptation require that adaptation interventions be prioritized. Community participatory climate risk and vulnerability assessment can help in identifying and targeting adaptation measures. Knowledge of the nature of risks, their geographic coverage and their potential future behaviour is fundamental for designing viable adaptation practices to reduce the impact of climate change in the agriculture sector.

The likely impacts of climate change on the vulnerability of resource-poor smallholder farmers and livestock farmers need to be better understood, so that resilience to current climate variability as well as to the risks associated with longer-term climate change can be gauged and appropriate actions taken to increase or restore resilience where it is threatened. The differential impacts of droughts on communities also mean that communities and individuals have different capacities to adapt and mitigate the effects of climate change. Vulnerability is also a dynamic process, thus to assess it, one must possess a good knowledge of the current situation, the evolution and trends of the problems faced by the vulnerable, and the resources and choices that may be available to stakeholders in the future, including vulnerable groups (ENDA, undated).

> **Box 1.1 Elements of risk identification**
>
> Probability measures how frequently an event is likely to occur.
> Exposure means the number, quality and monetary value of various types of property, infrastructure or lives that may be subject to undesirable outcomes.
> Consequence means the full or partial damage, injuries or loss of life, property, environment and business that can be quantified, usually in economic or financial terms.

1.2 Methodology

The Intergovernmental Panel on Climate Change (IPCC, 2001) has developed a framework for vulnerability analysis (Fig. 1.2), and a risk management framework to identify vulnerability "hot-spots" and identify possible adaptation measures, respectively. The climate vulnerability analysis and adaptation options in this report are based on these approaches.

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[1] ***ENDA. Undated**. Capacity strengthening in climate change vulnerability and adaptation strategy assessments.*

[2] *IPCC. 2001. Climate Change 2001: Impacts, Adaptation and Vulnerability", Technical Summary, IPCC Publication. <<http://www.ipcc.ch/pub/wg2TARtechsum.pdf>>;Full document: <http://www.ipcc.ch/pub/tar/wg2/index.htm>>.*

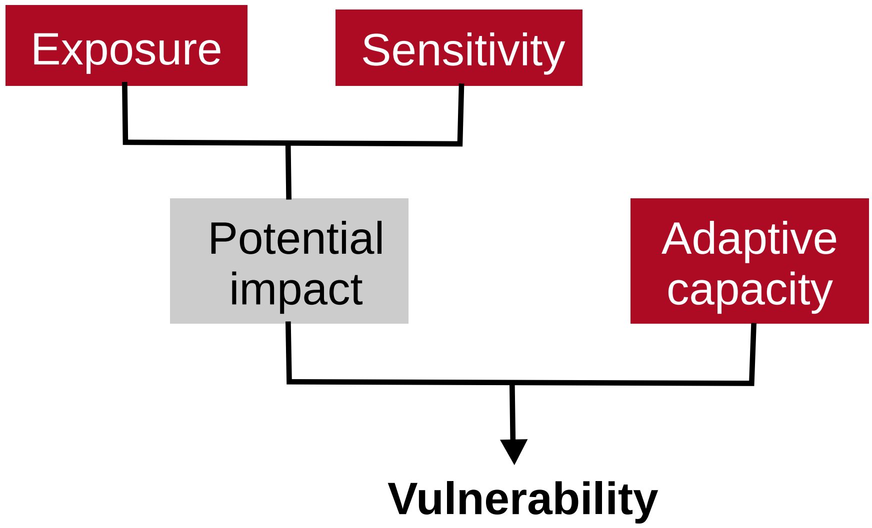

Figure 1.2 Vulnerability and its components. Source: Adapted from D. Schroter and the ATEAM consortium 2004, *Global change vulnerability —assessing the European human–environment system*, Potsdam Institute for Climate Impact Research.

Much of the methodology for identifying adaptation measures has been drawn from 'How to Reduce Drought Risk', because it is a simple step-by-step process for users (communities) to identify actions to reduce climate change impacts. Risk reduction actions were identified from a root-cause analysis from community focus group discussions comprising a sample of men and women farmers from the district. The process followed is shown in Figure 1.3.

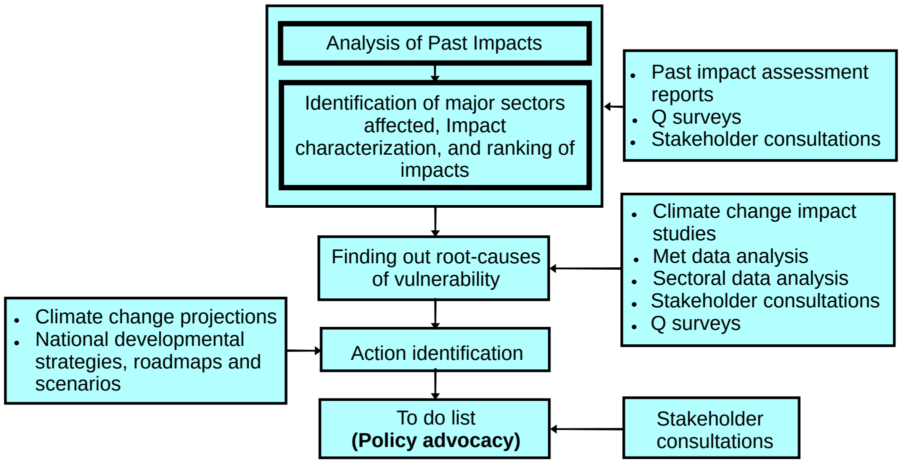

Figure 1.3 Community participatory processes used to identify adaptation measures.

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[3] ***C. Knutson, M. Hayes, and T. Phillips, 1998****: How to Reduce Drought Risk, Western Drought Coordination Council, National Drought Mitigation Center, Nebraska, USA.*

2.0 State of Climate Change

Warming of the global climate system is unequivocal, as evidenced from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice-caps, and rising global average sea level (IPCC, 2007). Eleven of the last twelve years (1995-2006) rank among the twelve warmest years in the instrumental record of global surface temperature since 1850. The 100 –year linear warming trend of 0.74°C (1906-2005) is larger than the corresponding trend of 0.6°C (1901-2000) last reported in the IPCC Third Assessment Report. Global mean annual temperature has increased by about 0.4°C between 1900 and 2000, and the 1990s decade has been the warmest years this century.

There is growing consensus that Zimbabwe will face some degree of Climate Change over the next 30-50 years irrespective of global or local efforts to reduce Greenhouse Gas (GHG) emissions. The scale of that change and the way it will be manifested in different regions such as Chiredzi is less certain, but climate models help to project possible future climates which can also be used to assess possible impacts on different systems.

2.1 IPCC 4th Assessment Report

Since the beginning of the industrial revolution, it is estimated that atmospheric concentrations of carbon dioxide (CO_2) (the main heat trapping Greenhouse Gas) have risen by 35%, primarily from burning of fossil fuels and deforestation. The IPCC Fourth Assessment Report cautions that if current trends in GHG emissions continue, global temperatures could rise by 1.4 to 5.8°C by 2100. Such temperature changes are likely to have detrimental impacts on the climate system (including changed rainfall patterns, temperature extremes and extreme weather events), agricultural production, ecosystems, water supply, forests and overall human development. Some of these changes are already occurring in different regions of the world.

The IPCC Fourth Assessment Report also concludes that, although Africa has contributed only about 3.8% of GHG emissions, it is likely to be affected the worst by climate change. The report estimates that:

- By 2020, between 75 and 250 million people in Africa will be exposed to increased water stress due to climate change,
- By 2020, in some countries, yields from rain-fed agriculture could be reduced by up to 50% and access to food could be highly compromised.
- By 2080, Arid and Semi-Arid lands in Africa are projected to increase by 5-8% under a range of climate change scenarios.

[4] ***Intergovernmental Panel on Climate Change (IPCC),*** *2007. Climate Change 2007. The physical science basis. Report of WGI to the 4th Assessment Report of the IPCC, NY, Cambridge University Press.*

2.2 Downscaled climate change scenarios for Chiredzi district

Applying ten-downscaled models to the Save Basin for the high emissions, high sensitivity scenarios generated by the IPCC for the 3rd Assessment report, the Coping with Drought and Climate Change Project (2009) has identified a number of possible outcomes for Chiredzi, including:

- An increase in annual average temperature of between 1.5 to 3.5°C by 2050 from the current baseline
- Total rainfall does not change much, but the rainfall pattern may undergo significant modifications by 2050. Most models project rainfall increases in most months followed by decreases during the second part of the season, and
- Runoff shows high inter-annual variability in future

Of these possible outcomes, the most likely are for temperature change. However this does not mean that the results of the models for other possible dimensions of change, -rainfall and runoff, should be disregarded as they still provide useful basis on which to test the sensitivity of different systems- such as crops and livestock –to the possible scale of change. The wisest approach is to use these projections as “thought experiments” to assess the additional risk that the potential exposure to hazards on this scale pose to life.

The period through to 2030 and to some extent 2050 is the one that is most relevant today for decisions about adaptation strategies. This is because most decisions that are to be affected by climate risks involve assets and business systems whose economic life falls within or near this time horizon.

3.0 Chiredzi district's climate sensitivity

Main constraints to agricultural land use in Zimbabwe are summarized in the description of agro-ecological regions developed by Vincent and Thomas (1961). Rainfall emerges as the greatest physical constraint to agricultural production and occurs in a single season, November to March. It is estimated that when land suitability is included, the country has only about 7% of arable land available for intensive dryland cropping. Natural Regions IV and V, which jointly constitute about 64% of the country, have the most marginal climatic conditions for agriculture. These low-lying regions to the north and south of the country have annual rainfall generally below 650 mm. The regions are subject to periodic seasonal droughts, erratic rainfall and severe dry spells during the rainy season. Chiredzi district is mostly in Natural Region V. It is generally marginally suitable for dryland cropping and suited to extensive livestock production or game ranching. In the absence of adaptation, climate change could make livelihoods in this district unsustainable.

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[5] *GoZ-UNDP/GEF: Coping with Drought and Climate Change Project (2009). Climate Change: Scenarios for the Save Catchment of Zimbabwe with Special Reference to Chiredzi. Synthesis Report. Harare, Zimbabwe*

3.1 Drought hazard exposure

The Standardized Precipitation Index (SPI) was used to assess drought hazard exposure for Chiredzi district, using 3, 6, 12, 24 and 48 months time steps. A time series analysis of the SPI for Chiredzi from 1966 to 2005 (Fig. 3.1) shows a high frequency of moderate and severe drought conditions between 1980 and 2000. Moderate drought is when SPI ranges from -1 to -1.49, for severe drought SPI is from -1.5 to -1.99 and for extreme drought it is below -2.0.

Results from this study show that Chiredzi has drought hazard scores of about 0.2 for moderate, severe and extreme drought categories for the January, February and March (JFM) rainfall season. There is a probability of 0.15 for most of Chiredzi district experiencing a moderate drought during January, February and March (JFM). The probability of severe drought is 0.10 for the same period, whereas for extreme drought it is 0.15. The 3, 6, 12 and 24 month droughts have recurrence intervals of 2 years, whereas the 48 months drought is rare with a recurrence interval of 16 years. The dominance of the drought hazard for the 3 month time step ending March suggests the importance of terminal drought in Chiredzi district. For terminal drought, rains may start off well for most applications but terminate earlier than normal from January or February onwards. This type of drought will have adverse impacts on late planted rainfed crops and some livestock as pastures dry up earlier than normal.

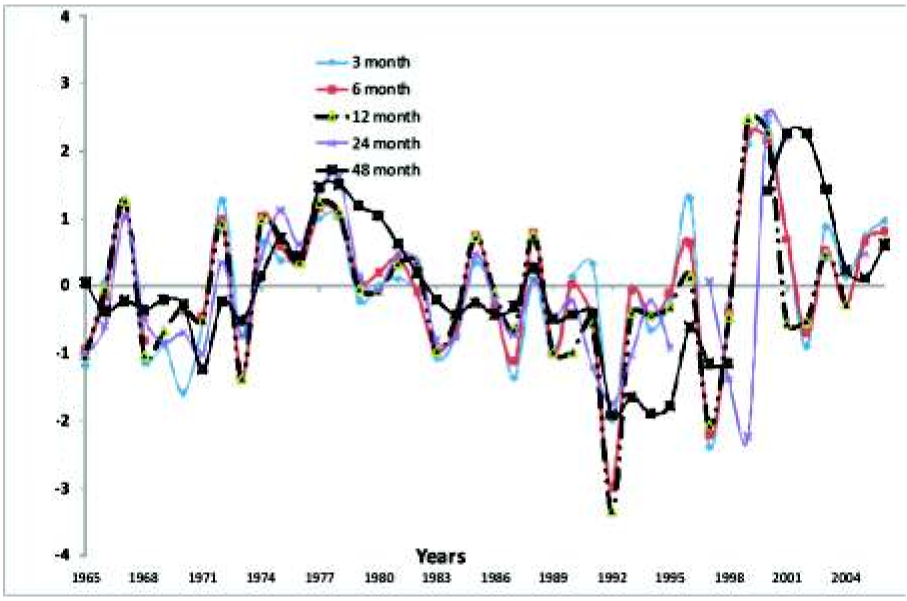


Figure 3.1 Time Series analysis of the Standardized Precipitation Index (SPI) for Chiredzi

[6] **Vincent, V.a nd R.G. Thomas (1961).** *An Agricultural Survey of Southern Rhodesia, Part I: Agro-Ecological Survey, Government Printers, Salisbury.*

[7] *N. Singh and P. Kalala (undated). Adaptive Strategies and Sustainable Livelihoods: Policy Issues. Zimbabwe. IISD, Winnipeg, Canada.*

3.2 Sensitivity of surface water resources

A number of dams for surface water supply augmentation have been developed in the Save Basin (Fig. 3.2) in response to seasonality of water supplies and recurrent droughts. Historical data clearly shows that runoff is sensitive to inter-annual rainfall variability (Fig. 3.3). The period 1980-1996 had the lowest runoff with devastating impacts on livelihoods in Chiredzi district. Future water balance projections across the Save Basin show an increase in inter-annual variability of runoff, with some sub-basins such as Chiredzi experiencing water deficits.

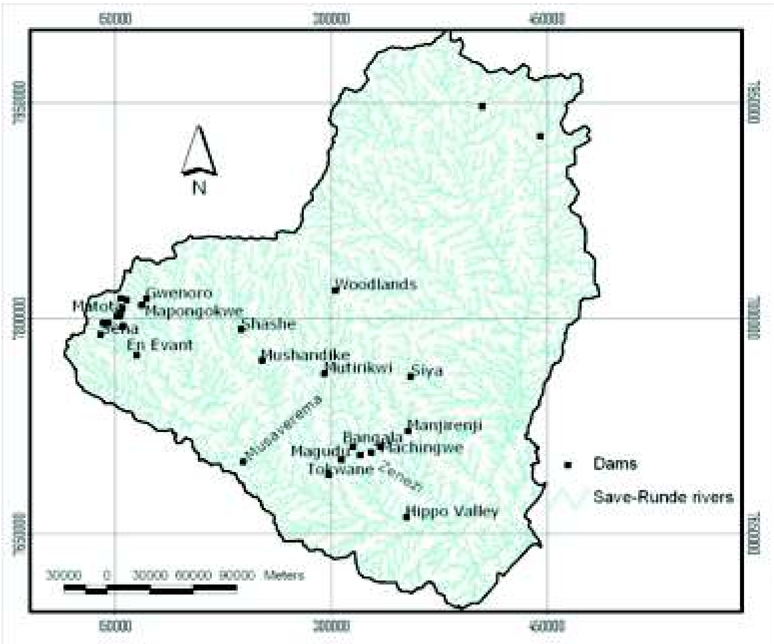


Figure 3.2. Dam infrastructure across the Save Basin.

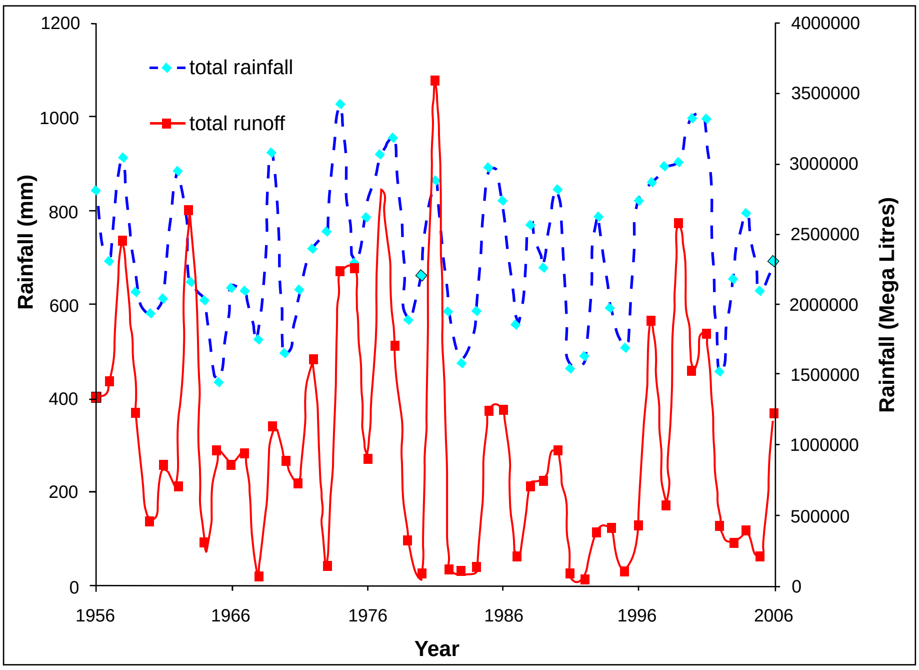


Figure 3.3 Area average rainfall-runoff relationship across the Save Basin from 1956-2006.

3.3 Sensitivity of crops

Sorghum, maize, groundnuts and cotton are the main crops currently grown among small-holder farmers in Chiredzi district. The Famine Early Warning System (FEWS) has adopted 250 kg of maize meal/person/year in their assessment of food security. In most years communal farmers in Chiredzi attempt to grow a cereal crop but the yields are low and uncertain (Fig. 3.4). Besides low rainfall, yields are also constrained by lack of draught power to take advantage of early rains and lack of seed of appropriate crop varieties.

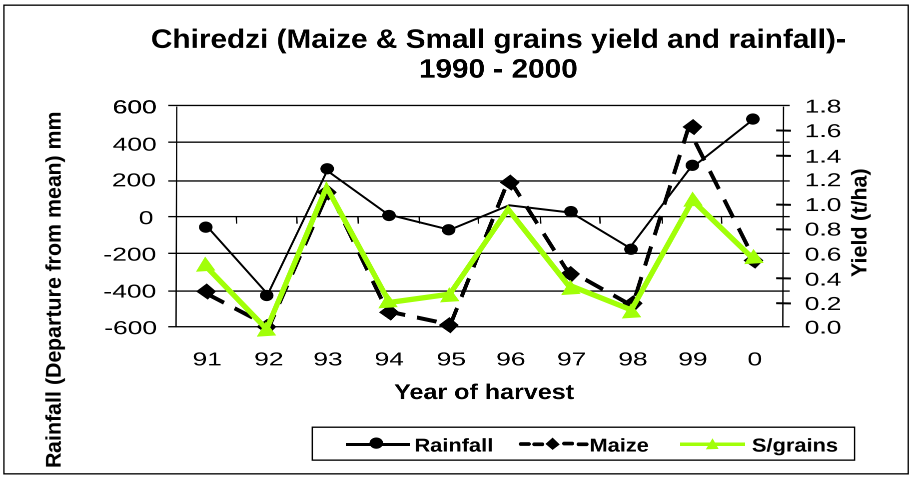


Figure 3.4. Relationship between yields of small grains and maize, and rainfall in Chiredzi district from 1990 to 2000 (Source of data: Agritex, 2008. personal communication).

Modeling is the tool commonly used to assess the sensitivity of agriculture to climate change impacts. The sections that follow describe the sensitivity of sorghum, maize and cotton to climate change projections for 2050.

Sorghum

Under the current climate, the whole of Chiredzi district is suitable for sorghum production (Fig. 3.5a). Mean yields for rural small-holder farmers have averaged 0.52 t/ha from 1990-2000 compared with the global average of 1.8 t/ha. However, under the worst case climate change scenario (i.e. temperature increases significantly and rainfall declines by up to 50% by 2050) the district becomes largely unsuitable for sorghum production (Fig. 3.5b). Only the extreme northeastern sections of the district remain marginally suitable for production of the crop.

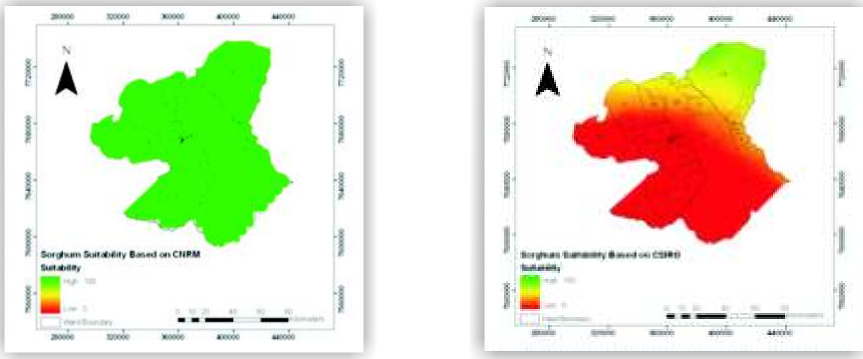


Figure 3.5. Suitability of Chiredzi district for sorghum production, (a) best case climate scenario and (b) worst case scenario.

Maize

Chiredzi is marginally suitable for rainfed maize production under the current climate(Fig. 3.6a). Production records from the district show a mean yield of about 0.55 t/ha for smallholder farmers under rainfed production compared with a national average of about 1.2 t/ha for the same category of farmers. The global average maize yield for rainfed agriculture under small-holder farming is 2.8 t/ha (FAO, 2004). If the temperature and rainfall for Chiredzi district were to change as projected by the best case climate change scenario, its suitability for maize production would improve from the current situation to cover the whole district. However, under the worst case climate change scenario (high temperature increase and rainfall declines by up to 50%) the whole district becomes completely unsuitable for the crop (Fig. 3.6b).

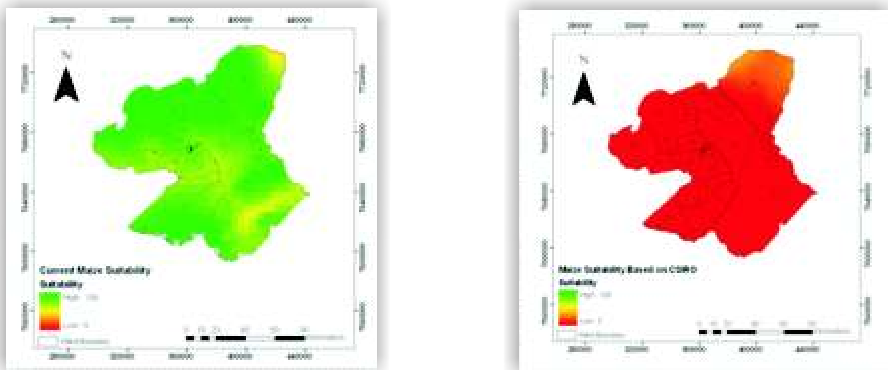
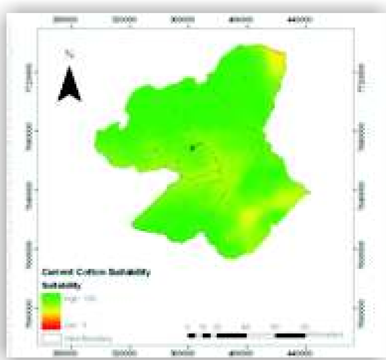


Figure 3.6: Suitability of Chiredzi district for maize production (a) current climate, and (b) worst case scenario.

Cotton

Chiredzi district is currently suitable for cotton production (Fig. 3.7a) and yields for small-holder farmers growing the crop under rainfed conditions average 0.41 t/ha. For the best case climate change scenario the suitability of the project area for the cotton production improves from the current situation to cover the whole district. However, for the worst case climate change scenario, the whole district becomes unsuitable for cotton production (Fig. 3.7b).



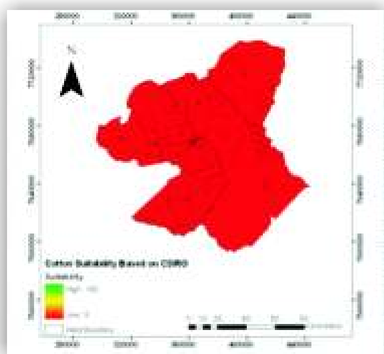


***Figure 3.7:** Suitability of Chiredzi district for cotton production (a) current climate and (b) worst case scenario.*

3.4 Sensitivity of livestock

Small-holder farmers in Chiredzi keep cattle, goats, sheep and donkeys. Proceeds from sale of livestock can be used to purchase food and pay for other needs. Thus livestock is clearly important to food security at household level. Annual fluctuations in livestock numbers and productivity have been affected by drought and disease (Fig. 3.8). In eutrophic savannahs, such as Chiredzi district, during droughts, virtually no grass grows in such areas, and leaf fall and browse from trees is practically the only fodder available. According to an Agritex census of 2009, the district supported 153,250 cattle, 700,880 goats and 11,500 donkeys in 2009. Livestock, particularly cattle and goats thrive naturally because of the sweet veldt. According to a 2008 baseline study conducted by the CwD, the predominant livestock classes owned (of at least a single livestock unit) by household are goats (51%); cattle (46%); donkeys (12.7%) and sheep (5.8%). Poultry was owned by at least 54% of all households.

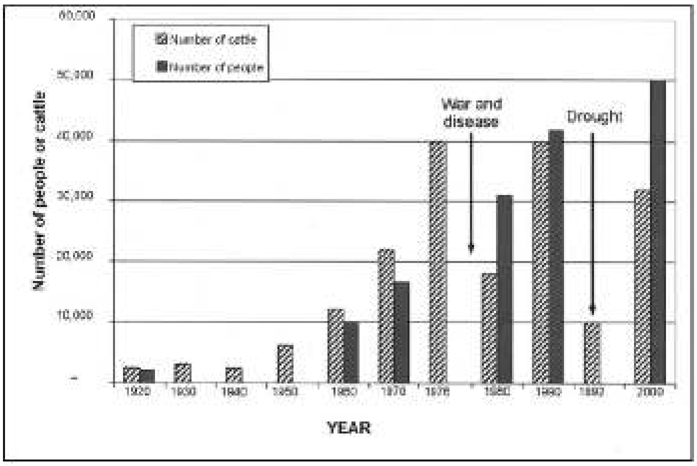


***Figure 3.8** Growth of human and cattle populations in Matibi II Communal Land between 1920 and 2000. Cattle numbers declined markedly in the late 1970s and during the 1991–1992 drought. Statistics for human population not available for some of the individual years (Source: Cumming, undated)*

Sensitivity of cattle and goats to climate change impacts

Acronyms
NDVI – Normalized Difference Vegetation Index.
NOAA – National Oceanic and Atmospheric Administration.
AVHRR – Advanced Very High Resolution Radiometer.

Using NDVI data for the period 2002 – 2007 from the NOAA AVHRR, empirical relationships between Net Primary Productivity (NPP) and temperature and rainfall were derived. Using an estimate of daily intake of an average cow and goat the crude carrying capacity of the district was estimated. Areas with high carrying capacity have low sensitivity scores while areas with low carrying capacity have high sensitivity scores. Under the current climate it can be seen that the whole of Chiredzi district has low sensitivity for both cattle and goats (Fig 3.9). The changes in sensitivity of cattle and goat production for the best and worst case climate change scenarios are shown in Figures 3.10 and 3.11, respectively. The figures reveal that both cattle and goats will become sensitive under both the worst and best case climate change scenarios, with the worst case scenario showing the greatest sensitivity.

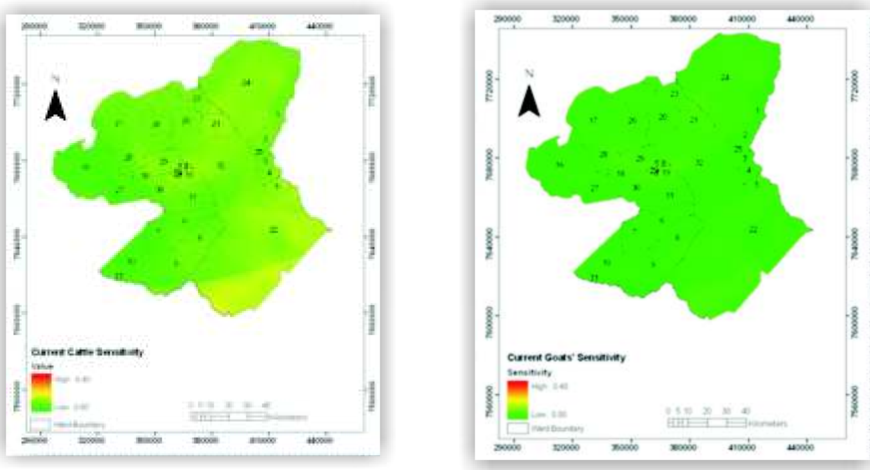


Figure 3.9. *Current climate sensitivity for (a) cattle and (b) goats in Chiredzi district.*

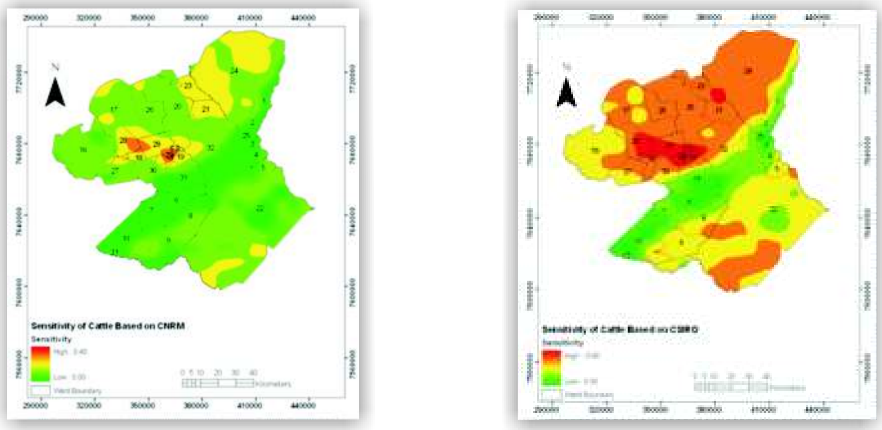


Figure 3.10. *Cattle sensitivity under (a) best case and (b) worst case climate change scenarios for Chiredzi district.*

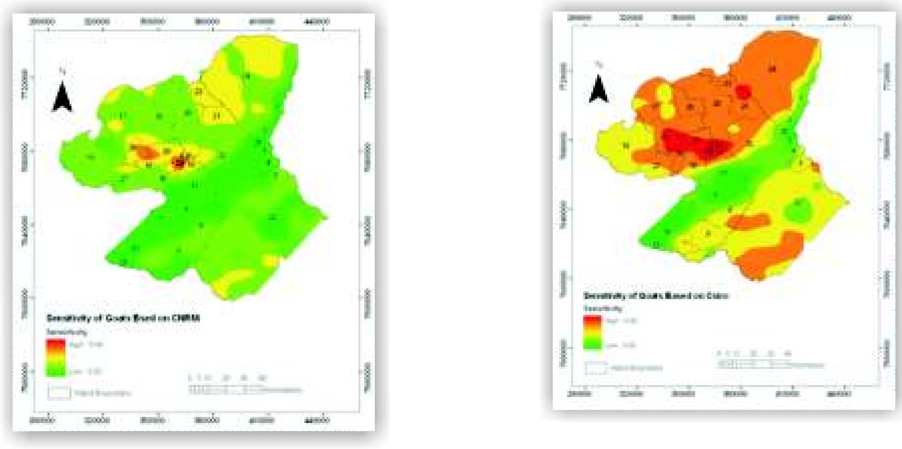
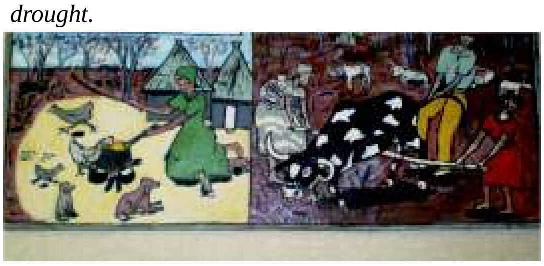


Figure 3.11. *Goat sensitivity under (a) best case and (b) worst case climate change scenarios for Chiredzi district. Analysis*

3.5 Community perspectives on climate risks and impacts

Community participatory climate risk analysis for Chiredzi district revealed that drought is the most important climatic hazard and five types of drought are normally experienced in the district. The five drought types are: early season (characterized by delayed or slow onset of the rains), mid-season (rains break for weeks on end about January/February), terminal (rains just terminate from about January/February), seasonal (rains are light and patchy throughout the season) and extreme drought (in this case rains fail for two or more consecutive seasons). The extreme drought type is locally referred to as "Chingwangwa" and usually calls for state intervention to save livestock and human-lives. A community historical drought time-line captured, 1946/47, 1948, 1965, 1966, 1968, 1969, 1982, 1983, 1984, 1987, 1991, 1992, 1995, 1996, 2001, 2002, 2006, 2007, 2008 as some of the droughts that had severe impacts on rural-livelihoods in Chiredzi district. Common impacts of droughts experienced in the past are summarized in textbox 3.1.

Picture box 3.1: *Cartoon by a rural Chiredzi resident depicting experiences from the 1991-92 drought.*



Text Box 3.1: Common drought impacts at community level in Chiredzi

Livelihoods

- Crop failure
- Lack of fodder for cattle
- Lack of water for cattle & irrigation

Food security

- Reduced availability of food
- Reduced availability of nutritious food

Health

- Insufficient water for hygiene purposes
- Increase in diarrheal diseases
- Stress associated with loss of livelihoods

Economic

- Increased prices of food and fodder
- Loss of income from agriculture
- Loss of employment

Social

- Migration and associated impacts on families
- Increased inequity among social groups
- Increase in crime
- Increase in school drop-outs
- Increased burden on women and children
- Increased burden on government and relief agencies

Environmental

- Increase in deforestation
- Loss of biodiversity
- Saline water intrusion

4.0 Vulnerability of livelihood systems in Chiredzi district

This section presents the vulnerability of crop and livestock production systems in Chiredzi district to climate change impacts.

4.1 Vulnerability mapping

Vulnerability is the net effect of sensitivity and exposure on adaptive capacity. The exposure of Chiredzi district to drought has been assessed, the sensitivity of crop and livestock production systems to current and future climate change has been determined and the adaptive capacity (Fig.3.12) for the district has been estimated as a function of socio-economic and technological factors (such as, access to markets, communication infrastructure, irrigation facilities, seed technology, institutions, etc). With the three parameters (exposure, sensitivity and adaptive capacity) mapped, vulnerability is then calculated simply as:

Vulnerability = (adaptive capacity) – (sensitivity + exposure)

In this relationship, a high (positive) net value indicates less vulnerability and vice versa.

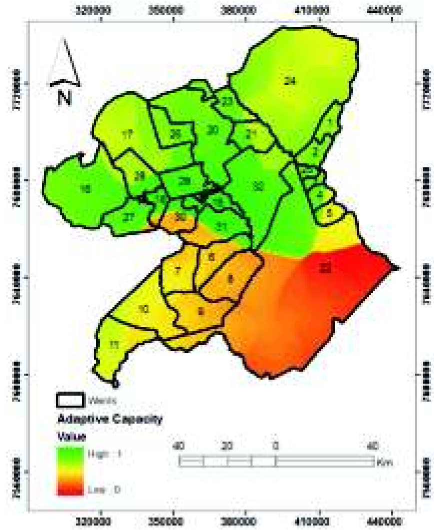
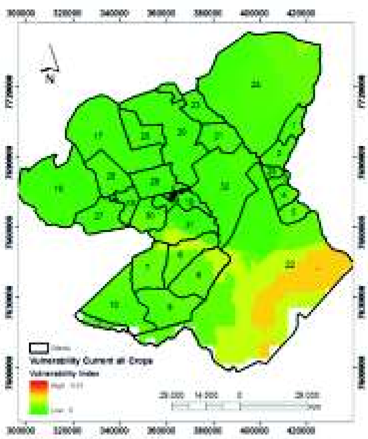
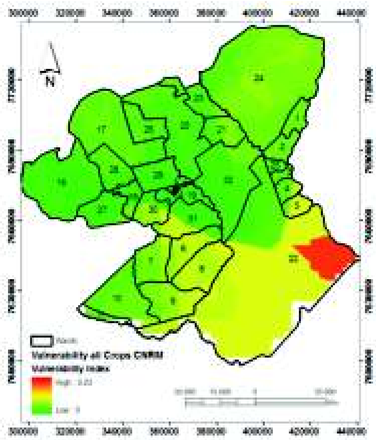


Figure 3.12: The distribution of adaptive capacity in Chiredzi district.

The vulnerability of the crop production system under the current climate, worst – and best case climate change scenarios are shown in Figure 3.13. The southern and south-eastern parts of Chiredzi show the highest vulnerability. Thus the southern and south-eastern parts of Chiredzi district are the crop production system vulnerability "hot spots".

The vulnerability of the livestock production system for the current, worst - and the best case climate change scenarios is shown in Figure 3.14. Again like in the cropping production system case, the southern and south-eastern parts of Chiredzi district show the highest vulnerability. Thus, the southern and south-eastern parts of Chiredzi district are also the livestock production system vulnerability "hot spots".





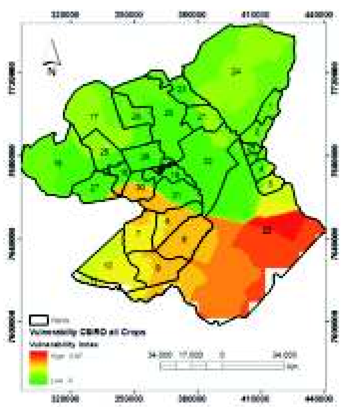
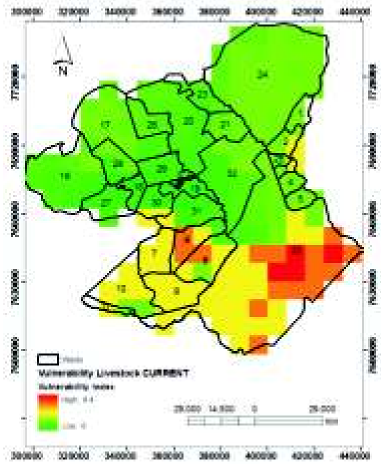
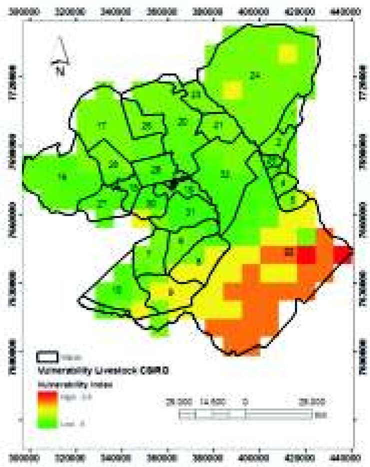


Figure 3.13: *Crop production system vulnerability index for the study area calculated for the current (Current), best case (CNRM) and worst case (CSIRO) climate change scenarios.*





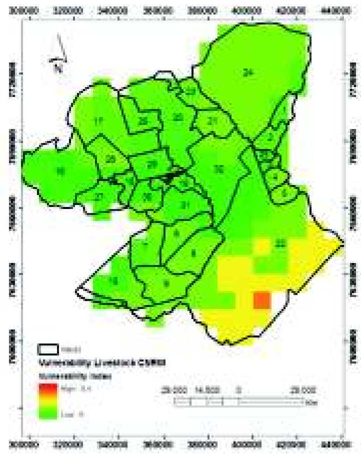


__Figure 3.14:__ Livestock production system vulnerability index for the study area calculated for the current (Current), best case (CNRM) and worst case (CSIRO) climate change scenarios

4.2 Community perspectives on drivers of vulnerability

Community focus group discussions came to the conclusion that, the vulnerability of Chiredzi district to drought and climate change can be ascribed to:

- Inherent dryness
- a high frequency of drought,
- monocropping (over-dependence on maize)
- Poor farming practices
- high incidence of poverty
- Limited alternative livelihood options outside agriculture.
- Low access to technology (irrigation, seed), markets, institutions and infrastructure (poor roads, bridges, modern energy, dams and water conveyance).
- Population pressure
- Skewed ownership and access to drylands livelihood assets such as livestock and wild-life.
- Lack of drought preparedness plans
- Limited use of climate early warning systems

Text box 3.2. “People don't wake-up one morning and find a drought – it is the result of a weather phenomenon that develops over time. It is therefore something that can be monitored and managed.” Adan Bika, Kenya.

5.0 Adaptation options

The previous sections have reviewed the vulnerability of Chiredzi district to drought and climate change. In this section, adaptation options identified from community focus group discussions and expert consultations are described.

5.1 Autonomous adaptation strategies

Communities could identify currently prevailing autonomous adaptation strategies in agriculture, livestock production, water resources, food and economic security. Traditional agriculture had survival strategies build into it. In the past, most crop lands would hold two or more crops intercropped, and a range of other crops to reduce the chances of total harvest loss should the rains fail. Currently, growing drought tolerant crop varieties (particularly small grains), livestock farming and remittances were the most important household drought risk management strategies cited by farmers from the project area. The menu of autonomous adaptive strategies is summarized in Table 5.1.

Table 5.1. Autonomous drought risk management strategies identified by communities in Chiredzi district.

Level	Response
Household	- Saving available food
	- Growing drought tolerant crops especially sorghum
	- Exchange casual labour for food
	- Remittances
	- Dependence on social networks
	- Migration, especially to neighbouring countries
	- Distress sale of assets (particularly livestock)
Local government	- Sink boreholes
	- Food for work
NGOs	- Sink boreholes
	- Provide food relief
	- Provide seed for recovery phase
	- Nutrition gardens
	- Livestock support (to rebuild livelihood assets)
	- Small-scale Irrigation
Private sector	- Provide employment
	- Provide fodder for livestock (molasses)
	- Provide relief grazing
	- Provide game meat
	- Sell grain
	- Purchase livestock from farmers
Central Government	- Provide seed
	- Food assistance
	- Rehabilitate/develop irrigation facilities
	- Credit facilities

5.2 Planned adaptation actions

Central government and local authorities are responsible for developing national and regional level development strategies and programmes. Available development strategies for Masvingo province have prioritized the following adaptation strategies in Chiredzi district, mainly in response to the problem of recurrent droughts:

Agriculture

- Extend irrigation facilities
- Provide drought tolerant open pollinated maize and sorghum seed
- Promote small-grains
- Matching livestock numbers to carrying-capacity of area

? Water

- Supply side augmentation through building dams and drilling boreholes
- Demand side management through enforcing water rights and improving water use efficiency

? Food security/safety

- Strategic grain reserves

5.3 Limitations of current drought management initiatives

Key informants identified the following as some of the limitations of current drought management initiatives:

? Policy-related limitations:

- Insufficient importance given to drought risk management by government institutions,
- Lack of drought management structures at community and district levels,
- Poor management of irrigation projects
- Poor community participation in long-term drought risk reduction programmes

? Technology, knowledge and human resources related limitations:

- Lack of drought tolerant crop varieties and livestock breeds
- Limited knowledge on how wild-life can be used as buffer by communities during times of drought
- Limited knowledge on appropriate agricultural practices for Arid and Semi-Arid Lands
- Absence of reliable and tailored seasonal climate forecast systems
- Limited access to energy for pumping water and to support alternative livelihoods

? Financial limitations:

- Lack of sufficient financial support during periods of drought
- Financial constraints on irrigation projects

5.4 Priority Adaptation options

Based on the root cause analysis, adaptation options were identified and ranked for drought-risk reduction by farmers from Matibi 2 communal lands. Table 5.2 summarizes the suggested adaptation measures which could apply for most of rural Chiredzi district. These measures could be implemented by government, NGOs, and communities themselves.

Box 5.1 Adaptation and adaptive capacity

Coping range – is the range in which the effects of climate conditions are beneficial or negative but tolerable. Beyond the coping range, the damage or loss-are no longer tolerable and a society (or system) is said to be vulnerable.
Adaptation – is a process by which strategies to moderate, cope with or take advantage of the consequences of climatic events are enhanced, developed and implemented.
Adaptive capacity – is the ability of a system to adjust its characteristics or behaviour in order to expand its coping range under existing climate variability or future climate conditions.

- Actions that lead to adaptation can enhance a system's coping capacity and increase its coping range thereby reducing its vulnerability to climate hazards.
- 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 pursuit of adaptation.

Table 5.2. Drought risk reduction-action identification matrix for Matibi 2 communal lands in Chiredzi district

Drought impact	Root Causes	Possible Actions
➢ Crop failure	• Lack of drought tolerant varieties of sorghum, maize, millet	• Develop village seed banks with seeds of traditional and improved drought-resistant crops/varieties. • Develop drought-resistant crop varieties. • Ensure that appropriate crop seeds are in place before the rains.
	• Poor soil moisture management practices	• Improve soil-moisture management.
	• Rainfall failure	• Enhance weather monitoring and forecasting
	• Poor soils	• Avoid farming on marginal soils
	• Human - Wild-life conflict	• Problem animal control • Make land-use compatible
➢ Lack of water for irrigation	• No dams	• Control siltation through land stabilization in catchment areas • Build more dams where appropriate
	• No canal distribution network	• Invest in canal networks for water transfer
	• Lack of rain-water harvesting	• Educate and introduce catchment-management practices
	• Lack of electricity	• Supply solar-power systems, • Extend access to national power grid
➢ Livestock deaths	• Lack of financial capital • Lack of drought tolerant breeds	• Provide adapted cattle breeds by means of subsidies • Train farmers to maintain livestock during times of drought • Consider suitable insurance scheme
➢ Lack of fodder	• Lack of fodder banks	• Promote new drought feed sources discovered by local farmers in recent droughts • Invest in woodland management for fodder • Encourage relief grazing arrangements with neighbouring areas • Establish community-based fodder banks • Offer training in fodder-storage practices • Offer training in better fodder-management practices

Drought impact	Root Causes	Possible Actions
Loss of income	• Lack of alternative livelihoods outside agriculture	• Provide training in alternative livelihood practices
	• Poor access to high value markets	• Provide market opportunities
Food shortages	• Market failure • Post harvest storage bottlenecks • Farmers sell little harvest to earn income for other needs	• Establish local buffer stocks of food (action needed by both the government and communities)
Loss of bio-diversity	• Recurrent droughts and heat stress	• Encourage community involvement in maintaining biodiversity
Stress	• Lack of local safety nets	• Promote culture of collective action

6.0 Conclusions

This report assessed the climate risk and vulnerability of crop and livestock production systems in Chiredzi district and possible climate change adaptation measures. The vulnerability analysis followed the IPCC (2001) conceptual framework which defines vulnerability as a function of adaptive capacity, exposure and sensitivity. Socio-economic factors of the district were included in developing the vulnerability indices. Thus, integrated vulnerability assessment approaches were adopted to combine biophysical and socio-economic indicators. Drought impact and root cause analysis was used to identify adaptation options for the project using a risk management framework.

Results show that drought is the main climatic hazard affecting Chiredzi district. The hazard exposure increases from north to south in sympathy with altitude. Community participatory drought risk analysis shows that the district is prone to early, mid-, terminal, seasonal and extreme droughts that can last for up-to four years in succession. A sample of small-holder farmers in the district ranked terminal, seasonal and the extreme drought types as the ones having the worst impacts on their livelihoods.

Sensitivity analysis on crops shows Chiredzi becoming unsuitable for maize, sorghum and cotton production under the worst climate change scenario where temperatures rise by upto 5°C and rainfall declines by about 50% by 2050. The best case scenario shows the whole district remaining suitable for the production of the three crops. For livestock, both goat and cattle production show high sensitivity to decline in rainfall and a rise in temperature projected under the worst case scenario.

Adaptive capacity across Chiredzi district for both crop and livestock production livelihood systems are shown to decrease from north to south. Vulnerability “hot-spots” are mainly concentrated in the southern sections of the district. Rainfed cropping systems and livestock production systems based on cattle were identified as the most vulnerable livelihood systems. Lack of access to markets, institutions, poverty, communication infrastructure (all-weather roads, bridges) and high frequency of drought were some of the main drivers of vulnerability identified.

Community participatory approaches are used to identify possible priority adaptation measures using the root cause analysis as a risk reduction identification framework. Priority adaptation measures identified for Chiredzi district are as summarized below.

- Agriculture
    - Develop village seed banks with seeds of traditional and improved drought-resistant crops/varieties.
    - Establish field schools for farmers.
    - Improve soil fertility and moisture management.
    - Ensure that appropriate crop seeds are in place before the rains.
    - Promote mulching practices so that the limited available soil moisture is saved during critical stages of crop growth.
    - Support irrigation development
    - Reducing human - wild-life conflicts

- Livestock production
    - Promote the rearing of goats and donkeys in areas where feed and water are scarce.
    - Promote rearing of drought-resistant local cattle breeds
    - Preserve endangered productive and drought-resistant local animal breeds.
    - Establish fodder banks at community/household level.
    - Make better use of natural fodder/grazing sources
    - Improve the quality and productivity of the existing livestock population,
    - Improve marketing of livestock, particularly small-stock
    - Grow seasonal grasses/perennial fodder trees in community forest, fallow lands, and permanent pastures.
    - Promote indigenous drought fodder such as zhombwe and other fodder trees discovered by local farmers in recent droughts
    - Construct rainwater-harvesting structures (mini-ponds, tanks).
    - Improve veterinary services

- Livelihood strategies
    - Support and protect livelihoods and livelihood diversification (carpentry, shops, handicraft, etc.), so that people have a safety net to rely on during all stages of drought.
    - Establish/strengthen micro-credit systems.
    - Strengthen social networks
    - Consider alternative landuse options such as wild-life farming
- Water use
    - Encourage rainwater harvesting (e.g. roof-top rainwater harvesting).
    - Install water pumps

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