MULTI-HAZARD RISK ASSESSMENT REPORT

For the project

Enhancing Community Resilience and Sustainability (ECRAS) in Chiredzi and Mwenezi Districts

Prepared for:

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Executive Summary

Background and Context

Small-holder farming communities in Chiredzi and Mwenezi districts operate in an environment characterised by low and erratic rainfall. As a result, the risk of crop failure is quite high. Owing to constraints to development posed by the harsh biophysical environment, limited access to markets as well as poor financing, the two districts have some of the highest rates of poverty prevalence in the country. Consequently, the occurrence of climate-related shocks such as drought and other stresses tend to wipe out development gains achieved during 'normal' years. Against this background, this report presents findings of a multi-hazard risk assessment undertaken in Chiredzi and Mwenezi districts to inform evidence-based decision making on what needs to be done to enhance the resilience of communities. Building the resilience of communities in these semi-arid districts is critical to enable the communities to sustain development gains and achieve improved well-being in the face of shocks and stresses. This goal is at the core of the nationwide project titled "Enhancing Community Resilience and Sustainability" (ECRAS) supported by the Zimbabwe Resilience Building Fund (ZRBF). In Chiredzi and Mwenezi districts, ECRAS has targeted 47,000 beneficiaries.

The specific objectives of the multi-hazard risk assessment were to:

- Establish and understand the context for the two districts (Mwenezi and Chiredzi);
- Develop detailed hazards and risks profiles in the targeted 29 wards of the two districts;
- Undertake a capacity gaps analysis and identification of indicators of Disaster Risk and Risk Management;
- Identify priority problems in the targeted wards of the two districts;
- Prepare hazard and risk maps for the rural areas of the two districts;
- Carry out a detailed assessment of the two districts institutional capacity to manage the identified risks, including doing a review of the legal framework and practice;
- Conduct a Household Livelihoods Security Assessment covering the two districts; and
- Make recommendations to ECRAS and the key stakeholders based on identified range of options for managing the identified risks in a sustainable way.

Methodology

Qualitative methods

To achieve the stated objectives and produce a balanced report a mixed methodological approach was adopted. First, a multi-stage stratified random sampling procedure was used to select ten wards participating in the ECRAS project for detailed assessments. The sampled Chiredzi wards were: wards 1, 6, 10, 14, 22 and 23. The sampled Mwenezi wards were: ward 1, 5, 9 and 12. Then in each selected ward, community meetings were organised to ascertain which hazards the community perceived as the most destructive and therefore significant. The meetings also aimed at identifying priority problems and adaptation options in the face of multiple hazards as well as to explore copying mechanisms. A total of 191 community members participated in these meetings in Chiredzi and 93 in Mwenezi. Prior to the plenary meetings, participants were divided into four focus groups based on gender to maximise participation. These were women, men, young women and young men. Separate focus group discussions (FGDs) were then held with these groups. During the plenary, participants were asked to rank the most important climatological, meteorological, biological hazards as well as any other problems threatening their livelihoods.

A total of 14 key informant interviews (KIIs) were also conducted in the sampled wards. KIIs targeted traditional leaders, AGRITEX, Veterinary Department, Livestock Production and Development, Religious leaders, health personnel and education personnel. To complement these methods, a household survey was conducted. A structured questionnaire targeting household heads was administered. The questionnaire solicited for information on household characteristics and demographics, livelihood strategies as well as the vulnerability and resilience of the household to climate-related shocks and disasters. In Chiredzi, a total of 195 respondents were interviewed at household level. The number of respondents was 152 in Mwenezi district. Frequency counts, cross tabulations and descriptive statistics were generated in search of patterns in the responses while comparison of proportions based on the z-test was performed to test whether sex had a significant effect on ownership of and control of assets.

Statistical analyses of risks

After engaging the communities to identify priority hazards the following methods were used to calculate and map hazards. The aim was to show spatial variations in risk within and across all ECRAS wards. The frequency, magnitude, and duration of meteorological droughts were assessed using the standardised precipitation index (SPI). To characterise agricultural drought, the normalised difference vegetation index (NDVI) was first computed from SPOT VGT satellite imagery covering the period 1998 to 2016. The output NDVI maps were then used to calculate a drought index called the Vegetation Condition Index (VCI). All grid cells with a VCI threshold value of 35% or less were classified as affected by extreme drought in a given period. Point maps showing occurrence of FMD and lumpy skin were produced using GIS to show spatial variations of disease outbreaks in cattle. To assess the flood hazard, four variables influencing the probability of flooding namely slope angle, topographic wetness index, distance from the river channel and height above channel were assembled and stacked in a GIS using the weighted index overlay techniques.

In this assessment, risk was defined as the probability of harmful consequences, or expected losses (that is, deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between (natural or human-induced) hazards and vulnerable conditions in a given area and time period. Therefore, risk was calculated as the product of hazard exposure and vulnerability.

To assess risk, poverty prevalence rate extracted from the Zimbabwe Poverty Atlas was used as a proxy for vulnerability based on the rationale that poverty is positively related with vulnerability. After calculating hazard risks separately, the output risk maps were added together and divided by the maximum value to normalise them so that multi-hazard risk ranged between 0 and 1. All calculations were done in a GIS environment using the ward as the spatial unit of analysis to match the scale at which poverty prevalence rate was mapped.

Main findings

The results indicate that drought was consistently ranked by the communities as the top priority hazard in all the sampled ECRAS wards in Chiredzi and Mwenezi districts. Results of statistical analyses of long-term monthly rainfall data for Buffalo Range Station in Chiredzi as well as satellite data confirmed high frequency of occurrence of meteorological and agricultural droughts throughout the two districts. This implies high exposure of the communities in the ECRAS wards to drought.

At household level, heat waves, livestock diseases, strong destructive winds, and floods ranked among top five hazards but their relative ranking differed across the ten sampled wards. Long-term daily maximum temperature for the month of October indicated high exposure of communities in Chiredzi to heat waves especially during the hot dry season. The high prevalence of livestock diseases of economic importance to households such as foot and mouth disease (FMD) was also revealed and mapped throughout the ECRAS wards. The probability of flooding was also found to be high (>50%) for riparian

communities in wards 1, 3, 5, 6, and 25 of Chiredzi. In Mwenezi, communities in wards 3, 5, 7 and 9 were exposed to a higher flood risk than those in non-riparian wards. The result for the multi-hazard risk assessment indicated that wards 13, 14, 15 and 22 of Chiredzi had the highest multi-hazard risk owing to high poverty prevalence. By contrast ward 6 had the lowest overall risk. For Mwenezi, wards 5 and 8 stood out as facing extremely high multi-hazard risk followed by wards 2, 7 and 9, which were classified in the very high multi-hazard risk category.

The other ancillary findings show widespread food insecurity as well as differences in ownership and control of assets between men and women. The results for differences in literacy rates between men and women as well as in the quality of living conditions are also provided at ward level in the report. The rationale for providing these findings is to lay the basis for gender-sensitive recommendations aimed at building overall community resilience to multiple shocks.

Conclusion and recommendations

Overall, the findings of this assessment demonstrated that the communities in Chiredzi and Mwenezi have high exposure to natural shocks such as drought, floods, and disease outbreaks that are occurring with high frequency. The interactive effects of high poverty prevalence, widespread food insecurity, strong dependence on rain-fed agriculture and natural resources as well as limited access to markets and finance contribute to the high vulnerability of communities to hazards observed in all the sampled wards. In light of this conclusion, the following major recommendations were made to help build community resilience, reduce exposure to and sensitivity of communities to hazards.

To transform the adaptive capacity of the farming communities in the light of frequent droughts, it is recommended that farmers in all the ECRAS wards working with resident AGRITEX officers stagger planting dates to minimise the risk of crop failure in the event of drought. Diversifying crop varieties and types in favour of production of more drought-tolerant varieties/types is necessary to enhance resilience of the current rain-fed crop production system to drought. AGRITEX, ICRISAT and other institutions could play a leading role to implement these recommendations.

As a the long-term intervention measure, it is recommended that existing small-scale irrigation schemes be expanded. At the same time, new irrigation schemes need to be established. It is however more economical to resuscitate existing irrigation schemes that are not functional than set up new ones as this entails investment in water resources development that include building new dams. Irrigation has the potential to build the adaptive capacity of the small-holder farming communities in Chiredzi and Mwenezi to drought as reliance on rain-fed agriculture exposes the communities to negative impacts of drought. If implemented, irrigation would serve the dual role of reducing dependence on rain-fed agriculture thus building overall community resilience to drought while simultaneously improving food security.

With regard to livestock, in particular cattle and goat production, improving the hardiness of existing local breeds to drought is a vital long-term strategy that is recommended to the ECRAS project. To achieve this, bulls and bucks (uncastrated male goats) that survive extreme droughts such as the 1991-92 drought must be identified first. These hardy adapted animals are then selected and bred on account of their high survivability and adaptation to multiply their desirble genes. The current widely used intervention strategy involving supplementary feeding of cattle in drought years is expensive and not sustainable as it results in the perpetuation of less adapted cow and doe (female goat) lines. The Livestock Production and Development Division (LPD) could play a coordinating role in line with its official mandate to improve the livestock sector.

The result of the multi-hazard assessment also uncovered high prevalence of vector-borne and tick-borne

disease among cattle. To increase the resilience of livestock to these shocks, careful selection of animals with high parasite resistance is a recommended long-term intervention strategy for the ECRAS project. This recommendation is underpinned by scientific research that has demonstrated that disease and parasite resistance is highly heritable. However, for tick-borne diseases such as heart water and red water, regular dipping and annual vaccination using combo vaccines should remain the cornerstone of a viable disease control strategy. The Departments of Veterinary Services as well as LPD could coordinate the implementation of this recommendation for ECRAS.

From the general livelihood calendars prepared from information gathered during the household survey, strong dependence on farm income and natural resource was deduced in all the sampled ECRAS wards. This strong dependence entails high exposure of communities to shocks. Thus, to reduce the sensitivity of households and communities to shocks, the household income earning options must be widened and diversified. The recommended intervention to achieve this is to diversify the income base. To this end, access to credit loans (capital) is critical. Out of the many different models in micro-credit provision that exist, indigenously run village savings and lending (VSL) groups that do not depend heavily on the continued involvement of NGOs for their sustainability are recommended for the ECRAS project. The membership to such groups need not be restricted to women but should also accommodate men as well as the youth who are projected to constitute at least 25% of the project beneficiaries. With increased access to credit, several non-farm income earning projects could be pursued.

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Abbreviations and Acronyms

CBO	Community Based Organisation
CVCA	Climate vulnerability and capacity analysis
ECRAS	Enhancing community resilience and sustainability
FGD	Focus group discussion
FMD	Foot and mouth disease
GIS	Geographic Information System
GPS	Global Positioning System
HLSA	Household Livelihood Security Assessment
KII	Key Informant interview
NDVI	Normalised Difference Vegetation Index
NGO	Non-Governmental Organisation
PSP	Participatory Scenario Planning
SPSS	Statistical Package for Social Sciences
VCI	Vegetation Condition Index
ZimASSET	Zimbabwe Agenda for Sustainable Socio-Economic Transformation
ZRBF	Zimbabwe Resilience Building Fund

1.0. General Introduction

1.1. Introduction

All human communities face hazards but the ability to withstand, cope and recover from the impact of hazards varies in space and over time. In recent years, it has been observed that both the frequency and the magnitude of natural disasters such as extreme droughts and floods have increased due to climate change (IPCC, 2007). Widespread poverty, weak road infrastructure and extreme weather events interact in a complex way to enhance the vulnerability of populations to disasters. In Zimbabwe, communities located in the driest and peripheral districts such as Chiredzi and Mwenezi fall under agro-ecological region V characterised by low and erratic rainfall (Vincent and Thomas 1960) with high risk of crop failure. In order to enhance the resilience of communities to sustain development gains and achieve improved well-being in the face of shocks and stresses, be they natural or anthropogenic in origin, multi-hazard risk analysis is a pre-requisite. In the light of the observed increases in the co-occurrence of several hazards affecting the same community, the traditional approach to risk analysis targeting one hazard and specific elements is no longer sufficient. A multi-hazard risk analysis framework grounded in social theory and underpinned by scientific research has emerged as a promising approach to tackle hazards and enhance community resilience.

Throughout this report, a hazard is defined as any potentially damaging physical event such as drought or human activity such as traffic accidents that may cause loss of life or injury, property damage as well as disrupt the social and economic well-being of people (UNICEF 2013). In this report, a mixed methods approach involving careful blending of qualitative and quantitative techniques was followed to achieve a comprehensive assessment of the hazards, vulnerabilities and capacities of communities in Chiredzi and Mwenezi districts. An over-arching feature of the methodology was integration of indigenous knowledge systems with solid scientific research in order to generate multi-hazard risk maps that underpin evidence-based decision making and leads to solutions most likely to be adopted and adapted by the community based on local needs and conditions.

1.4. Context and brief background of the project

The security of livelihood system of small-holder farming communities in the semi-arid districts of Chiredzi and Mwenezi districts of Zimbabwe is threatened by various stressors and shocks such as climate change, recurrent droughts as well as outbreaks of diseases of economic importance such as foot and mouth (Scoones and Wolmer. 2007). In addition, the persistent economic hardships of the last decade have significantly reduced the resilience of communities in these districts where rain-fed agricultural production is the mainstay of peoples' livelihoods. These stressors alone and in combination, undermine the resilience of these marginalised communities to cope with shocks. In the end, the communities in these water-limited districts with a harsh climate often fail to sustain development gains. While progress has been achieved with regard to establishment of irrigation schemes to boost agricultural production, most of the irrigation schemes such as Chilonga in ward 6 of Chiredzi are not fully operational. Besides, the number of beneficiaries has been limited to those riparian communities which are located adjacent to major rivers. Thus to increase the capacities of communities in Chiredzi and Mwenezi districts to sustain development gains and achieve improved well-being in the face of various shocks and stresses, a consortium comprising CARE International in Zimbabwe, Plan International and ICRISAT is implementing a 3-year project titled: Enhancing Community Resilience and Sustainability (ECRAS) project in Chiredzi and Mwenezi Districts.

In order to ensure the success of this project within the national development priorities as outlined in ZIMASSET, a multi-hazard risk assessment was undertaken. One of the key milestones of this assessment was the production of multi-hazard risk maps for the all the 17 targeted wards in Chiredzi

district and 12 wards in Mwenezi district. The target wards are all located in communal land where the risk of crop failure is high due to erratic rainfall and unpredictable shifts in the start and end of the growing seasons attributed to climate change. Due to the erratic nature of rainfall, livestock production, in particular cattle and goats, is one of the mainstays of the livelihoods of these communities. However, the recurrence of diseases of public and economic importance such as foot and mouth disease (FMD) results in the imposition of movement restrictions of cattle. Such a ban this cripples trade in livestock (cattle) and this reduces farm income.

Outbreaks of FMD cripple the local beef economy and wipe out the export market for beef. In recent years, FMD outbreaks have become more frequent in Zimbabwe (Scoones and Wolmer 2007). In Chiredzi and Mwenezi districts, during severe drought such as the recent 2015-2016 drought, forced many farmers to move their cattle into protected areas such as national parks in search of forage. This inevitably resulted in the mixing of cattle and buffalo especially at water points (Miguel et al. 2013) thus contributing to high recent outbreaks of FMD in the two districts.

1.5 Purpose, Objectives and Scope of the multi-hazard analysis

The eight specific objectives of the multi-hazard risk assessment were to:

- Establish and understand the context for the two districts (Mwenezi and Chiredzi);
- Develop detailed hazards and risks profiles in the targeted 29 wards of the 2 districts;
- Undertake a capacity gaps analysis (this will include hazard identification with historical and probabilistic analysis and preparation of an inventory and categorisation of key elements that are exposed as well as vulnerability analysis together with risk assessment) and identification of indicators of Disaster Risk and Risk Management;
- Identify priority problems in the targeted wards of the two districts using CARE's Climate Vulnerability and Capacity Analysis (CVCA) tool;
- Prepare hazard and risk maps for the rural areas of the two districts;
- Carry out a detailed assessment of the two districts institutional capacity to manage the identified risks, including doing a review of the legal framework and practice;
- Conduct a Household Livelihoods Security Assessment covering the two districts; and
- Make recommendations to ECRAS and the key stakeholders based on identified range of options for managing the identified risks in a sustainable way.

2. Methodology

2.1 Description of study sites

The multi-hazard risk assessment was conducted in Chiredzi and Mwenezi districts during the months of November and December in 2016. A total of 29 wards were selected to participate in the ECRAS project on the basis that they all had communal land use type and were characterised by high poverty prevalence (>75%)1. This economic situation makes these communal wards the most vulnerable to the impact of shocks and stress in the two districts. Seventeen of these wards were in Chiredzi district while 12 were located in Mwenezi district. Figure 1 shows the distribution of these target communal wards in the two districts.

It can be observed in figure 1 that some wards, for example wards 6, 7, 8 and 9 of Mwenezi district are adjacent to perennial rivers (riparian). In contrast, other wards, for example, wards 11 and 12 in the

[1] Zimbabwe Poverty Atlas 2015

same district are non-riparian. The same pattern can be observed in the target wards of Chiredzi district. Since water is one of the key resources limiting agricultural production in both Chiredzi and Mwenezi districts, access to surface water was one of the criteria used to select a representative sample of wards for the multi-hazard risk assessment.

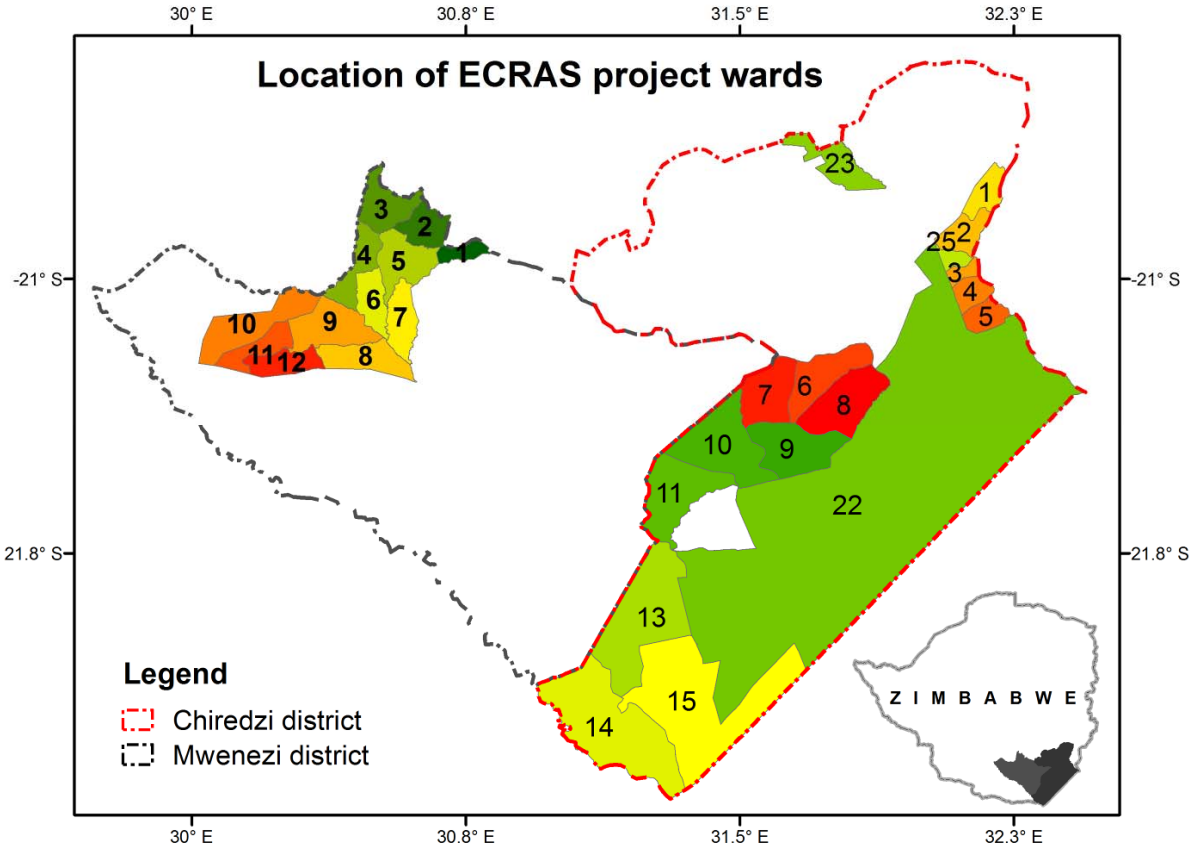


Figure 1: Distribution of ECRAS wards in Chiredzi and Mwenezi districts in southern Zimbabwe.

Table 1 presents the main demographic, biophysical and socio-economic characteristics of 17 Chiredzi wards participating in the ECRAS project. The similarity in the soil type and vegetation characteristics is evident. All the 17 Chiredzi wards are characterised by a high proportion of households classified as poor in the recent Zimbabwe Poverty Atlas of 2015. The climate is arid and small-holder farmers in these rural wards operate in agro-ecological region V characterised by low erratic rainfall (Vincent and Thomas 1960). The vegetation is dominated by *Colophospermum mopane* woodlands. The dominant soils in the ten of the 17 Chiredzi ECRAS wards are fertile pale-brown deep clay soils derived from calcium-based parent material (see Table 1). These vertisols have a high clayey content and are irrigable (Nyamapfene 1991).

Table 1: Main demographic and physiographic characteristics of ECRAS wards in Chiredzi

Ward number	Area (ha)	Total human population	Total number of households	Number of poor households	Number of dams	Agro-ecological region	Dominant soils	Major vegetation formations
1	10,667	4,165	945	756	0	V	Luvisols	*Senegalia nigrescens-Combretum*; *Terminalia sericea*
2	12,253	3,950	870	699	0	V	Luvisols	*Senegalia nigrescens-Combretum*; *Colophospermum mopane*
3	4,257	3,626	806	590	0	V	Vertisols, Luvisols	*Senegalia nigrescens-Combretum*; *Colophospermum mopane*
4	8,374	5,573	1,282	907	0	V	Vertisols	*Senegalia nigrescens-Combretum*; *Colophospermum mopane*
5	9,209	3,975	898	705	0	V	Vertisols	*Senegalia nigrescens-Combretum*; *Colophospermum mopane; Terminalia sericea*
6	24,234	3,067	862	211	0	V	Vertisols	Shrubby *C. mopane*; *Vachellia nilotica*, *V. karroo*, *V. rehemanniana-Albizia-Bolusanthus*
7	25,258	7,710	1,535	1,196	0	V	Vertisols	Shrubby *C. mopane*; *Vachellia nilotica*, *V. karroo*, *V. rehemanniana-Albizia-Bolusanthus*
8	32,240	7,840	1,612	1,307	0	V	Vertisols	Shrubby *C. mopane*; *Vachellia nilotica*, *V. karroo*, *V. rehemanniana-Albizia-Bolusanthus; Terminalia sericea*
9	31,902	3,556	656	559	0	V	Vertisols	Shrubby *C. mopane*; *Terminalia sericea*
10	43,906	9,890	1,928	1,552	0	V	Vertisols	Shrubby *C. mopane*; *Terminalia sericea*
11	35,921	11,398	2,303	1,790	2	V	Vertisols	Shrubby *C. mopane*;
13	66,034	4,074	825	717	2	V	Lithosols	*C. mopane*; *Terminalia sericea*
14	79,103	8,314	1,758	1,499	0	V	Luvisols, Cambisols, Vertisols	*C. mopane*; *Terminalia sericea*
15	99,961	7,935	1,621	1,361	3	V	Vertisols, Lithosols, Cambisols	*C. mopane*; *Terminalia sericea*
22	572,230	6,243	1,356	991	1	V	Arenosols, Lithosols, Vertisols and Cambisols	*C. mopane*; *Terminalia sericea*
23	19,049	5,331	1,103	811	1	IV/V	Luvisols	*C. mopane*
25	4,282	2,945	652	488	0	V	Vertisols, Luvisols	*C. mopane*

Information on vegetation was extracted from Wild and Barbosa (1967); demographic data were extracted from 2012 ZIMSTAT census reports. Dams were mapped through on-screen digitizing using the recent Landsat 8 imagery as the base layer.

Data in table 1 suggests that the physical characteristics in the Chiredzi ECRAS wards present constraints as well as opportunities for increasing the resilience of small-holder farming communities to hazards in the wards. For example, the widespread occurrence of irrigable vertisols offers an opportunity to the ECRAS project to expand small-scale irrigation schemes and create new ones as a key strategy to copying with climatic shocks such as drought. It has to be emphasised that the major factor constraining crop production in the project wards is low and erratic rainfall. Hence, establishment of new irrigation schemes, rehabilitation or expansion of existing ones have the potential to enhance community resilience to climate-related shocks by reducing dependence on rain-fed agriculture.

The vegetation in the ECRAS wards is dominated by *C. mopane* woodlands. These woodlands support the caterpillar of the emperor moth (*Imbrasia belina*). The caterpillars (mopane worm) are a rich source of protein and income for rural farmers. Hence, a proper value-chain analysis needs to be undertaken to assess how the communities can exploit this resource and market it efficiently to boost household income and increase their resilience to economic shocks.

Table 2 summarises soil and vegetation characteristics of the ECRAS wards in Mwenezi district. The soils in the project wards are dominated by granite-derived sandy soils with low inherent fertility known as Lithosols. Most project wards belong to agro-ecological zone V but some parts of wards 3, 4, 7, and 9 are located in agro-ecological region IV, which is wetter. This explains differences in the vegetation types with wards located in northern areas being dominated by miombo woodland whereas those wards in the eastern and southern areas are dominated by *C. mopane*. The high prevalence rate of poverty is a characteristic feature of all the ECRAS wards in Mwenezi as evidenced a high number of households classified as poor in the last census report (Table 2).

Table 2: Main demographic and physiographic characteristics of ECRAS wards in Mwenezi

Ward number	Area (hectares)	Total human population	Total number of households	Number of poor households	Number of dams	Agro-ecological region	Dominant soils	Main vegetation types
1	6,503	5,467	1,214	917	2	V	Lithosols and Luvisols	*Brachystegia spiciformis* and *Julbernardia globiflora* woodland; *Colophospermum mopane* woodland
2	13,752	5,135	1,051	870	3	V	Lithosols and Luvisols	*Brachystegia spiciformis* and *Julbernardia globiflora* woodland
3	19,007	7,807	1,602	1,294	4	IV/V	Luvisols	*Brachystegia spiciformis* and *Julbernardia globiflora* woodland
4	16,197	5,500	1,192	962	6	IV/V	Lithosols and Luvisols	*Brachystegia spiciformis* and *Julbernardia globiflora* woodland
5	21,635	9,757	2,105	1,613	10	V	Luvisols	*Brachystegia spiciformis* and *Julbernardia globiflora* woodland; *Colophospermum mopane* woodland
6	13,642	4,236	838	727	5	V	Lithosols	*Brachystegia spiciformis* and *Julbernardia globiflora* woodland
7	15,793	6,138	1,248	1,072	7	IV/V	Luvisols	*Colophospermum mopane* woodland
8	19,643	6,538	1,268	1,099	7	V	Luvisols	*Colophospermum mopane* woodland
9	26,438	6,797	1,394	1,217	11	IV/V	Lithosols	*Colophospermum mopane* woodland
10	29,589	7,468	1,466	1,247	14	V	Lithosols	*Colophospermum mopane* woodland
11	13,341	6,112	1,225	1,075	9	V	Lithosols	*Colophospermum mopane* woodland
12	13,768	5,115	998	895	12	V	Lithosols and Luvisols	*Julbernardia globiflora* &; *Colophospermum mopane* woodlands

Information on vegetation was extracted from Wild and Barbosa (1967); demographic data were extracted from 2012 ZIMSTAT census reports. Dams were mapped through on-screen digitizing using the recent Landsat 8 imagery as the base layer.

In contrast to vertisols that are fertile, the Luvisols that characterise Mwenezi ECRAS wards are typically coarse sandy soils of poor fertility (Nyamapfene 1991). Luvisols are also prone to chemical and physical degradation hence rehabilitating degraded fields may be the key to increasing crop productivity in Mwenezi. A widely used programme to achieve this is integrated fertility management involving consistent use of locally available indigenous legumes, manure, liming and multi-nutrient mineral fertilisers and woodland litter (Mapfumo et al. 2005). In wards 1, 2, 3, 4, 6 and 12 with miombo vegetation, the litter could be collected from under the canopies of *Brachystegia spiciformis* (Msasa) and *Julbernardia globiflora* (Mnondo) as these species shed copious amounts of litter in winter.

Table 2 indicates that all the ECRAS wards in Mwenezi have at least one small-scale dam with wards 5, 9, 10 and 12 having ten or more dams. While siltation of dams is prevalent, these dams are an important source of water for livestock. The dams also present an opportunity to establish vegetable gardens to meet the household's nutritional needs as well as serve the local market as a way to diversify the household income base. To implement a similar strategy in Chiredzi, investment in groundwater is necessary since the ECRAS wards in Chiredzi have few dams and most have no dam at all (see Table 1).

2.1.1. Selection of wards for detailed assessments

Ten wards were selected following a multi-stage stratified random sampling procedure for fieldwork. Figure 2 shows the distribution of the sampled wards. To select the representative sample of wards in Mwenezi, all the 12 target wards were first classified into one stratum if they belonged to the same agro-ecological zone as illustrated in figure 2. Wards 8, 10, 11 and 12 belong to agro-ecological zone V hence they experience drier conditions than other wards (Vincent and Thomas, 1960). As a result, they were assigned to one cluster whereas those belonging to agro-ecological zone IV were grouped into the second cluster. Within each cluster, wards that are riparian (adjacent to major rivers) were further subdivided into one sub-cluster and those that are non-riparian formed the second sub-cluster. After this stratification, simple random sampling was then used to select the sampled wards shown in figure 2.

For Chiredzi, since all the wards belong to agro-ecological region V hence ward selection proceeded as follows. Wards with communal land use were assigned to three strata (western, central and southern cluster) based on their geographical proximity. For instance, wards 1, 2, 3, 4, 5, and 25 are adjacent to each other. Hence, they were assigned to the western cluster. It was assumed that the socio-economic processes and the biophysical factors that influence vulnerability of communities to shocks and stresses are likely to be similar the closer in geographical space the wards are. Next, those wards in a given cluster were assigned to two sub-clusters to distinguish those that are riparian from the riparian ones. After this multi-stage stratification, the sample wards were selected without bias using a random number generator.

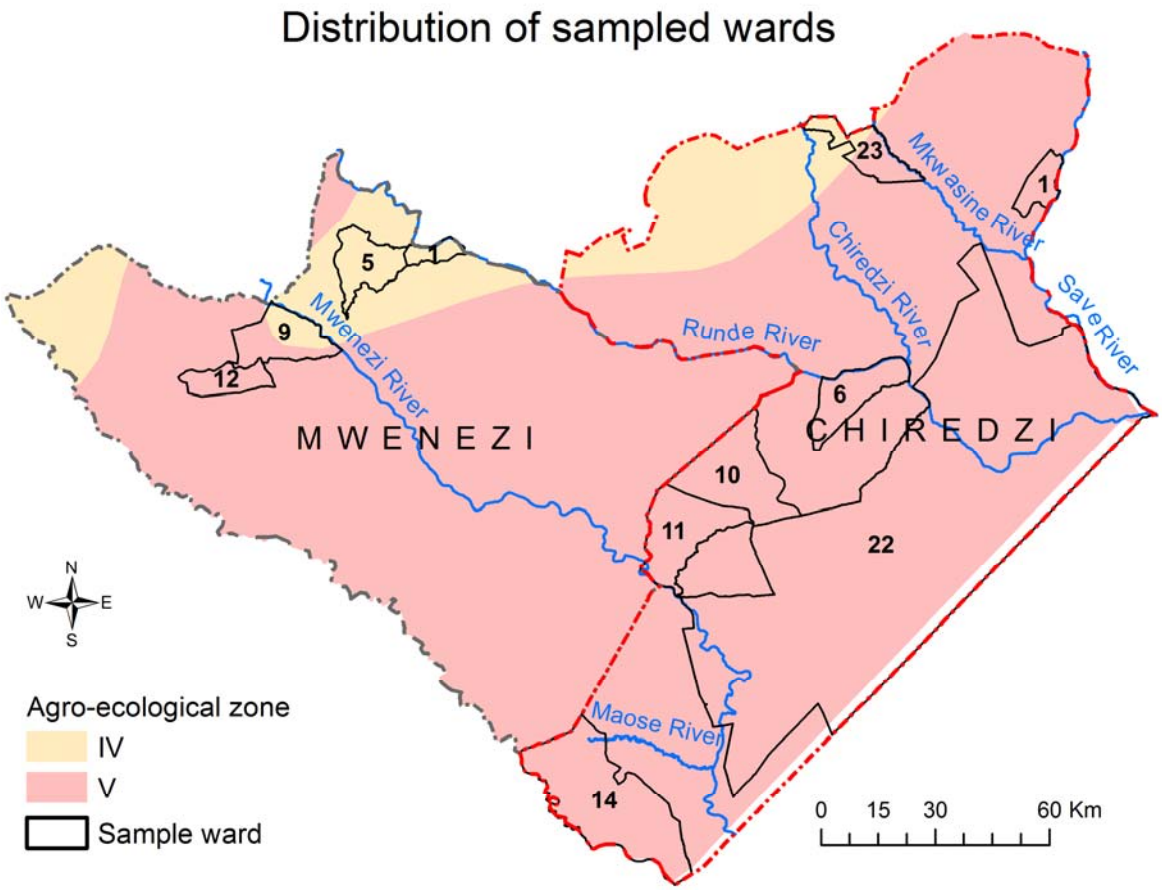


Figure 2: Map of sampled ECRAS wards for the multi-hazard risk assessment. Major dams and perennial rivers are overlaid to distinguish wards with greater access to surface water from those with less access.

2.2 Qualitative approaches

2.2.1 Focus group discussions (FGDs)

In each selected ward, a series of meetings were organised to ascertain which hazards were perceived by local communities as the most important. The meetings were also aimed at identifying priority problems and adaptation options in the face of multiple hazards. The total number of community members who participated in these meetings was 191 in Chiredzi and 93 in Mwenezi. At each meeting, the community was divided into four groups based on gender to maximise participation. These were women, men, young women and young men. The fifth group comprised key informants who included local councillors, church leaders, AGRITEX staff, village heads and school heads among others. Members of this group were separated from the four groups to guard against dominance and to avoid introduction of bias during group discussions (Rurinda et al. 2014). Two researchers skilled in participatory approaches conducted focus group discussions (FGDs) with the four main gender groups to gauge community perceptions and understand existing priority hazards, problems and copying mechanisms. During the plenary, participants were asked to:

- Rank the most important climatological, meteorological, biological and any other problems threatening their livelihoods;

- Indicate the most destructive hazards from the list they provided;
- Describe which hazards affect women more than men;
- List hazards likely to recur in the next 12 months;
- Describe how and give reasons as to whether the hazards were likely to change over time as a result of other stressors like climate change;
- Agree on key indicators of vulnerability such as loss of cattle; and
- Describe the current adaptation options and copying mechanisms including 'social' nets.

Due care was taken to ensure consensus was reached during the plenary. For female groups, a female researcher and female note taker facilitated the discussion to make sure that the qualitative assessment voiced the actual and unbiased perceptions of female beneficiaries. The same approach was used for male groups.

2.2.2 Key Informant Interviews (KIIs)

Individual interviews were also conducted with key informants. The KIIs addressed the same issues addressed during community meetings but in greater depth. A total of 14 KIIs were conducted over a two week period. KII targeted included traditional leaders, AGRITEX, Veterinary Department, Livestock Production and Development, Religious leaders, health personnel and education personnel. Eight KIIs were conducted in Mwenezi and six in Chiredzi with stakeholders from government departments such as health, agriculture, mechanisation, education as well as small and medium enterprises.

2.3 Quantitative approaches

2.3.1 Household survey

A household survey was also conducted concurrently with 347 respondents for household livelihood security assessment. Based on the existing register provided by Plan International, respondents were divided into three strata indicating their participation status in the ECRAS project. The three strata were model households, participating households and non-participating households. To select respondents, villages participating in the ECRAS project were first selectedg using a simple random sampling procedure. Then, household heads were selected for interviews again following a stratified random sampling technique. A structured questionnaire was the main research tool used for the household survey.

In Chiredzi district, a total of 195 households were interviewed in wards 1, 6, 10, 14, 22 and 23 participating in the ECRAS project. The sample size was 48, 40, 19, 23, 22 and 43, respectively. Thirty respondents were selected from model households split 50-50 based on sex. Participating households constituted 30 % of the total sample (n = 59) since they were fewer than non-participating households. Half of the households interviewed were non-participating households whose views were gathered to be compared to those of participating households. Figure 3 illustrates that men constituted the larger component of the respondents in all the six sampled ECRAS wards in Chiredzi. This skewed distribution in the sex of respondents implies a patriarchal community since respondents were drawn at random from a list of registered and non-registered households in the wards.

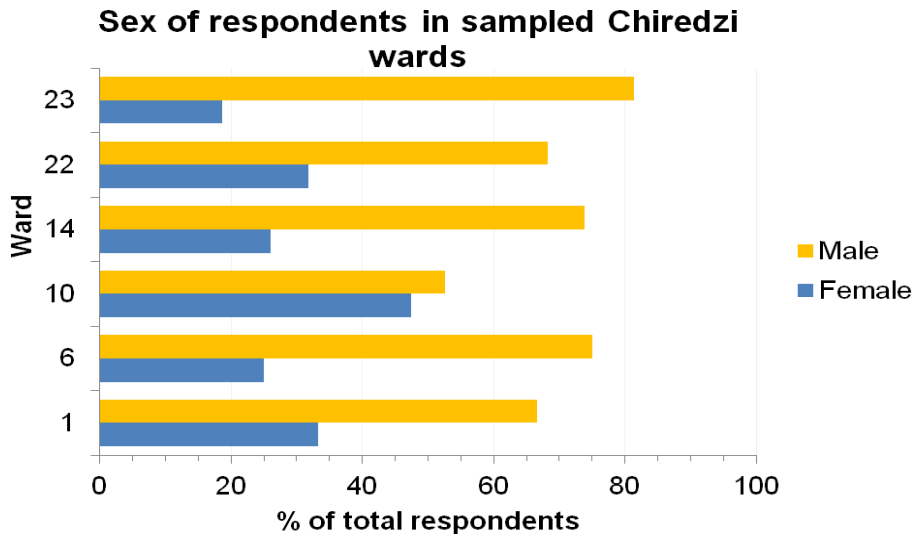


Figure 3: Distribution of respondents by sex in sampled Chiredzi ECRAS wards.

A total of 152 respondents were interviewed at household level in wards 1, 5, 9 and 12 all of which participate in the ECRAS project in Mwenezi district. The sample size was 32 each for wards 1 and 5 and 44 each for wards 9 and 12. Model households constituted 20 % of the total sample (n = 30). Other participating households constituted 48 % of the total sample (n = 72). The remainder (32 %) were non-participating households who were the largest group in all the wards. Figure 4 shows the distribution of respondents by sex. There were more male-headed households than female-headed households in the sampled wards. This suggests a patriarchal community.

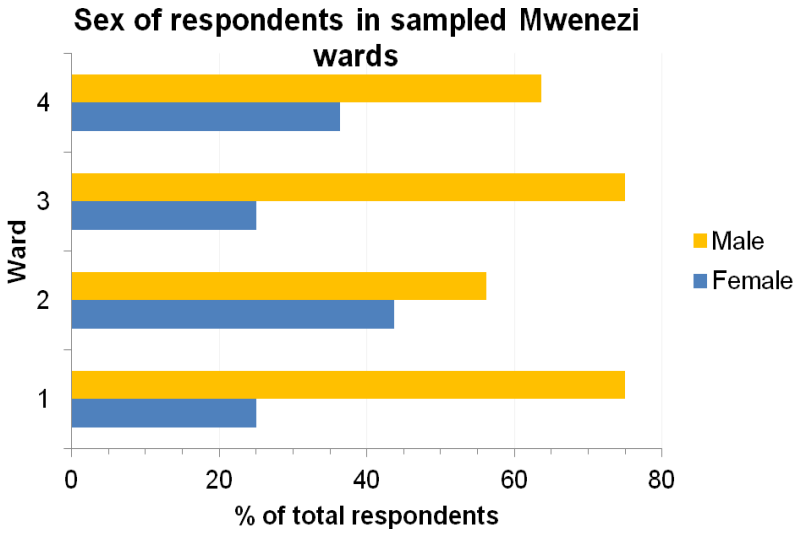


Figure 4: Distribution of respondents by sex in sampled Mwenezi ECRAS wards.

In all the sampled wards, household heads were interviewed by trained enumerators at their 'normal' residences to allow enumerators to make direct observations. A structured questionnaire was administered to solicit for information on household characteristics and demographics, household livelihood strategies as well as the vulnerability and resilience of the household to shocks such as

extreme drought. All responses were coded and inputted into SPSS, cleaned and analysed. Frequency counts, cross tabulations and descriptive statistics were generated in search of patterns in the responses. Non-parametric methods, in particular the z-test were used to test whether sex had a significant effect on ownership of physical assets (resource endowments). No distinction was made between *de-facto* female-headed and widowed female-headed households during the statistical analyses. For all statistical analyses, $P < 0.05$ was used as the cut-off value indicating statistical significance.

2.4 Pilot testing

Prior to conducting community meetings and the main household survey, a pilot study was undertaken in ward 11 of Chiredzi district to pre-test all data collection tools. Plate 1 shows community members in ward 11 who were gathered to pre-test the research instruments.

Plate 1: Ward 11 community members participating in pre-testing of data collection tools. Notice how the members were seated separately in line with their culture. The right panel shows a household head being interviewed by a trained enumerator to pre-test the structured questionnaire.

Two FGDs were held with members to fine-tune the discussion guidelines. The groups were disaggregated by sex prior to discussions. For the household survey, 11 questionnaires were administered. Six of the households were female-headed. The remainder were male-headed. Following completion of the pilot survey, the questions were revised and those considered redundant removed.

2.5 Hazard modelling and multi-hazard risk analysis

The results from the household survey, FGDs, and KIIs which identified drought, extreme high temperatures (heat waves), livestock diseases, and floods were used to guide scientific assessment of hazard frequency, magnitude and risk in the project wards. For drought assessment, multi-temporal SPOT Vegetation satellite imagery for the period 1998 to 2016 were used to map agricultural drought using a drought monitoring system developed at the University of Zimbabwe. Monthly total rainfall data for Buffalo Range Station for the years 1966 to 2014 was used to detect meteorological droughts. The standardised precipitation index was computed from the data to quantify meteorological droughts (Keyantash and Dracup 2002). For detecting heat waves, daily maximum temperature for Buffalo Range Station for the month of October was used. Only the data for Buffalo Range Station was used since other stations lacked long-term meteorological data needed to calculate the long-term average, which forms the basis for detection of anomalies. Livestock disease risk mapping was based on geo-referenced cattle disease incidence data provided by the Department of Veterinary Services in Harare.

2.5.1 Meteorological drought

The frequency and magnitude of meteorological drought were assessed using the standardised precipitation index (SPI), which allows comparisons across sites (Tsakiris and Vangelis 2004). The time-scales for analysis were six and 12 months. Formally, SPI was computed as follows:

$$SPI = \frac{X_{ik-\bar{X}}}{\sigma_i} \qquad \text{(eqn. 1).}$$

where:

X_{ik} is the precipitation for the ith station and k^{th} observation;

$\bar{X}$ is mean precipitation for the ith station; and

σ_i is standard deviation for the ith station.

If the calculated SPI ≤ -2 it indicated an extreme drought, values between -1.99 and -1.5 indicated severe drought, those ranging between -1.49 and -1 indicated moderate drought whereas values in the range -0.99 and 0 represented mild drought (Keyantash and Dracup 2002).

2.5.2 Agricultural drought

To characterise agricultural drought, first the normalised difference vegetation index (NDVI) was computed from SPOT VGT data as shown in equation 2. NDVI was calculated as:

$$\text{NDVI} = (NIR - R)/(NIR + R) \qquad \text{(eqn. 2).}$$

where:

NIR is reflectance in the near infrared band of the electromagnetic spectrum while *R* is the reflectance in the red region. NDVI values below 0 indicated water while NDVI values above zero indicated different land surfaces from bare ground (0-0.1) to dense green vegetation (0.5-1). From NDVI - a dimensionless index which shows green vegetation density and vigour (Tucker, 1979) - a drought index called the Vegetation Condition Index (VCI) was then derived. Formally, VCI was calculated as:

$$\text{VCI}_i = 100\frac{\text{NDVI}_i - \text{NDVI}_{\text{min}}}{\text{NDVI}_{\text{max}} - \text{NDVI}_{\text{min}}} \qquad \text{(eqn. 3).}$$

where NDVI_i is the dekadal NDVI for the ith dekad (i.e., calculated for every 10 days), NDVI_{max} and NDVI_{min} are the absolute long-term maximum and minimum NDVI respectively calculated for each pixel and dekad from multi-year NDVI dataset. Following Kogan (1995), a VCI value of 35% or less was then used as the threshold for extreme drought. VCI values between 36-50% indicated moderate drought. Only the results for extreme drought are shown owing to their significant impacts of both crop and livestock production systems. VCI has been shown to explain variation in crop yield in response to drought under Zimbabwean climatic conditions hence its use for this assessment was deemed appropriate (Kuri et al. 2014, 2017).

2.5.3 Livestock diseases

Considering that livestock diseases ranked top among hazards threatening people's livelihoods, geo-referenced cases of disease incidence were obtained from the Department of Veterinary Services in Harare. This department is obligated by law to report and record all outbreaks. The data were reported at dip tank level. Point maps showing occurrence of FMD and lumpy skin were produced using standard functionalities in a computer-based geographic information system (GIS) to show spatial variations of disease outbreaks.

2.5.4 Flood hazard

To assess the flood hazard, four variables influencing the probability of flooding namely slope angle, topographic wetness index, distance from the river channel and height above channel were assembled and stacked in a GIS using the weighted index overlay techniques. The probability of flooding was computed using spatial logistic regression.

2.6 Multi-hazard risk analysis

In this assessment, risk was defined as the probability of harmful consequences, or expected losses (that is, deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between (natural or human-induced) hazards and vulnerable conditions in a given area and time period. Formally, risk was calculated as the product of hazard exposure and vulnerability as:

$$\text{Risk} = \text{Hazard Exposure} * \text{Vulnerability} \qquad \text{(eqn. 4).}$$

To calculate risk at ward level, poverty prevalence data were extracted from the Zimbabwe Poverty Atlas. Poverty prevalence rate was then used as a proxy for vulnerability factor (in eqn. 4) based on the rationale that poverty correlated positively with vulnerability. After calculating risk for the hazards identified during community engagements described earlier, the output risk maps were added together and divided by the maximum value to normalise them so that multi-hazard risk ranged between 0 and 1. All the calculations were done in a GIS using the ward as the spatial unit of analysis to match the scale at which poverty prevalence rate was mapped.

3. Results

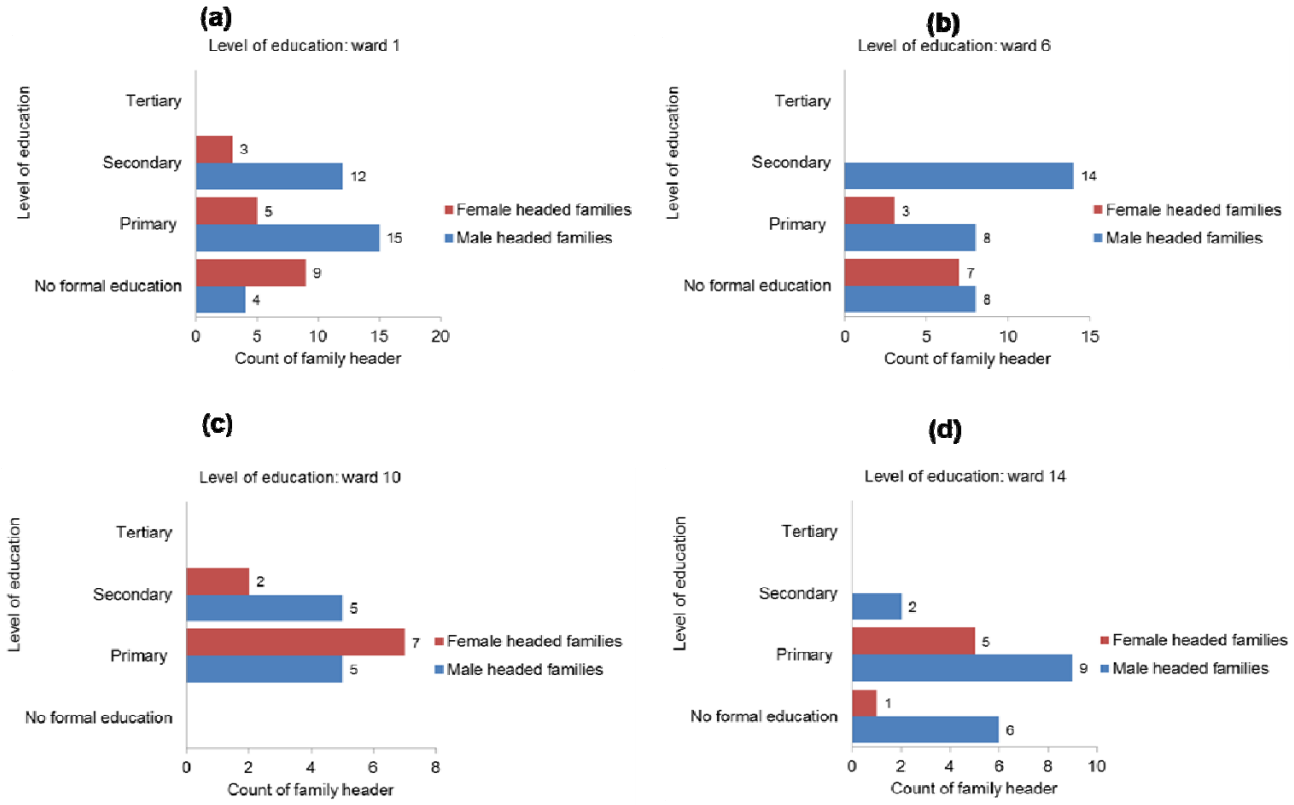
3.0 Chiredzi district results

In this section, the results for Chiredzi district are presented. First, the results for the household survey are given. They are organised around three themes namely household livelihood strategies, water and human health, vulnerability and resilience to hazards. In describing and interpreting these results at the household level in the light of terms of references, frequent reference is made to emerging issues from key informant interviews and focus group discussions. The results for the household questionnaire survey are followed by those for hazard risk analysis and mapping.

3.1 Household characteristics and demographics

3.1.1 Educational level of respondents

Education is a key component of human capital that has a direct bearing on the capacity of households to generate income as well as to absorb and adapt to shocks such as drought (Rurinda et al. 2014). Figure 5 illustrates differences that existed at ward level in the highest level of education attained by household heads in Chiredzi district. The data in figure 5 indicates the proportion of female-headed households without formal education was higher in most wards (e.g., ward 1, 6 and 22) compared to that of male-headed households. An important observation that can be made in figure 6 is the absence of household heads whose highest level of education was tertiary.



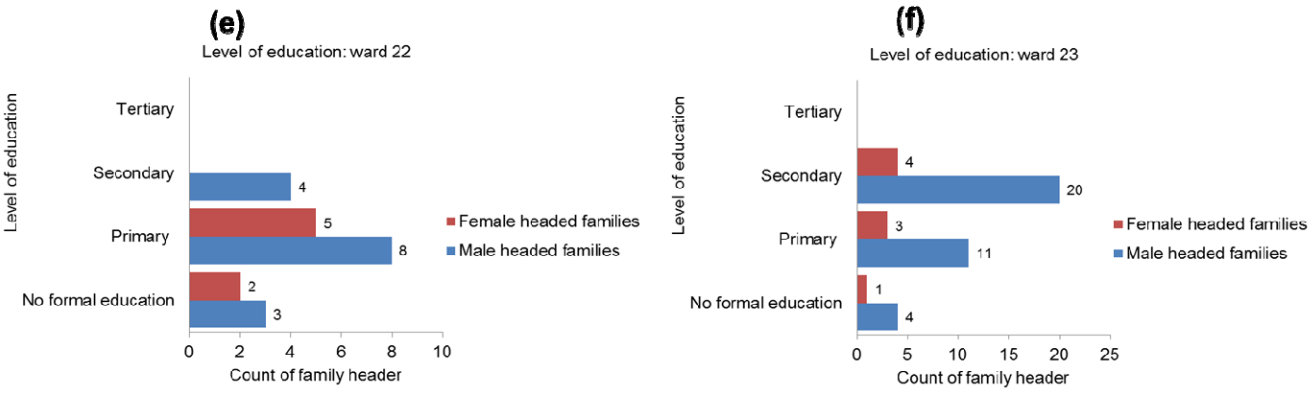


Figure 5: Variation in the highest level of education of respondents in relation to sex in Chiredzi wards.

The data in figure 5 suggests bias in literacy rates against women in the ECRAS wards of Chiredzi. This result is in accord with previous research done in sub-Saharan Africa (Denton 2002). In the context of the ECRAS project, this result matters for two reasons. First, the educational status of a household has been found to be a key human capital that is critical for achieving sustainable livelihoods in developing countries (Ellis 1999) for it increases prospects of getting paid formal employment. Second, the level of education attained by a household increases its awareness of the impacts of shocks such as drought and influences the mitigation measures the household takes. Thus, the data in figure 6 imply that women in Chiredzi ECRAS wards - having less formal education than men – tend to have less adaptive capacity and this potentially makes them more vulnerable to shocks. The differences in education status of households attributed to sex, further implies that the livelihood options of women are potentially limited to simple activities that do not require formal education. To bridge this gender gap in the adaptive capacity of households to shocks and disasters, adult continuing education targeting women needs to be rolled out in wards with gender disparities in education such as ward 1, 6, and 22. This will broaden women's skills set thereby helping build resilience to shocks.

3.5.3 Age-sex distribution

During the household survey, respondents were asked to indicate the sex and age of all household members. The data was used to calculate the age-sex distribution of the communities. Figure 7 indicates the population pyramids of the sampled wards in Chiredzi district. From figure 6, one observes that the population pyramids for wards 1, 6, 10 and 23 were broad at the base and narrow at the top. This result implies that the B1 and B2 rural population in Chiredzi is youthful. The pyramids for wards 22 and 14 were similar in shape.

The demographic data shown in figure 6 show that there were more women than men in all the Chiredzi ECRAS wards and yet women tended to have lower formal education. Therefore, increasing access to education for women must be considered a priority for the ECRAS project since the majority of the population at ward level were women.

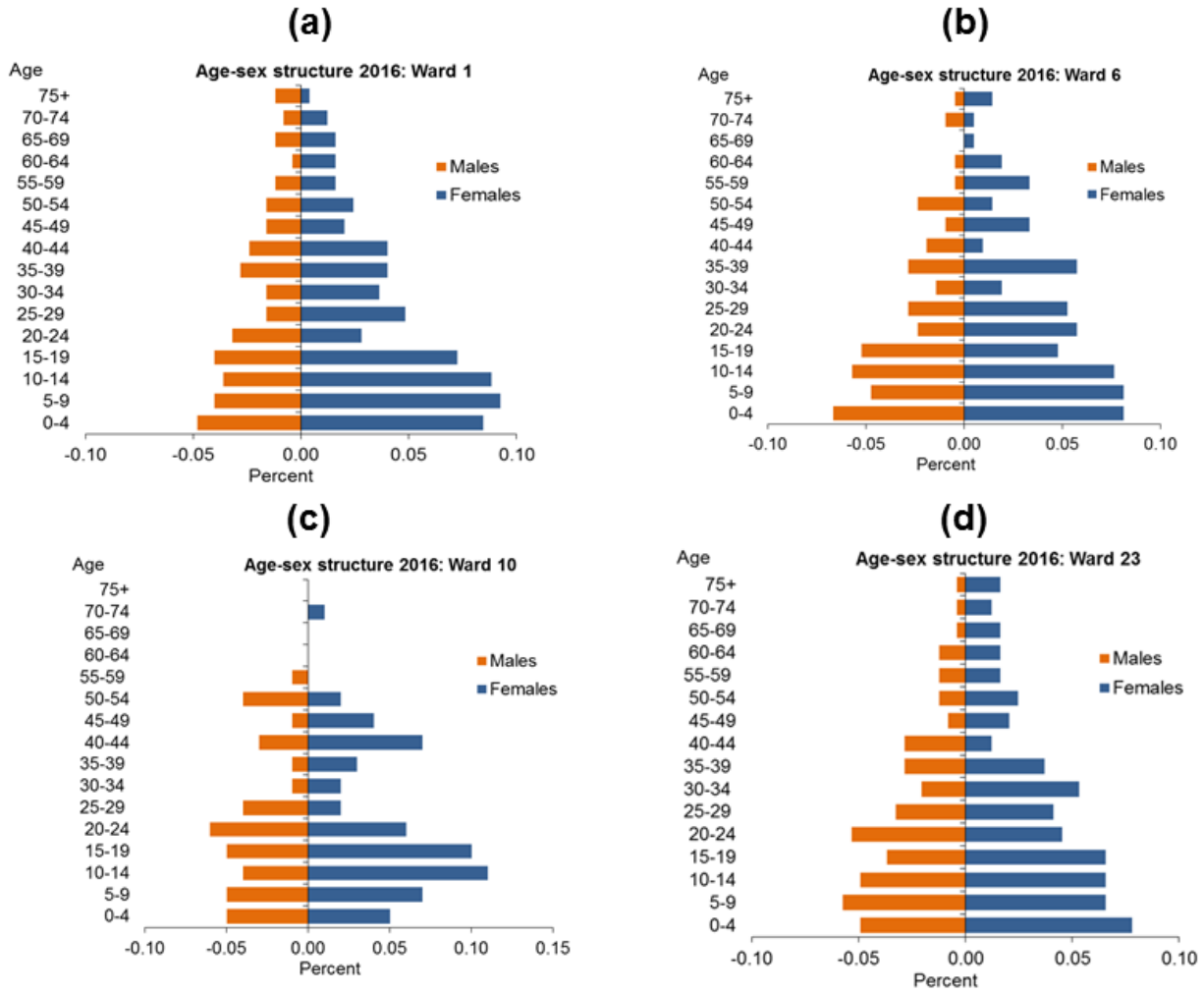


Figure 6: Age-sex structure of the population in sampled Chiredzi ECRAS wards.

Based on the population composition shown in figure 6, the percentage of school-going age (aged 5-24) was 43 % in ward 1 of which 28 % were female. The percentage of school-going age was 47 % in ward 22 and 44 % each for wards 6, 10, 14 and 23. The percentage of males was consistently lower than that of females for this important demographic group. Males of school-going age constituted 15 %, 18 %, 20 %, 3 %, 4 % and 20 % of the total population in wards 1, 6, 10, 14, 22 and 23 of Chiredzi district, respectively. The low numbers of males of school going age observed in wards 14 and 22 may be attributed to migration of males to South Africa in search of employment. The low number of males among the youth may pose a risk to the sustainability of the ECRAS project in that the interventions to build community resilience must surely target women who were clearly in the majority and yet the target community is patriarchal with women having less say in decisions taken by the family or the community as reported in the literature (Denton 2002).

With regard to the percentage of the population aged 15-64, the demographic data from the household survey indicates the potential labour force in all the wards was quite high. In the six sampled wards, that is, wards 1, 6, 10, 14, 22 and 23 those aged 15-64 comprised 54 %, 55 %, 62 %, 66 %, 56 % and 58 % of the population, respectively. Similar to the gender differences observed for the population classified in the school-going age category, women constituted more than 30 % of the total potential labour force in all the wards.

Considering the important link between age, poverty and vulnerability to disasters among smallholder farmers in semi-arid districts reported in the literature (Rurinda et al. 2014), the proportion of the elderly in Chiredzi was calculated and found to be 6 %, 3 %, 1 %, 12 %, 5 % and 5 % for wards 1, 6, 10, 14, 22, and 23, respectively. Although these percentages are much lower than those classified in the school-going age and labour force, the elderly tend to be the most vulnerable to disasters (Ellis 1999). As a result, social protection programmes must give priority to this group. Ward 14 stood out for having the highest percentage of the population classified to as elderly. In contrast, ward 10 had the least percentage of the elderly. Considering that the ECRAS project mostly targets youth and women as it aims to build community resilience against shocks, the responsibility for provision of social protection services to vulnerable and disadvantaged groups such as the elderly must remain with the Ministry of Public Service, Labour and Social Welfare in Zimbabwe.

3. 2 Household livelihood strategies

3.2.1 Housing conditions

Table 3 summarises information on housing characteristics, in particular, the type of the best dwelling unit owned by the household. The information in table 4 is a useful to assess variations and similarities in the living conditions of the people in the ward and was confirmed by field observations made by enumerators. The data in table 4 shows that comparatively, the highest number of respondents who indicated that the best type of dwelling unit was pole and dagga under thatch was in ward 1 (62.5%) followed by ward 23 with 37 %. Ward 6 had the highest number of respondents (40 %) who indicated that their best dwelling unit was made of bricks under sheets. This result indicates important variations within the same ward in the quality of housing condition. The widespread use of pole and dagga structures under thatch in wards 1 and 23 of Chiredzi suggest high prevalence of poverty and high vulnerability to climate hazards such as strong destructive winds.

Table 3: Variations in the type of best dwelling unit.

Ward number	Gender	Pole and dagga under thatch	Pole and dagga under sheets	Bricks under thatch	Bricks under sheets	Mixed	Sample size (N)
1	Male	17	1	0	5	0	*23*
	Female	13	0	3	8	1	*25*
6	Male	5	1	10	12	2	*30*
	Female	4	0	2	4	0	*10*
10	Male	0	5	4	1		*10*
	Female	1	6	1	1		*9*
14	Male	3	1	6	6	1	*17*
	Female	5	0	1	0	0	*6*
22	Male	7	1	2	2	3	*15*
	Female	3	0	0	1	3	*7*
23	Male	13	2	17			*35*
	Female	3	2	3			*8*

The numbers shown in table 3 represent counts of the number of male and female respondents identifying a certain type of dwelling unit as the best they have. Significant differences attributed to sex were observed in the quality of best dwelling unit as presented in figure 8. In ward 6, a significantly higher percentage of males (83 %) indicated that bricks under thatch was their best dwelling unit compared to females (17 %). This difference was statistically significant ($Z = 3.8$, $P < 0.001$). Again in ward 14, 86 % of male respondents identified bricks under thatch as their best dwelling compared to 14

% of female respondents ($Z = 3.2$, $P < 0.001$). In ward 10, the percentage of female respondents (20 %) who indicated bricks under thatch was their best dwelling unit was significantly ($Z = 2{,}6$, $P < 0.001$) lower than that for male respondents (80 %). This difference is illused in figure 7.

Differences on account of sex in the quality of the best dwelling unit were also observed in ward 23. In this ward, the proportion of women with pole and dagga under thatch (19 %) as their best dwelling unit was four times lower than that of men (81 %). This result implies that in some wards, male-headed households were worse off than female-headed households with regard to housing conditions. Given that strong winds were identified as one of the five priority hazards in some wards (e.g., ward 1 and 23), improving the quality of dwelling unit by empowering the community to build stronger structures may contribute towards enhancing the ability of the community to cope with this hazard. However, one has to also consider the fact that pole and dagga structures tend to be relatively cheap and fast to construct hence their widespread use may reduce the cost of damage and quicken the time to recovery. In that regard, the use of pole and dagga structures for shelter could be considered an inherent copying mechanism for communities with chronic levels of poverty. Nevetherless, encouraging households to improve the quality of dwelling units is important as it has additional benefits such as reducing disease risk such as malaria. This is important in the light of climate mediated increases in malaria burden (Ngarakana-Gwasira et al. 2016).

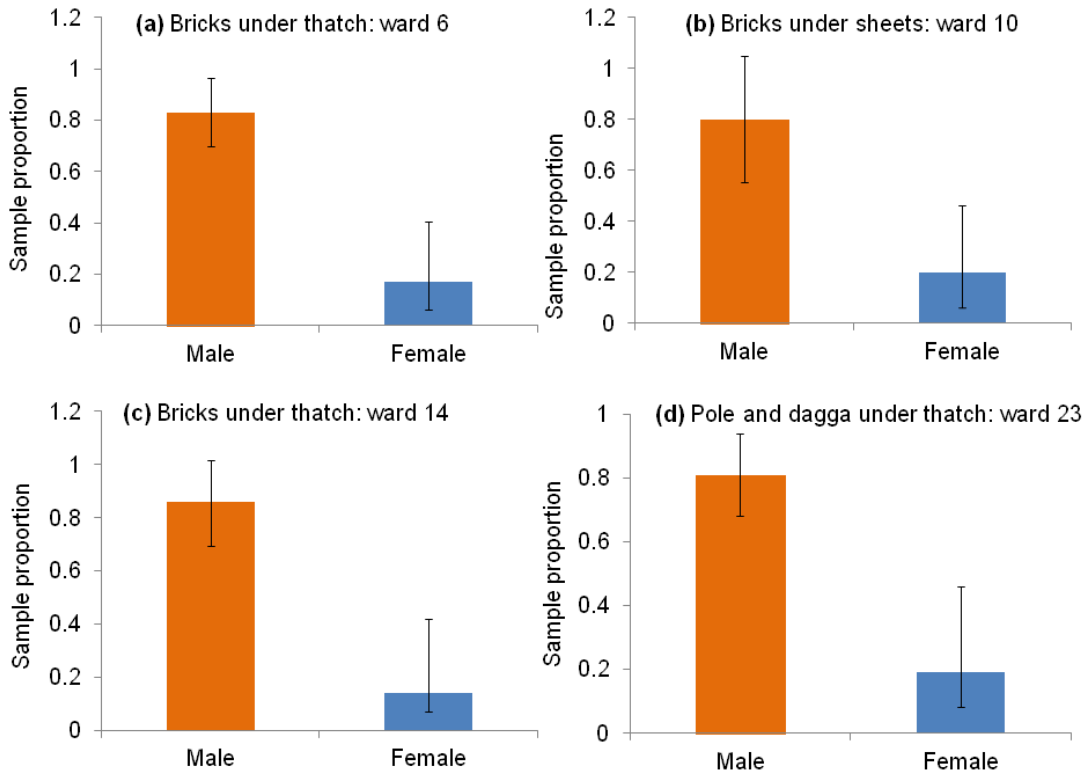


Figure 7: Sex differences in the quality of dwelling unit in sampled Chiredzi wards.

3.2.2 Major livelihood activities

Households in Chiredzi engaged in a variety of activities to support their livelihoods. Table 4 presents a general calendar of livelihood activities identified by households as contributing significantly towards

their livelihoods. The higher the percentage of respondents indicated in a given month the greater the contribution of that activity to household livelihood strategies. The data in table 4 indicates that the dominant livelihood options are livestock production (cattle and goats) and rain-fed agriculture based on growing of small grains. The typical production calendars for small grains (that is sorghum and millet) was similar in the ECRAS wards. The other important activity supporting livelihoods were moulding of builds for sale.

Table 4: General livelihood calendar at household level in Chiredzi ECRAS wards

Ward	Livelihood activity	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	Sorghum	17	71	83	73	58	60	21	6				
	Millet	13	21	25	21	23	23	8					
	Sesame		4	17	10	10	8	6					
	Vegetable	33	33	33	15	17	21	29	50	56	58	63	31
	Cattle	35	38	40	38	40	40	38	38	38	35	35	38
	Goat	42	50	52	44	42	44	44	42	42	42	42	44
	Brick moulding	10	8	4	2	2	2	4	6	13	13	15	13
	NTFP	2						2	2			2	2
6	Sorghum	33	65	83	63	60	48	35	13	13		3	
	Millet	3	8	20	15	15	10	3	3	3	3		
	Vegetable	28	15	13	13	15	23	33	50	58	60	63	35
	Cattle	60	83	60	63	63	60	63	63	63	60	65	63
	Goat	63	88	63	60	60	58	58	58	58	58	60	60
	Brick moulding	8	5	3	3	3	3	3	13	25	30	35	20
	NTFP				18	25	23		3	3	3	5	5
10	Sorghum	16	74	89	79	74	74	58	47	26	26		
	Millet		5	5	16	16	16	16	5	5	5		
	Vegetable	47	37	37	26	26	37	47	68	68	68	58	47
	Cattle	58	58	58	58	58	58	58	58	63	63	63	63
	Goat	37	42	37	42	42	37	37	37	37	37	37	37
	Brick moulding	26	16	16				5	11	16	11	16	21
	NTFP	5	11	11	5	5	11	11					5
14	Sorghum	48	83	78	70	61	48	52	22	13			
	Millet	4	9	9	39	39	4						
	Vegetable	35	35	30	35	35	39	43	57	52	52	39	30
	Cattle	39	39	39	48	43	43	43	43	48	48	48	43
	Goat	39	39	39	43	43	43	43	43	43	43	48	39
	Brick moulding	9	9	9					4	17	26	22	22
	NTFP							4	4				
22	Sorghum	18	64	73	73	73	68	36	18	9	5		
	Sesame	5	5	5	5	5	5	5	5				
	Vegetable	41	41	36	32	32	36	41	59	77	77	64	41
	Cattle	59	59	59	64	59	59	59	59	59	59	59	59
	Goat	68	68	68	73	68	68	68	68	68	68	73	68
	Brick moulding									9	14	18	5
	NTFP				5	9	9	5	5				
23	Sorghum	2	37	53	47	44	44	16	19	2	2		
	Millet		23	35	42	42	28	14	2	2	2		
	Sesame		5	5	9	12	12	12	5				
	Vegetable	26	26	23	19	21	23	37	53	63	65	42	67
	Cattle	56	51	53	53	53	56	53	56	51	51	56	56
	Goat	49	49	49	53	53	49	49	49	49	51	51	49
	Brick moulding	5	5	5	5	5	5	5	7	19	16	14	7
	NTFP	2		2		2	5	2	2	2		2	2

Shading corresponds with the period when farmers are doing activities related to the value chain. The number shown indicates % of farmers engaging in the value chain.

A similarity that can be observed in table 4 relates to the production calendars for cattle, goats and vegetables. These are all-year round activities taking the highest amount of time for the household. This highlights their significance to livelihoods. Brick moulding also featured prominently as an

important source of non-farm income and is practised throughout the year in wards 1, 6 and 23. However, in some wards such as 10, 14 and 22 during the main growing season (January to March) there seems to be a shift from brick moulding to other activities during this period.

With regard to sesame - an important crop that is being promoted by the ECRAS project – except for ward 1, the crop appeared not to be popular based on the percentage of respondents who indicated that they were involved in its production during some months in the year. For instance, in some wards, in particular ward 10 and 14, none of the respondents indicated that they grew sesame. From table 5, one deduces that all effort to diversify the types of crops grown targeting sesame production with the aim to increase food security and broaden sources of household income must start with ward 1 to guarantee results. However, wild relatives of sesame such as *Ceratotheca triloba* (False foxglove) were observed growing as weeds in Chiredzi and Mwenezi. This field observation suggests a suitable climate niche. Therefore promoting the growing of sesame as a cash crop in all wards is feasible for ECRAS. This seed crop may enhance the capacity of the community to bounce back from shocks by boosting household income if marketed effectively.

In summary, the data in table 4 indicates strong dependence of the communities on natural resources for their livelihoods - a common characteristic of farming communities in developing countries (Bäthge 2010). This makes these communities highly vulnerable to natural shocks such as drought. Hence, reducing community dependence on natural resources through diversifying the rural economy as well as investing in irrigation schemes especially in those wards with vertisols may reduce the overall exposure of the community several shocks.

3.2.3 Main household cash needs

During the household survey, respondents were asked to indicate their main cash needs. The data in figure 9 clearly indicates that cash for food is by far the most important requirement for household livelihood security. In all the wards sampled, more than two thirds of the respondents singled out cash to buy food as critical to their livelihoods. Cash for education consistently ranked second to food as a priority need for households. If one considers the fact that close to half of the population was of school-going age (see figure 6), investing in education is justifiably a priority cash need for all households. The other cash needs that were identified with low but varied number of respondents were medical fees (ward 6), housing repairs and improvements (wards 6, 10, and 23) as well as loan repayments (ward 6). The fact that the majority of respondents (>58 %) singled out buying food as the most important priority cash need at the household level point toward the current resilience standing of the community as overall low in the ECRAS project wards.

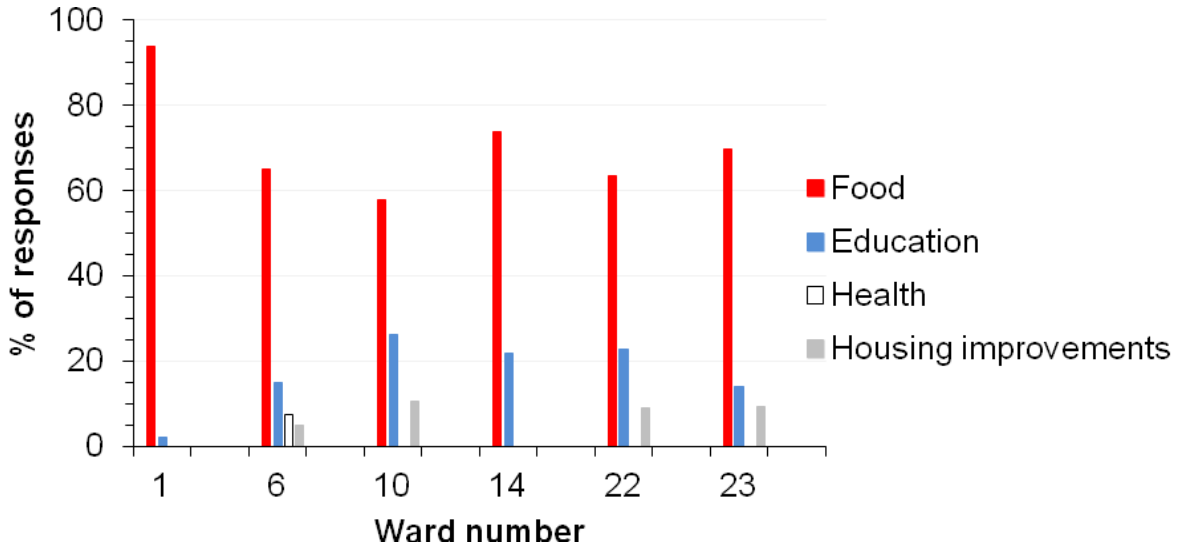


Figure 8: Priority cash needs for households in sampled Chiredzi wards.

3.2.4 Resources and variables needed for household security

Table 5 presents significant differences in the ranking by respondents of resources and variables considered important to women and men in the sampled Chiredzi wards. The data table 5 show that the resources and variables prioritised by men in ward 1 were: water, land for farming, income, access to health care services, improved nutrition, shelter and equipment for farming in that order. The resources and variables considered important to women were: water, improved nutrition, access to health care services, and shelter. For both women and men, water for domestic use, livestock watering and to support small-scale irrigation was identified as the most resource needed at household level.

For ward 6, land, shelter, income, equipment for farming and access to health care services were considered to be a priority for men. For women, land, access to credit, access to health care services, improved nutrition and access to means of transportation were identified as top priority in this ward. When comparing the two gender groups, it is clear access to land for farming is a top priority for both gender groups. This is followed by access to good shelter for men and access to credit for women, which suggests an important gender difference.

The results for ward 10 were similar to those for ward 1 in pattern but some subtle differences can be observed in the ranking of resources. Respondents in this ward indicated that land, income, access to health care services, equipment for farming and education were a priority for men. For women, water, improved nutrition, access to land and access to health care services were the top ranked resources as shown in table 5.

In ward 14, water ranked high for both men and women but the ranking differed thereafter. While respondents indicated that land, shelter, equipment for farming, income and improved nutrition were of importance to men after water, for women shelter, land, improved nutrition and income followed water in this order. There were no statistically significant effects of sex on ranking of resources of importance to men and women in wards 1 and 14 in Chiredzi suggesting similar importance.

The top ranked resources for women in ward 22 were water, improved nutrition, access to health care services and education. For men, the resources were ranked as follows: water, income, land, access to

health care services, equipment for farming and education. Thus, once again water was identified as the most important resource needed by household regardless of gender. The same result was obtained in ward 23 where water was considered to be the most important resource for both women and men. The ranking differed on account of gender with access to land, income, improved nutrition, farming equipment and education being more important for men whereas access to credit loan, access to health care, access to information and forests were ranked as most important for women after water.

Table 5: Resources and variables considered important to women and men in Chiredzi wards

		Number of		Percent			
Ward	**Resource/variable**	**Men**	**Women**	**Male**	**Female**	***Z***	***P*-value**
	Forests	12	22	**35**	**65**	2.5	0.01
6	Access to information	16	26	**38**	**62**	2	0.04
	Access to credit (loans)	15	27	**36**	**64**	2.3	0.02
	Education	19	1	**95**	**5**	7.5	0.00
10	Improved nutrition	7	14	**33**	**67**	2.2	0.03
22	Improved nutrition	10	18	**36**	**64**	2.1	0.04
23	Land	28	26	52	48	0.4	0.68
	Equipment	27	15	**64**	**36**	2.6	0.01
	Access to information	15	28	**35**	**65**	2.8	0.01
	Income	29	10	**74**	**26**	4.2	0.00
	Access to credit (loans)	18	31	**37**	**63**	2.6	0.01
	Education	24	2	**92**	8	6.1	0.00

Variables indicated by a Z statistic ≥ 1.96 and a *P* value ≤ 0.05 were statistically different for women and men.The results in table 7 indicates there was no statistically significant effect of sex on the qualitative ranking of resources in wards 1 and 14 (see table 5). By contrast the percentage of men (66 %) who indicated that water was important was significantly higher than that for women in ward 6. The opposite result was obtained with regard to forests with a significantly higher proportion of respondents (65 %) indicating that forests were important for women in this ward. A significantly higher percentage of respondents (64 %) also indicated that access to credit and loans was important to women compared to 37 % for men.

The differential evaluation of resources by men and women could be attributed to social norms, traditional roles and different power structures in the community (Ellis 1999). For example, previous research has shown that at the household level, women are typically responsible for providing food for the family. This likely explains why improved nutrition was significantly more important for women than men in several wards (e.g., ward 10 and 22).

In ward 10, a significantly higher proportion of respondents (67 %) indicated that improved nutrition was important to women compared to just a third for men. Similarly, two thirds of the respondents indicated that improved nutrition was important to women in ward 22. In these wards, better nutrition ranked top among women. Differences in resource needs appear to be most pronounced in ward 23 where significant differences due to sex were observed for access to farming equipment, income, access to information, access to credit loans and education as shown in table 5. This result implies gender-specific interventions are necessary to build community resilience and reduce the sensitivity of households to hazards in ward 23.

3.2.5 Resource ownership and control of key assets

Table 6 presents descriptive statistics indicating how respondents qualitatively evaluated the economic value of the physical assets they own. The median monetary value of buildings ranged from US$ 671 in ward 1 to US$ 850 in ward 6. The median number of cattle owned by a household was 4 in wards 6, 10 and 23 but slightly higher in the other wards. The median monetary value of all the cattle owned by a household ranged from US$ 450 in ward 1 to US$ 900 in ward 6. The percentage of respondents who indicated that they own cattle in sampled ECRAS wards in Chiredzi was 35 %, 72 %, 68 %, 56 %, 63

% and 74 % for wards 1, 6, 10, 14, 22 and 23, respectively. With the exception of ward 1, these percentages suggest high ownership of cattle overall.

The ownership of goats was more variable than that of cattle with a median number of 1 (ward 1) and the highest median value of 75 (ward 23). The median number of goats owned at a household level was 2 with a median economic value of USD 101. Given that livestock is considered an important hedge against crop failure, enhancing the value of livestock through organised marketing and giving farmers a bargaining voice may increase the resilience of the livestock sector to market fluctuations.

Table 6: Descriptive statistics for key physical assets owned by households in Chiredzi wards.

Asset	Summary statistic	Ward number					
		1	**6**	**10**	**14**	**22**	**23**
Number of buildings	Mean	3	3	3	4	3	4
	Median	3	3	3	3	2	4
Estimated value of buildings (USD)	Mean	671	1,599	979	2,127	2,704	1,174
	Median	389	850	450	600	700	600
Number of cattle	Mean	7	6	5	12	6	5
	Median	5	4	4	9	5	4
Estimated value of cattle (USD)	Mean	1,129	1,138	1,231	2,188	2,320	1,232
	Median	650	900	450	600	450	600
Number of goats	Mean	1	6	3	3	3	75
	Median	1	3	3	3	2	2
Estimated value of goats (USD)	Mean	199	143	265	120	141	113
	Median	133	68	180	95	55	78

Table 7 presents differences between men and women in ownership of key physical assets; access to as well as asset control evaluated using the widely used access and control tool. The resources and assets that were assessed were: land, buildings, cattle, goats, vegetable gardens, indigenous chickens, scotch carts, wells and mobile phones. Only significant differences between men and women in the ownership and control of these resources and assets are shown in table 7. The data in table 7 indicates that the ownership of most productive assets such as land, cattle and goats in the ECRAS wards (e.g., ward 1, 14, 22 and 23) rested with men.

The data in table 7 further shows that in almost all the wards, the ownership of both vegetable that had greater control over these assets compared to men. Unequal power relations between women and men has been proposed to explain differential control of assets (Denton 2002). This gender difference in land ownership confirms previous work (Ellis 1999) and makes women to be more vulnerable to shocks than men as it limits the opportunities available to them for income diversification based on working the land (Denton 2002). In the context of the ECRAS project, enhancing the asset status of rural women with regard to land ownership independent of their right to use it may be the key to enhancing the resilience of women to shocks such as drought.

Table 7: Gender differences in ownership and control of assets in Chiredzi wards

Ward	List of key assets	Owner of asset		Who has right to use		Who controls asset	
		Male	Female	Male	Female	Male	Female
1	Land	**23[a]**	16[a]	15[a]	18[a]	18[a]	16[a]
	Buildings	**24[a]**	17[a]	19[a]	19[a]	20[a]	17[a]
	Cattle	**13[a]**	5[b]	7[a]	8[a]	**12[a]**	5[b]
	Goats	**16[a]**	8[b]	9[a]	12[a]	12[a]	9[a]
	Garden	6[a]	**14[b]**	10[a]	13[a]	6[a]	**14[b]**

Ward	List of key assets	Owner of asset		Who has right to use		Who controls asset	
	Indigenous chickens	5^{a}	$\mathbf{13^{b}}$	5^{a}	9^{a}	4^{a}	$\mathbf{11^{b}}$
	Well	$\mathbf{4^{a}}$	1^{b}	2^{a}	3^{a}	3^{a}	2^{a}
6	Land	$\mathbf{24^{a}}$	12^{b}	12^{a}	13^{a}	$\mathbf{21^{a}}$	13^{b}
	Garden	7^{a}	$\mathbf{16^{b}}$	7^{a}	13^{a}	7^{a}	$\mathbf{16^{b}}$
	Indigenous chickens	5^{a}	$\mathbf{25^{b}}$	10^{a}	$\mathbf{20^{b}}$	6^{a}	$\mathbf{23^{b}}$
	Scotch cart	$\mathbf{11^{a}}$	3^{b}	6^{a}	7^{a}	$\mathbf{10^{a}}$	3^{b}
	Mobile phone	15^{a}	$\mathbf{19^{a}}$	13^{a}	19^{a}	16^{a}	18^{a}
10	Garden	3^{a}	$\mathbf{8^{b}}$	4^{a}	8^{a}	2^{a}	$\mathbf{10^{b}}$
	Indigenous chickens	3^{a}	$\mathbf{8^{b}}$	3^{a}	4^{a}	3^{a}	$\mathbf{8^{b}}$
	Scotch cart	$\mathbf{7^{a}}$	3^{b}	5^{a}	5^{a}	6^{a}	4^{a}
	Mobile phone	6^{a}	$\mathbf{9^{b}}$	6^{a}	8^{a}	6^{a}	8^{a}
14	Land	$\mathbf{18^{a}}$	5^{b}	14^{a}	8^{a}	$\mathbf{15^{a}}$	6^{b}
	Buildings	$\mathbf{16^{a}}$	7^{b}	14^{a}	9^{a}	$\mathbf{15^{a}}$	7^{b}
	Cattle	$\mathbf{12^{a}}$	5^{b}	11^{a}	7^{a}	11^{a}	7^{a}
	Garden	2^{a}	$\mathbf{13^{b}}$	5^{a}	9^{a}	2^{a}	$\mathbf{13^{b}}$
	Indigenous chickens	3^{a}	$\mathbf{13^{b}}$	7^{a}	$\mathbf{14^{b}}$	4^{a}	$\mathbf{12^{b}}$
22	Land	$\mathbf{15^{a}}$	5^{b}	$\mathbf{9^{a}}$	4^{b}	$\mathbf{14^{a}}$	6^{b}
	Cattle	$\mathbf{13^{a}}$	4^{b}	$\mathbf{8^{a}}$	3^{b}	$\mathbf{11^{a}}$	4^{b}
	Indigenous chickens	3^{a}	$\mathbf{13^{b}}$	5^{a}	7^{a}	3^{a}	$\mathbf{11^{b}}$
	Scotch cart	$\mathbf{8^{a}}$	1^{b}	5^{a}	2^{a}	$\mathbf{7^{a}}$	2^{b}
	Well	10^{a}	1^{b}	$\mathbf{6^{a}}$	2^{b}	$\mathbf{8^{a}}$	2^{b}
	Mobile phone	6^{a}	$\mathbf{12^{b}}$	5^{a}	8^{a}	5^{a}	$\mathbf{11^{b}}$
23	Land	$\mathbf{27^{a}}$	8^{b}	13^{a}	10^{a}	$\mathbf{24^{a}}$	10^{b}
	Buildings	$\mathbf{25^{a}}$	7^{b}	14^{a}	9^{a}	$\mathbf{23^{a}}$	10^{b}
	Cattle	$\mathbf{24^{a}}$	6^{b}	8^{a}	9^{a}	$\mathbf{18^{a}}$	7^{b}
	Goats	$\mathbf{18^{a}}$	8^{b}	8^{a}	7^{a}	13^{a}	8^{a}
	Garden	5^{a}	$\mathbf{17^{b}}$	8^{a}	11^{a}	8^{a}	13^{a}
	Indigenous chickens	10^{a}	$\mathbf{22^{b}}$	7^{a}	12^{a}	7^{a}	$\mathbf{22^{b}}$
	Scotch cart	$\mathbf{12^{a}}$	1^{b}	8^{a}	4^{a}	$\mathbf{11^{a}}$	2^{b}
	Mobile phone	$\mathbf{18^{a}}$	12^{b}	10^{a}	9^{a}	9^{a}	13^{a}

Note, only numbers with different small letters of the English alphabet presented as superscripts in a row ($^{a:b}$) (e.g., owner of asset) indicate significant difference between women and men for the same variable being assessed.

Another notable result shown in table 7 is that in some wards specifically ward 10 and 22 significantly more women own mobile phones than men. This result implies that information on disaster preparedness, for example warning the community of an impending drought or cyclone, can be relayed fast throughout the community through the use of cell-phone technology with the overall goal of building resilience.

3.2.6 Household food security

Household food security was assessed qualitattively in terms of adequacy of crop yields. The results disaggregated by ward indicated that at least 39 % of the respondents get inadequate yields as illustrated in figure 9. Ward 23 stood out as having nearly two thirds of the respondents (61 %) indicating that the crop yields they get are not enough to meet the household's food needs. The

relatively high percentage of respondents perceiving their yield as insufficient corroborate previous results presented in figure 9 indicating that food ranks number one among the household cash needs. Low yields can be attributed to low and erratic rainfall received in the district. This is compounded by the fact that households mostly rely on rain fed agriculture.

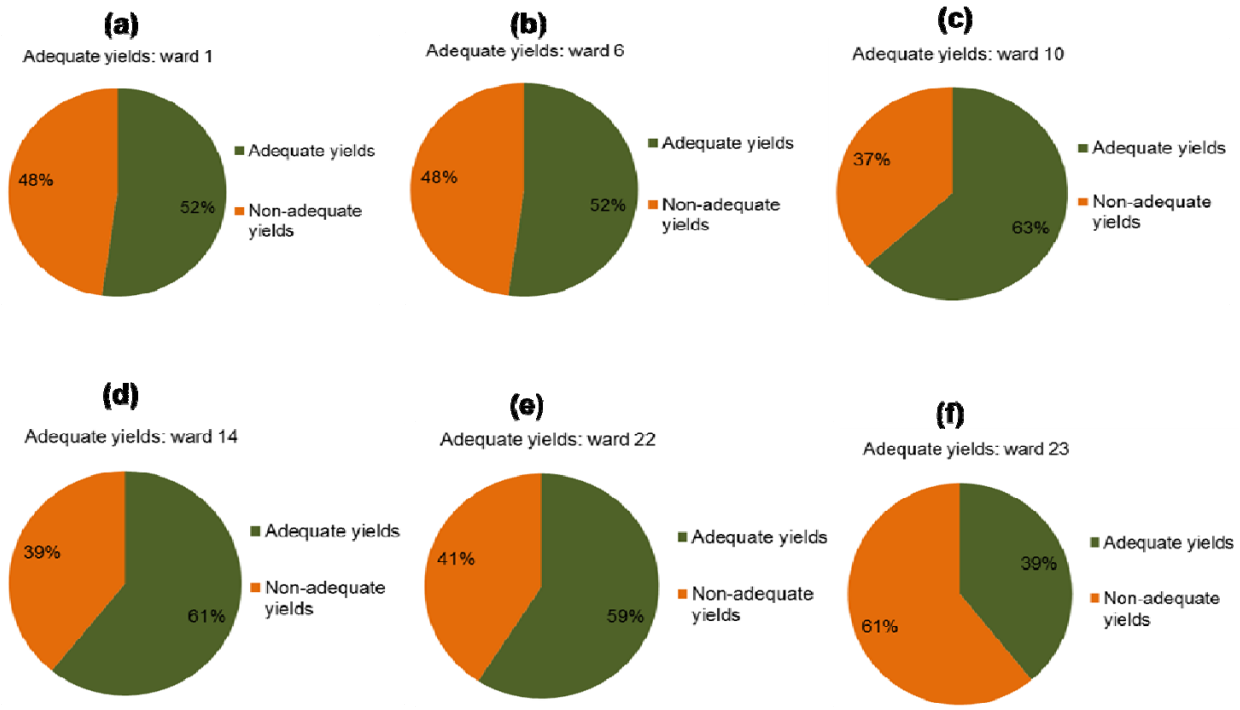


Figure 9: Perception of adequacy of crop yields in sampled Chiredzi wards.

The results for month-to-month food shortage at household level are presented in table 8 for each sampled ward as percentages. Table 8 suggests that the most critical months characterised by highest food shortage were September to December for all the wards. The months of April, May and June that are close to the period after crop harvests in rain-fed production systems appeared to have the least shortages. However, even during these months, nearly a third of the respondents likely went hungry.

Table 8: Monthly variation in food shortage at household level in Chiredzi district

Ward	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sample
1	50	48	52	40	40	46	58	67	75	75	69	65	*48*
6	53	48	38	28	28	38	45	58	60	73	73	55	*40*
10	68	53	53	37	37	37	42	58	68	68	68	63	*19*
14	52	52	52	43	39	48	57	70	74	65	61	43	*23*
22	77	77	59	32	32	32	41	45	73	77	91	82	*22*
23	58	56	51	35	33	40	44	58	70	63	60	51	*43*

With regard to number of meals consumed per day, the data in figure 10 indicates that the overwhelming majority of the households depended on two meals. Although the number of respondents who indicated that they relied on just one meal was relatively low, the fact that in all the wards there were households that go hungry every day provides evidence for chronic food shortage in the rural districts of Chiredzi.

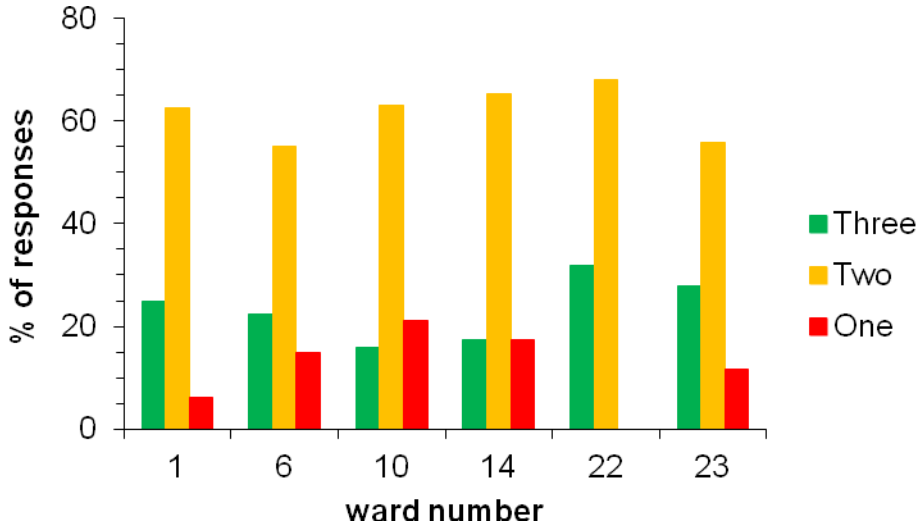


Figure 10: Variation in the number of meals consumed per day in six sampled wards

The data in figure 11 further indicates that almost half of the respondents indicated that they sometimes went for days without eating food. This result needs to be qualified in that the questionnaire targeted the household heads hence the responses shown represented the experiences of the adult population of a household. Usually there is difference in meal consumption by age as children can be served more meals than adults. Either way, the evidence points to household food insecurity in Chiredzi ECRAS wards. This result taken together with those on adequacy of yields, the number of meals consumed in a day as well as cash needs for food, paint a broad picture of high food insecurity at household level in most if not all the rural wards of Chiredzi.

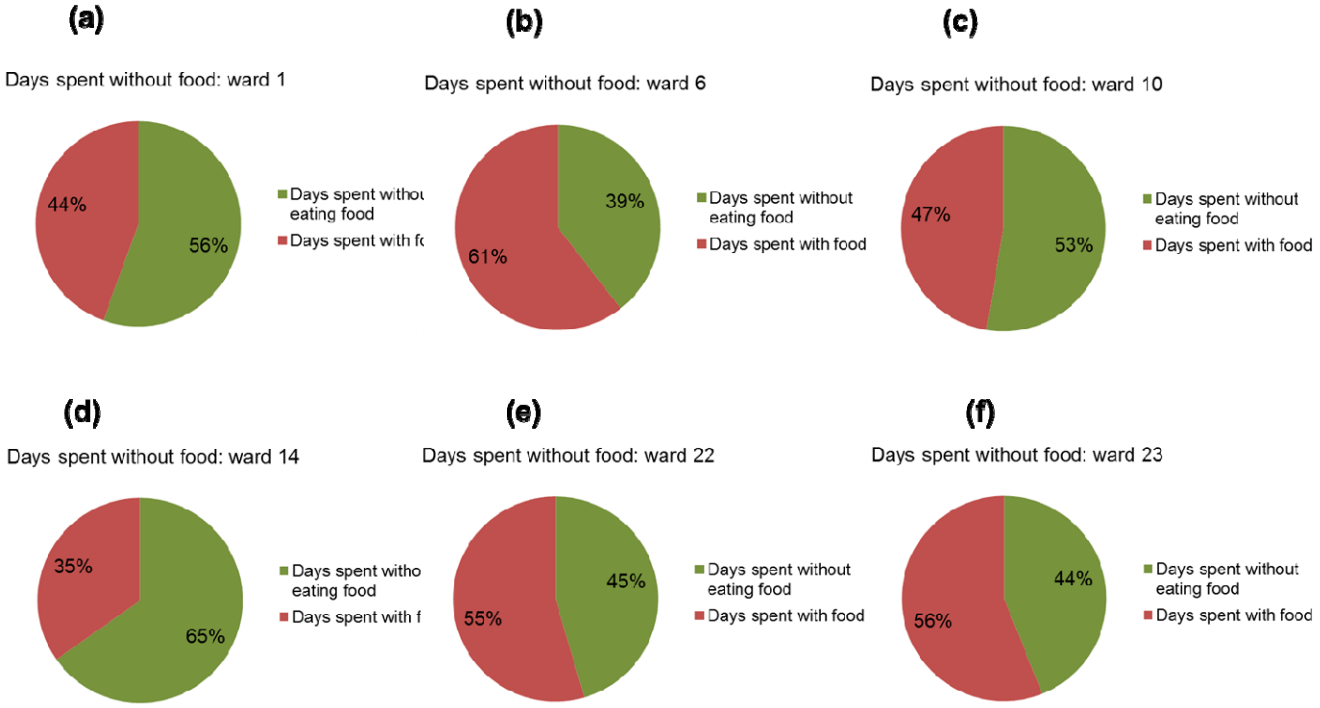


Figure 11: Proportion of respondents indicating days spent without food in Chiredzi.

3.2.7 Membership to a community savings/lending group

Considering that access to credit loan featured prominently among women as critical to ensuring livelihood security at household level, the role of community (village) savings/lending groups in addressing cash needs was assessed for all six sampled wards. The results in figure 12 illustrate that it is only in ward 6 where nearly 40 % of the respondents confirmed they belonged to a community savings/lending group. In the rest of the wards, less than 20 % of the respondents indicated that they were not members of a community savings/lending group, yet such memberships may be the key to unlocking access to capital and resilience at household level in the wards.

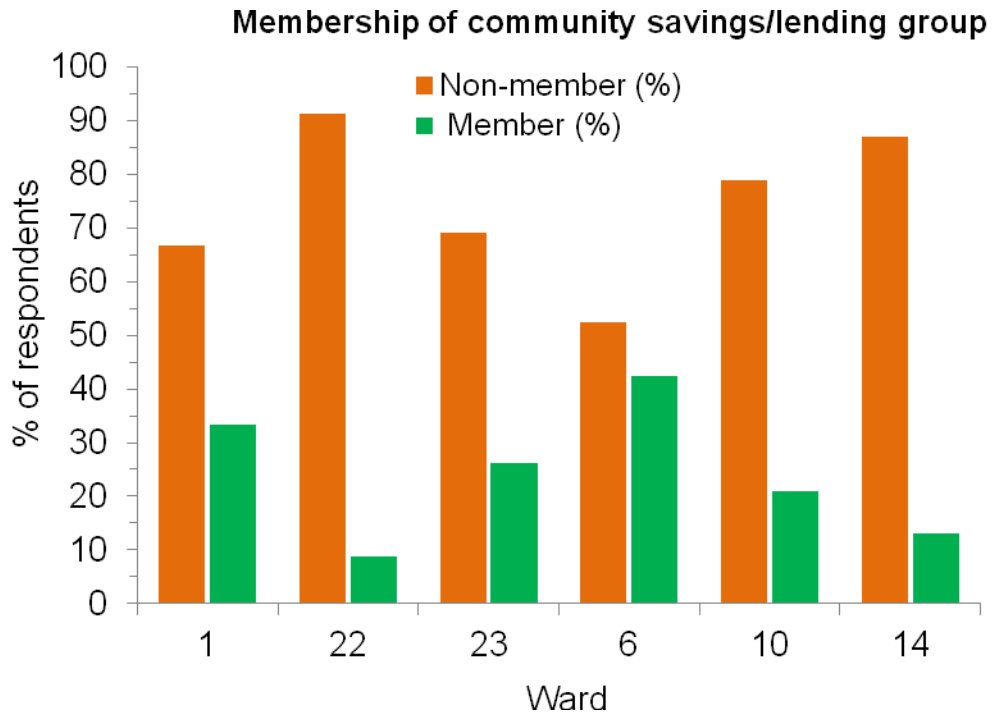


Figure 12: Membership to community savings/lending groups in Chiredzi.

3.3 Water supply and health

The previous results (see table 7) have shown that water ranks as the top resource needed by households. Figure 13 indicates that the main water sources were varied within and across wards but unprotected deep wells were identified as one of the most important water sources in wards 6, 10 and 14 and water from such sources puts the health of people at risk.

A pattern that can be observed from the data in figure 13 is that the people and livestock tended to rely on the same water sources and this tended to put pressure on that source. This finding implies that both the households as well as their livestock are exposed to natural shocks such as drought that reduce runoff and lower groundwater recharge. Therefore, in the ECRAS project, increasing access to water may be a long-term strategy to building the resilience of the community to hydrological drought. It is therefore recommended that water resources be developed through the sinking of more boreholes to tap groundwater and/or erecting small-scale dams that will last beyond the project tenure.

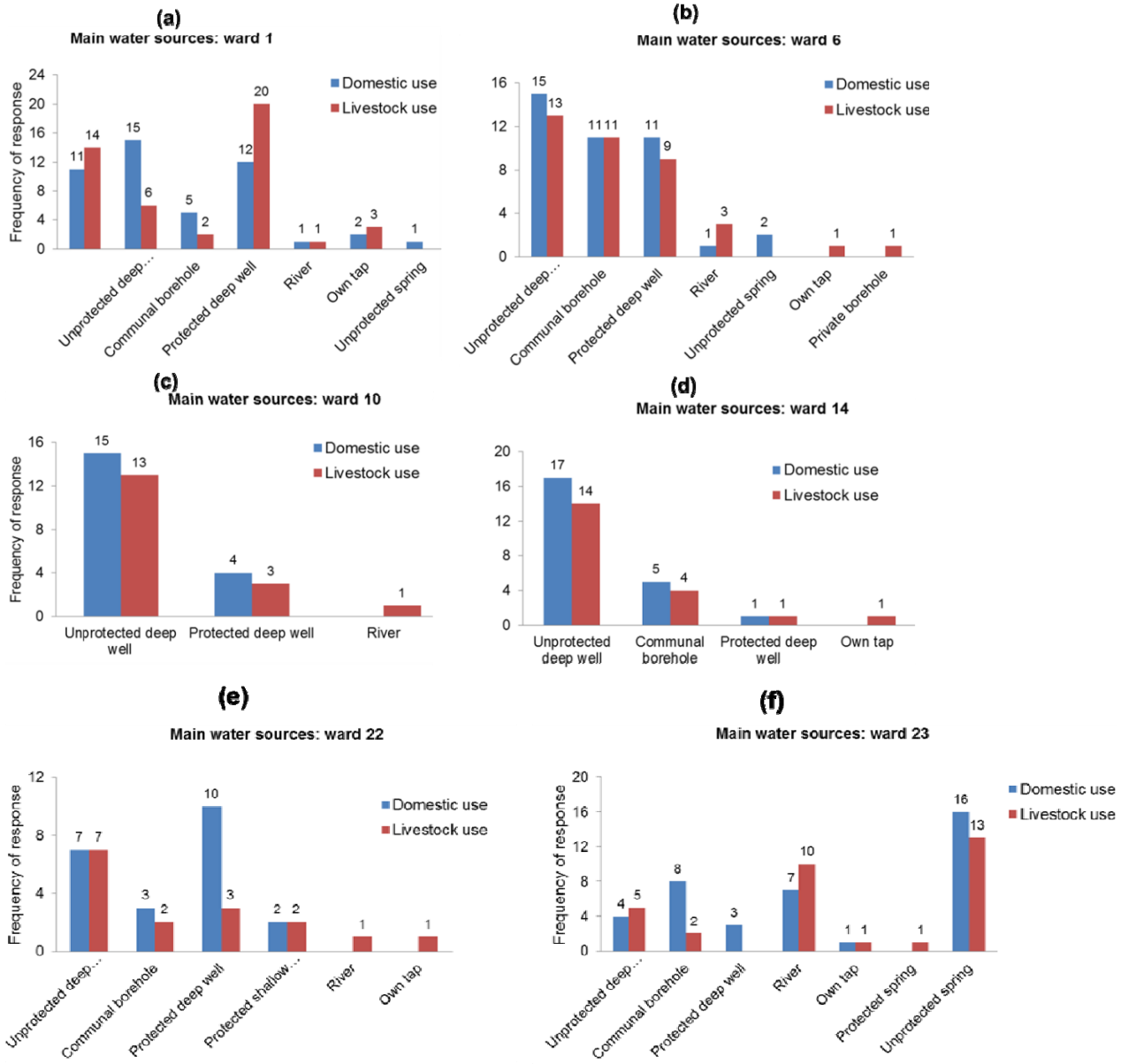


Figure 13: Main sources of water for domestic use and livestock watering in Chiredzi.

If the need to seek medical services arises, it is clear more than two thirds of respondents access medical services and/or treatment at public clinics followed by public hospitals as illustrated in figure 14. The data in figure 14 suggests the small-holder farming communities in rural Chiredzi have limited options when it comes to accessing medical services. This situation tends to compromise the community's adaptive capacity since good health is a pre-requisite for copying with shocks. Given that most public clinics tend to be located at or closer to major centres such as Chikombedzi and Malipati, the communities farther away may have additional problems accessing public clinics especially during the rainy season as most link roads become unpassable.

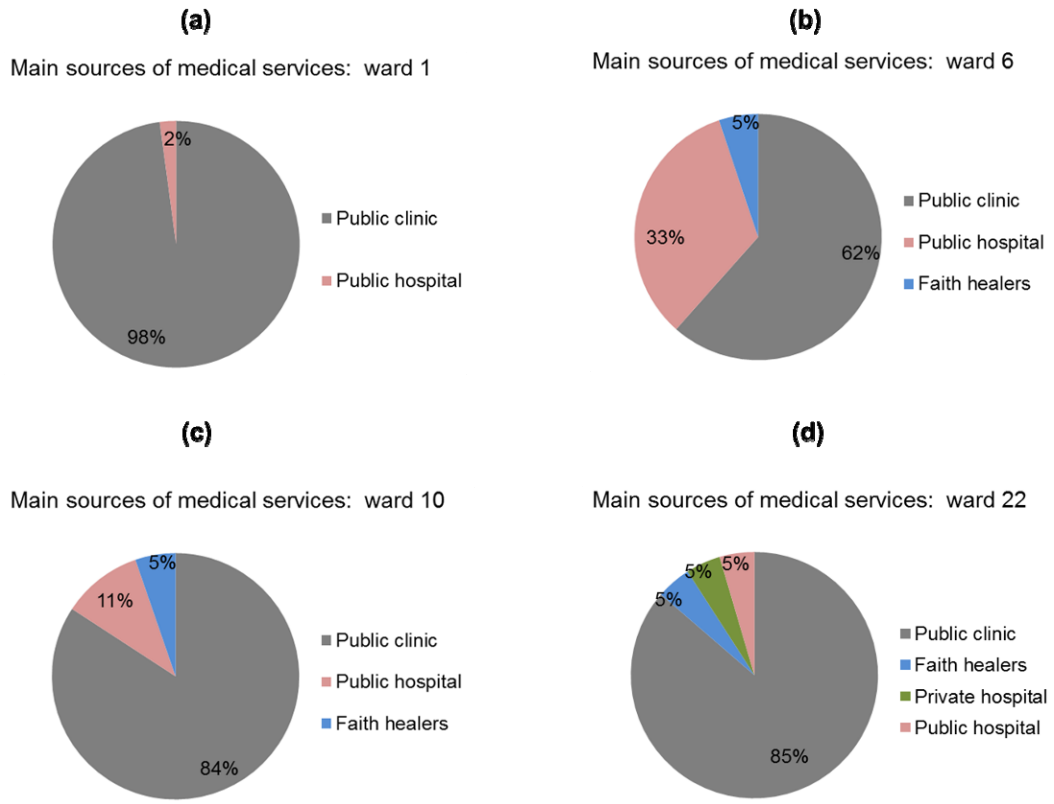


Figure 14: Main sources of medical services in sampled wards of Chiredzi district.

3.4 Vulnerability and resilience assessment

Figure 15 presents the top ranked hazards that were identified during the household survey at ward level in Chiredzi district. The results in figure 16 show that drought was consistently the top ranked hazard in all the wards. At household level, heat wave ranked second among top five hazards in five out of six wards. Apart from these two, mixed responses were obtained regarding the order of the following hazards that were included in the top five list: strong winds, livestock diseases, fire, flood, and crop pests.

The information in figure 15, which agrees with that from FGDs, indicates high exposure of households to drought. This implies that resilience building must give priority to this climate-related shock. The specific resilience activities for drought are presented in subsequent sections toward the end of the report.

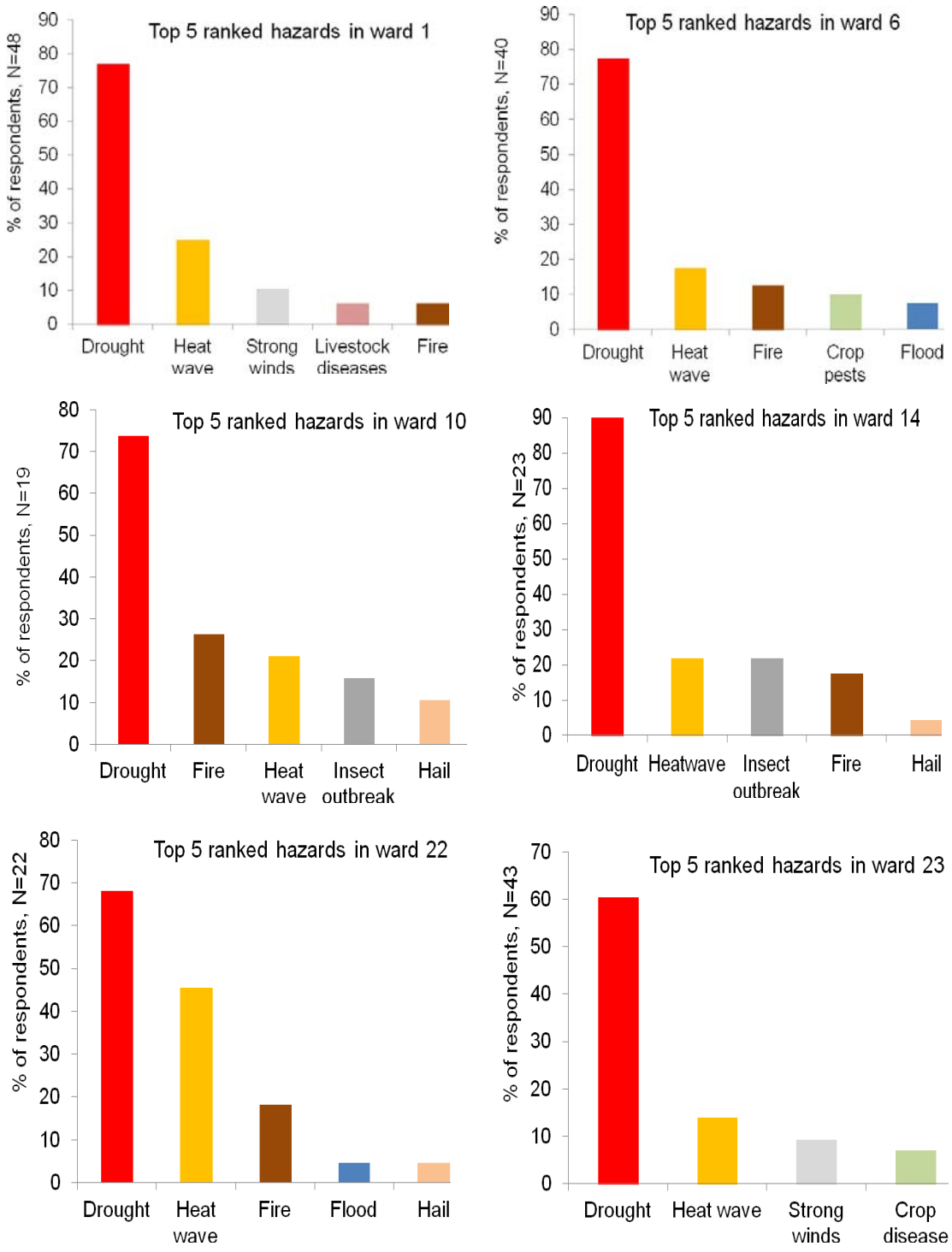


Figure 15: Top five priority hazards identified at household level in sampled Chiredzi wards.

3.4.1 Household risk assessment matrix

Table 9 presents the risk assessment matrix for sampled Chiredzi wards. Drought was once again consistently had the highest risk in all six sampled wards. This result from the community assessment matched long-term historical data based on spatial analysis of multi-temporal spectral vegetation data.

The risk categories for livestock disease and flood were variable with some communities classifying these hazards in the high and medium risk categories.

Table 9: Risk assessment matrix at household level for six sampled project wards in Chiredzi

Ward	Top 5 Hazards	% of respondents	Damage potential	N	Frequency	N	Risk	Sample size
1	Drought	77	VH	34	VH	34	VH	48
	Heat wave	25	H	7	VH	7	VH	
	Strong winds	10	M	5	VH	5	H	
	Livestock diseases	6	L	3	VH	3	H	
	Fire	6	L	3	H	3	M	
6	Drought	78	VH	29	VH	28	VH	40
	Heat wave	18	H	4	VH	4	VH	
	Fire	13	M	5	VH	4	H	
	Crop pests	10	L	3	L	3	L	
	Flood	8	L	2	L	1	L	
10	Drought	74	VH	13	VH	10	VH	19
	Fire	26	M	2	L	3	ML	
	Heat wave	21	L	3	H	2	M	
	Insect outbreak	16	M	1	L	1	ML	
	Hail	11	H	1	L	0	M	
14	Drought	91	VH	20	VH	18	VH	23
	Heat wave	22	H	4	VH	3	VH	
	Insect outbreak	22	H	1	VH	1	VH	
	Fire	17	M	4	VH	1	H	
	Hail	4	M	1	L	1	ML	
22	Drought	68	VH	15	VH	14	VH	22
	Heat wave	45	H	6	VH	7	VH	
	Fire	18	H	3	VH	2	VH L	
	Flood	5	H	1	L	1	M	
	Hail	5	H	1	L	1	M	
23	Drought	60	VH	25	VH	21	VH	43
	Heat wave	14	H	5	VH	4	VH	
	Strong winds	9	M	4	VH	4	H	
	Plant disease	7	M	1	VH	1	H	

L =Low, M = Moderate, ML = Moderately Low, H = High, VH = Very High.

3.5 Hazard frequency and risk mapping in Chiredzi

3.5.1 Extreme high temperatures

Figure 15 illustrates frequency of occurrence of heat waves during the month of October based on long-term data obtained from Buffalo Range Station in Chiredzi. Three consecutive daily maximum temperatures exceeding normal human body temperature (36.7 ^{o}C) were defined as constituting a heat wave. The solid orange line represents long term daily maximum temperature for October. The data in figure 15 indicates a high frequency and therefore high exposure of communities in Chiredzi to heat waves especially during the hot dry season. Some of the interventions that can be adopted at household level to build resilience to heat waves include planting trees at yards to increase availability of shade as

well as improving building designs by preferring materials such as treated thatch and bricks that ameliorate temperatures.

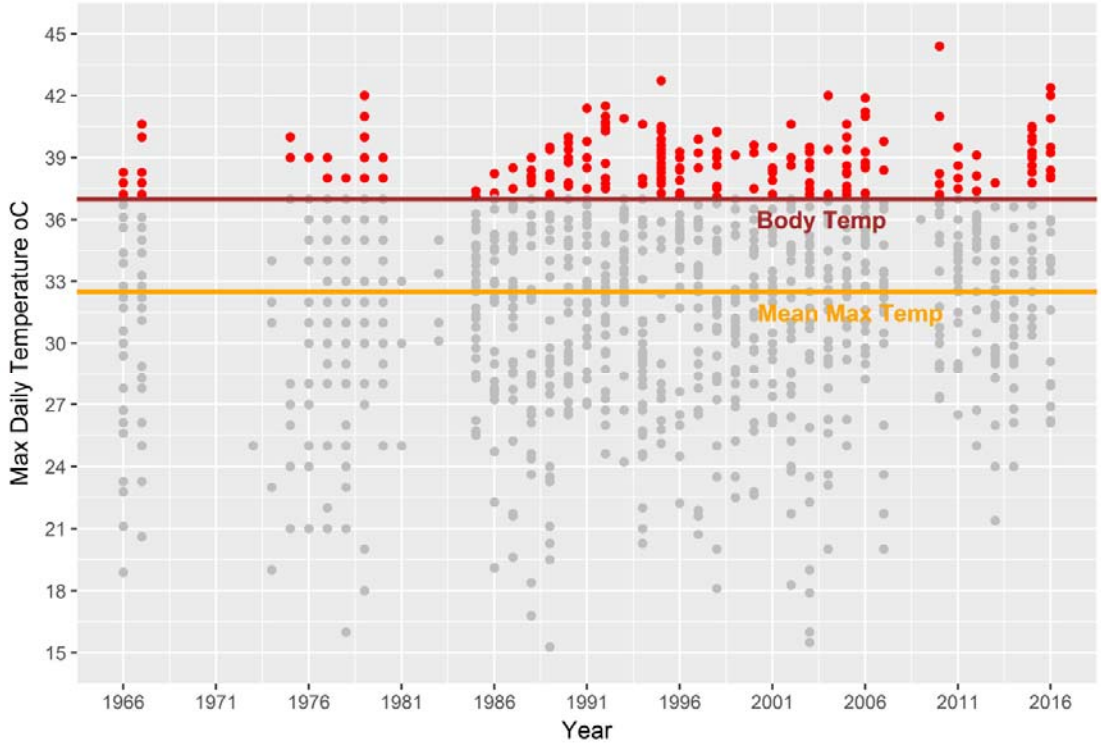
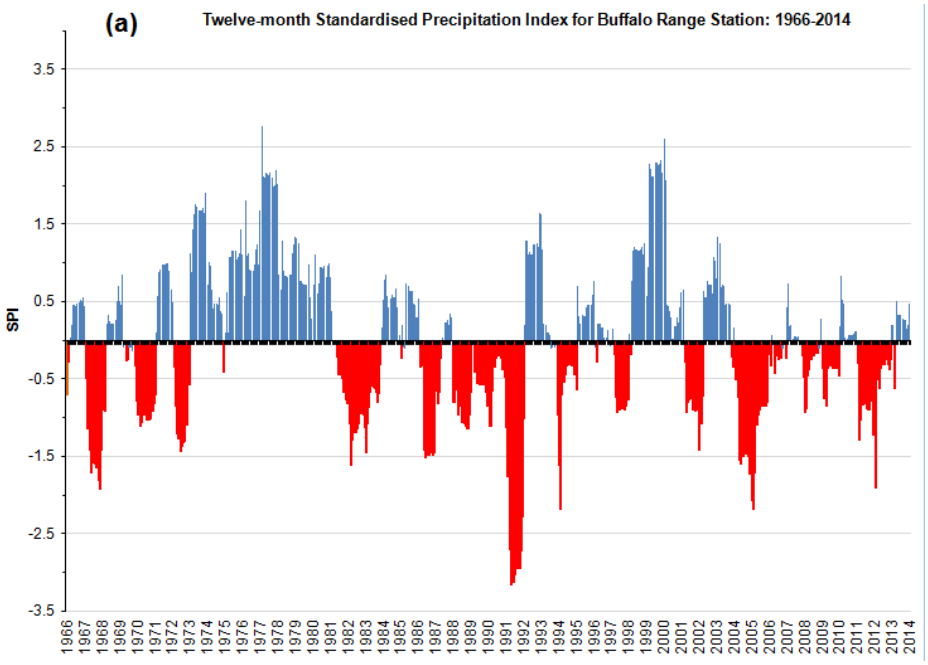


Figure 15: Temperature anomalies for Buffalo Range Station indicating heat waves during October.

3.5.2 Meteorological droughts

Long-term monthly rainfall data for Buffalo Range Station indicates that mild, severe as well as extreme meteorological droughts frequently occurred in all Chiredzi ECRAS district. A total of 16 such drought years can be observed in figure 16.



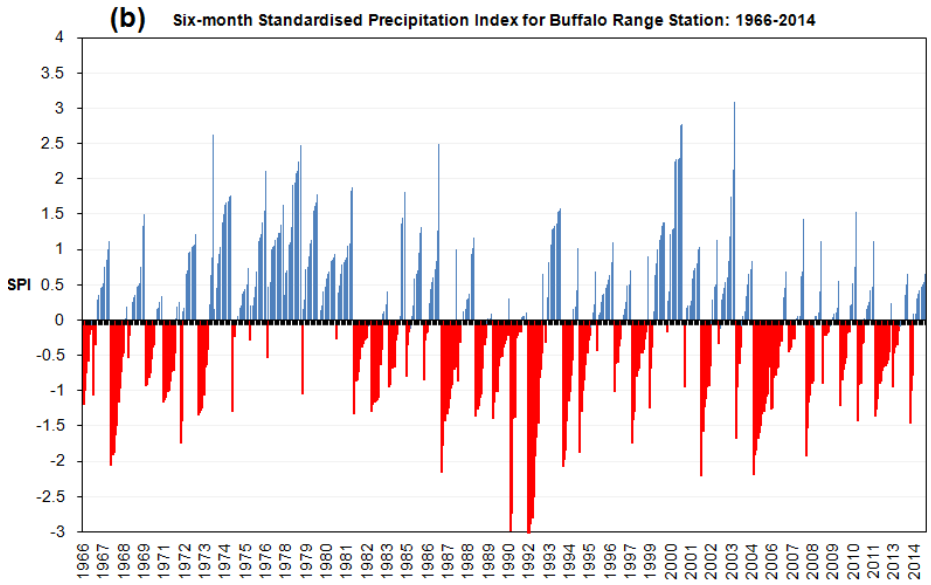


Figure 16: Frequency and magnitude of drought in Chiredzi calculated using rainfall data for Buffalo Range Station. The top panel (a) indicates 12-month SPI values whereas the bottom panel (b) shows results for 6-month SPI.

The data for the 2015-2016 were not available at the time when this report was compiled but the season was also characterised by a severe drought. Thus, the total number of drought years during the study period 1968 to 2016 stood at 17. The drought years that can be located in figure 18 based on the 12-month standardised precipitation index (SPI) were: 1968, 1970, 1973, 1982, 1987, 1991, 1994, 1998, 1998, 2001, 2004, 2005, 2008, 2009, 2012, 2013 and 2016. When the time-scale of analysis was reduced to six months the widespread occurrence of meteorological drought in the district becomes more apparent as illustrated in figure 16(b). These results apply to both Chiredzi and Mwenezi as the two districts experience a similar semi-arid subtropical climate. Overall, the data on frequency of data confirmed high exposure of the communities in ECRAS wards to meteorological droughts and this is consistent with information from the household survey.

The monthly return period for meteorological drought for the period 1968 to 2014 is presented in table 10. Table 10 shows that mild drought had the shortest return period followed by moderate drought. Severe and extreme drought were characterised by long return period and high magnitude.

Table 10: Monthly return period for meteorological drought for Buffalo Range Station: 1968-2014

Magnitude of drought	**SPI value**	**Monthly return period**	**Empirical probability**
Extreme	≤ -2	13/577	0.02
Severe	-1.99 to -1.5	19/577	0.03
Moderate	-1.49 to -1	50/577	0.09
Mild	-0.99 to 0	205/577	0.36

3.5.3 Agricultural drought

The spatial variation in the occurrence of drought in the project wards in Chiredzi district was mapped using satellite-derived drought index – the vegetation condition index (VCI) as illustrated in Figure 17. Using the VCI cut-off value of 0.36 to indicate extreme agricultural drought, the data shown in figure 19 demonstrates that all the 17 project wards were prone to agricultural drought but there were notable variations within and across wards. For example, wards 13 and 14 were the least affected by the recent 2016 drought whereas in 2003 these wards were the worst affected together with wards 9, 10 and 11.

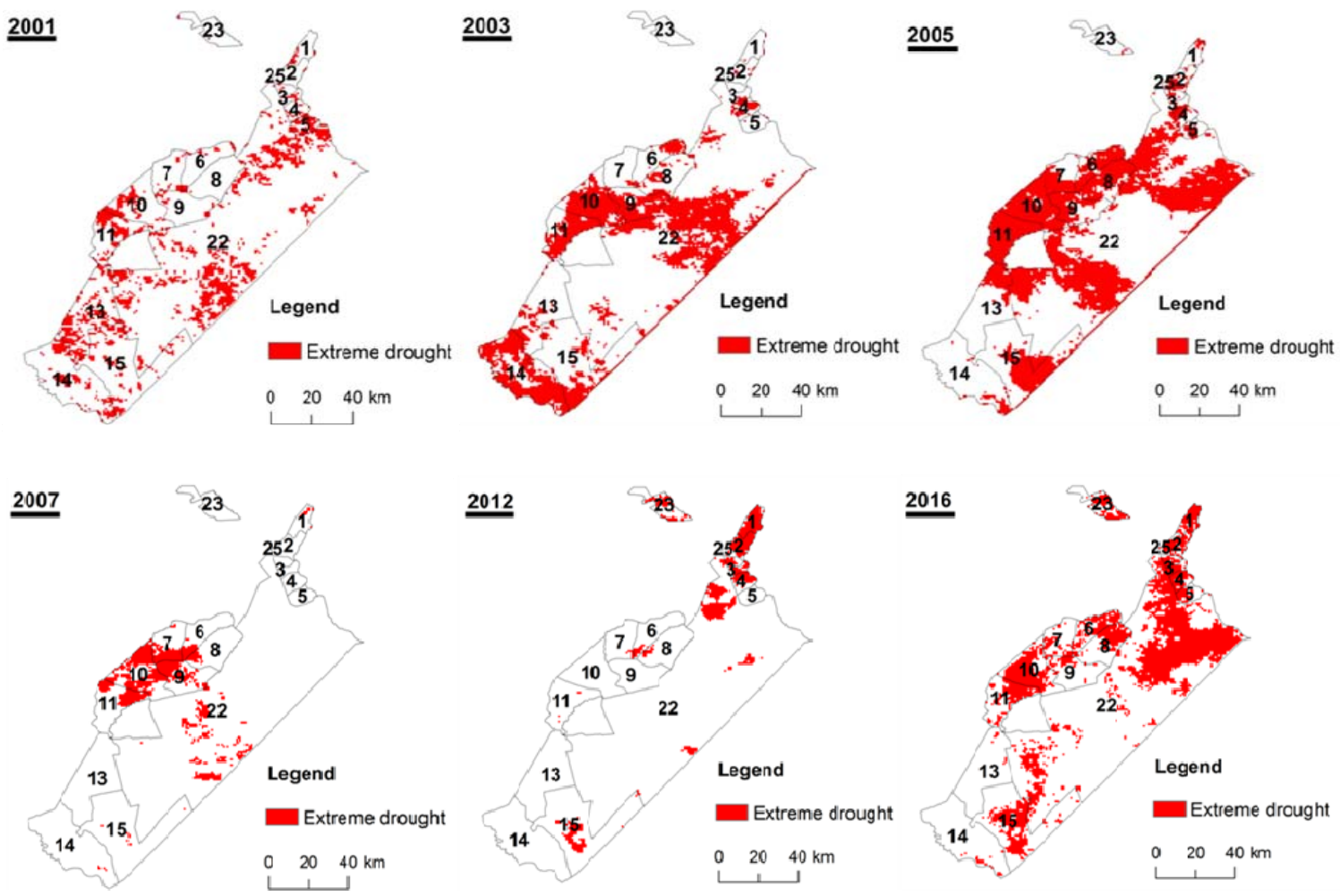


Figure 17: Multi-temporal maps showing spatial distribution of agricultural drought in project wards in Chiredzi district. Extreme agricultural drought was calculated from satellite imagery using the vegetation condition index threshold value of ≤ 36%.

At ward level, drought risk was variable as shown in figure 18. Wards 13, 14 and 15 characterised by the highest poverty rates in the district were at highest risk of agricultural drought. By contrast ward 6 had the lowest drought risk followed by wards 4 and 10. The remainder of the wards were characterised by moderately high drought risk.

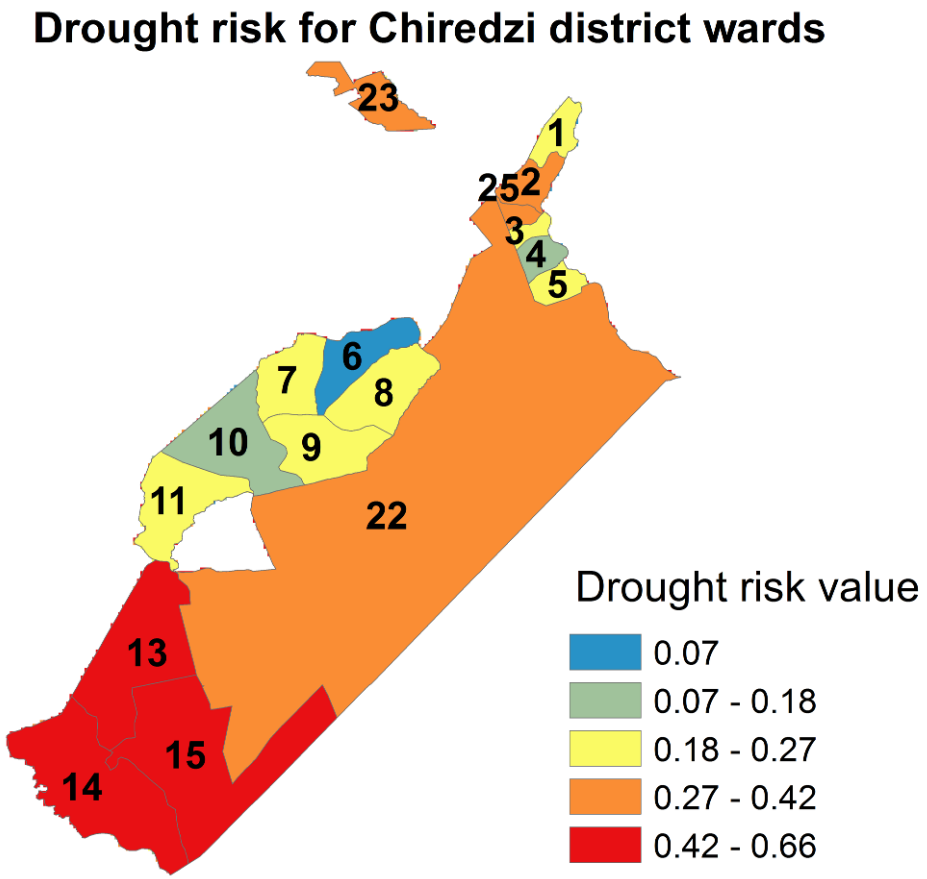


Figure 18: Spatial variation in drought risk at ward level in Chiredzi ECRAS wards.

Of all the natural hazards occurring in Chiredzi, drought was by far the most significant in terms of its impact on livestock production and animal performance (see plate 2). Hence, building the resilience of crop production and livestock systems to drought through use of drought-tolerant varieties, use of local adapted animal breeds, and boosting numbers of small ruminants such as goats is recommended.

Plate 2: A cow succumbing to nutritional stress caused by lack of forage due to the effects of the 2016 agricultural drought in ward 1 of Chiredzi district.

3.5.4 Cattle disease outbreaks

Farmers in the 17 project wards of Chiredzi also identified livestock diseases as a major biological hazard posing a direct threat to their livelihoods. Figure 21 maps outbreaks of foot and mouth disease (FMD) in cattle for the period 2002 to 2015. The trend that can be observed is that reported FMD cases were many with wards 1, 2, 3, 4 and 5 having recorded more outbreaks in recent years than before. The recent land reform, which increased herd mixing and was associated with destruction of veterinary fences may explain this trend (see Swiswa et al. 2016).

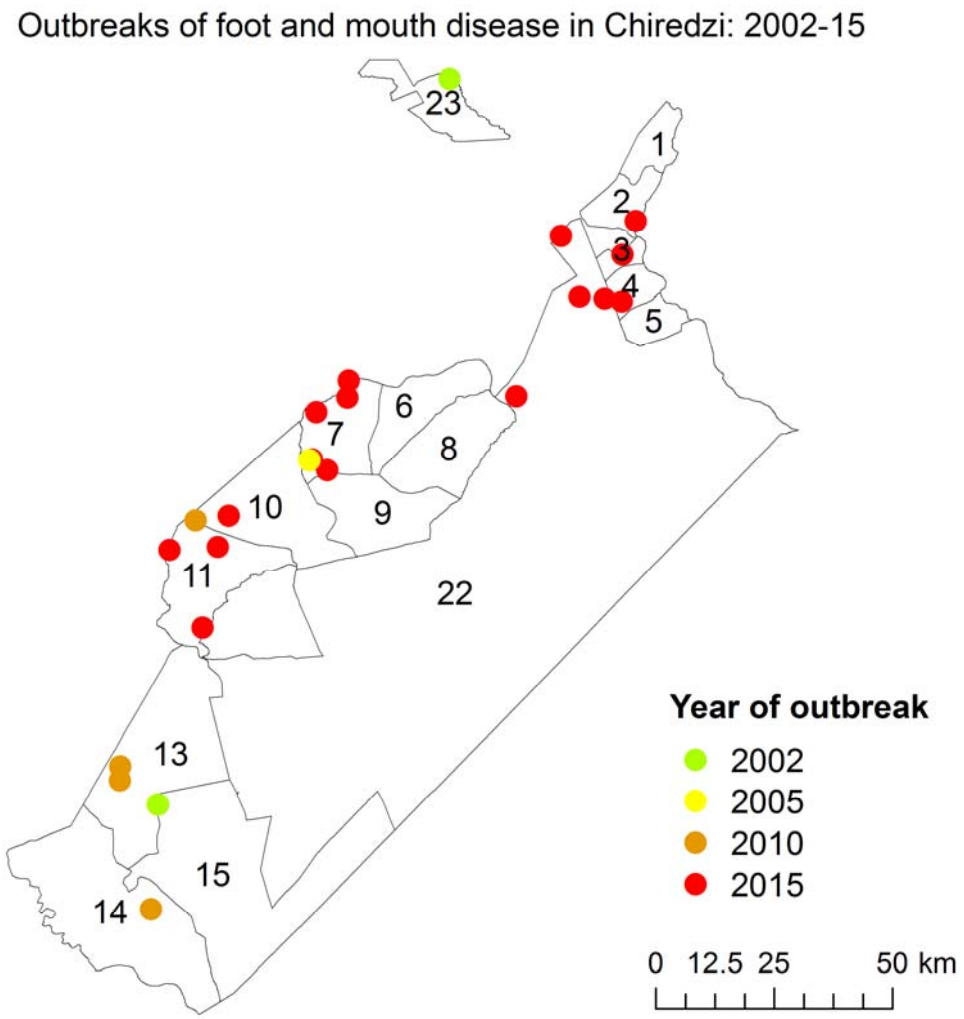


Figure 19: A point map showing location of diptanks reporting FMD in the project wards in Chiredzi between 2002 and 2015. Source: Department of Livestock and Veterinary Services, Harare.

The prevalence of FMD is shown in figure 20. In general there seemed to be a positive association between high prevalence rate and proximity to protected areas with 'dirty' buffalo populations as evidenced by the observed high prevalence of the disease in wards 11 and 22.

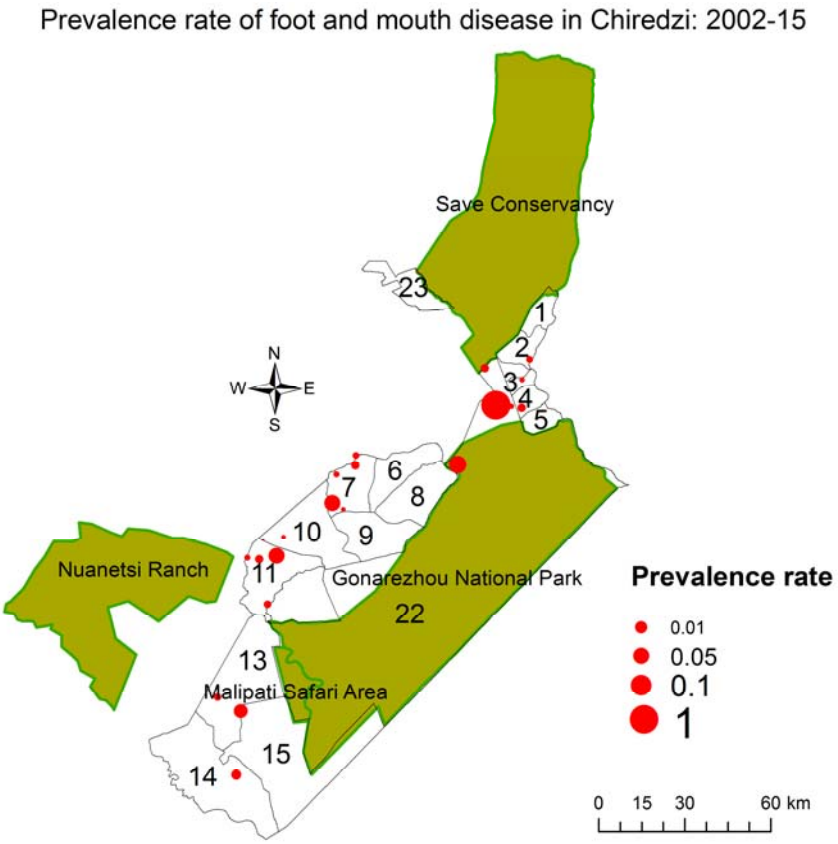


Figure 20: Prevalence rate of FMD in Chiredzi. Protected areas with dirty bufallo are shown to indicate potential transmission routes.

Using the ward as the spatial epidemiological unit of analysis, results in figure 21 indicate that FMD risk varied across wards. As expected ward 22 situated in Gonarezhou National Park with 'dirty' buffaloes had the highest FMD risk followed by wards 14 and 15 that are adjacent to the park. The lowest FMD risk was found in wards 1, 5, 6, 8, 9, 23 and 29.

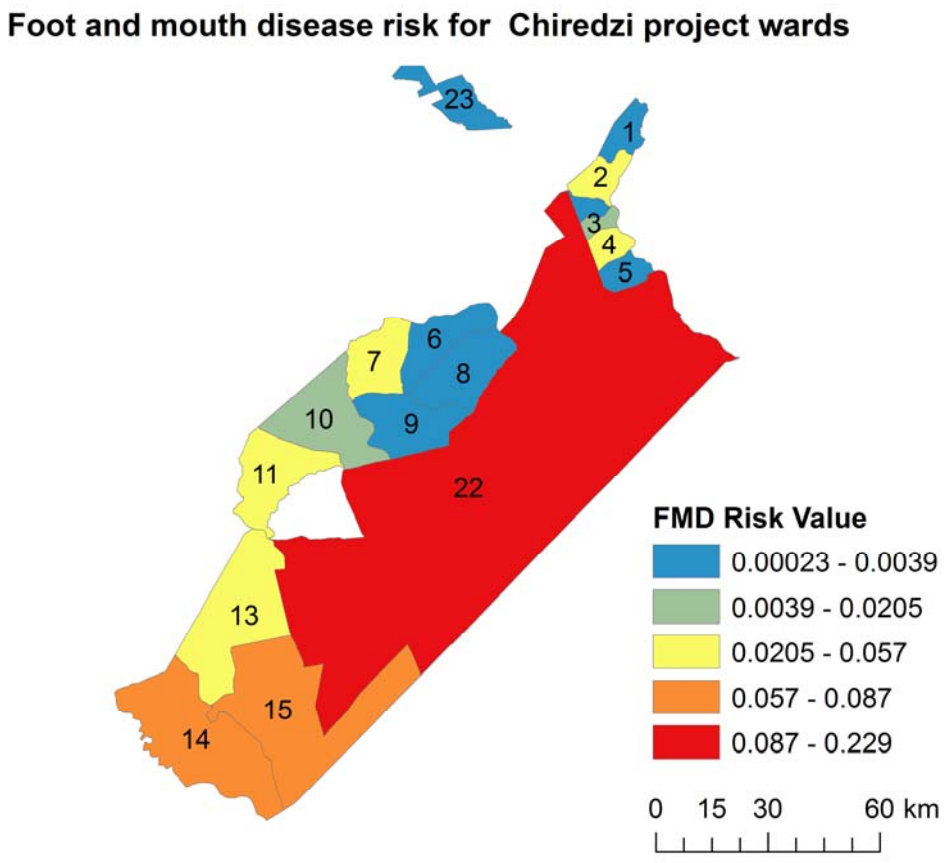


Figure 21: Variation in FMD risk in the project wards in Chiredzi.

Long-term historical data for lumpy skin disease - another cattle disease of economic importance – also revealed high prevalence rate of this disease in all the 17 project wards except wards 3, 4, 5, 6 and 25. This is illustrated in figure 22.

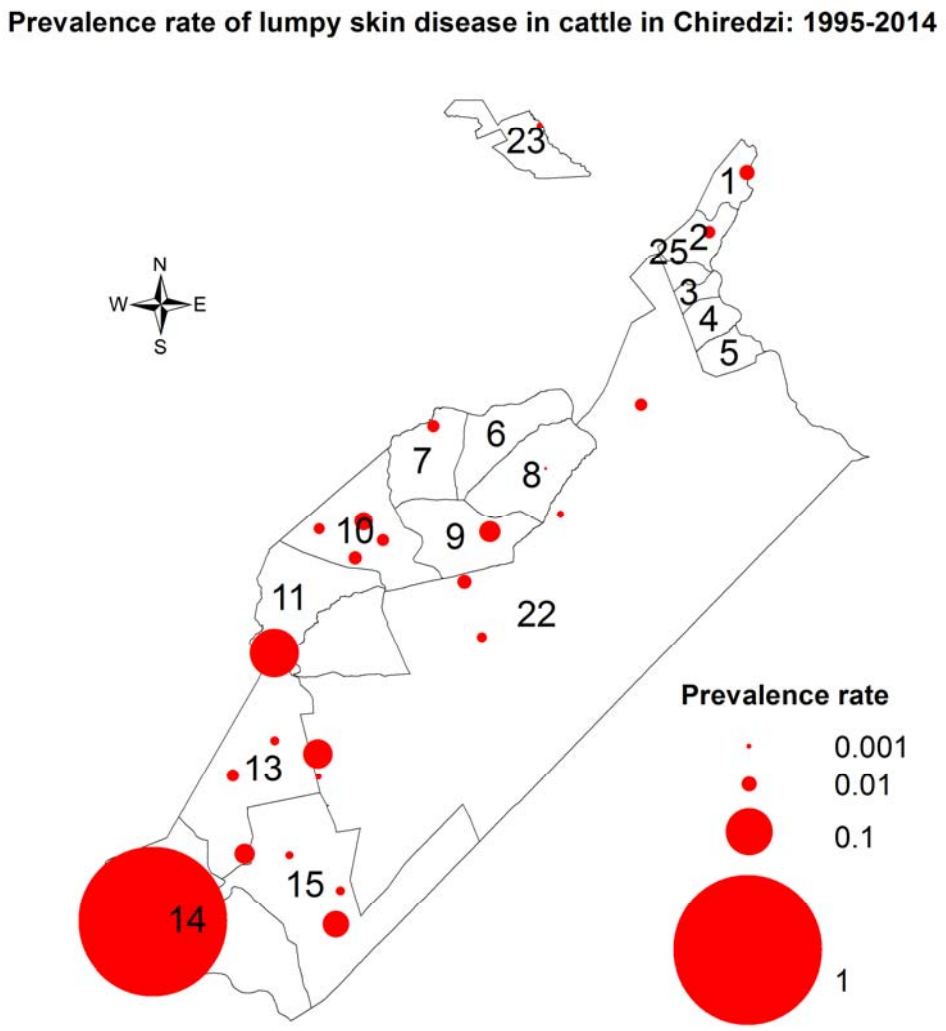


Figure 22: Variation in the prevalence of lumpy skin disease in the project wards in Chiredzi.

During fieldwork, some animals suffering from lumpy skin disease were observed giving a hint that the disease is widespread (see Plate 3).


Plate 3: A cow in the foreground affected by lumpy skin disease spotted in ward 1 of Chiredzi.

Figure 23 shows variation in lumpy skin disease risk in cattle in the target wards in Chiredzi. The data in figure 23 indicates that ward 14 faced the highest risk followed by ward 11 with wards 1, 9 13 and 14 having moderate risk. Wards 3, 4, 5, 6, 8, 23 and 25 faced the lowest risk.

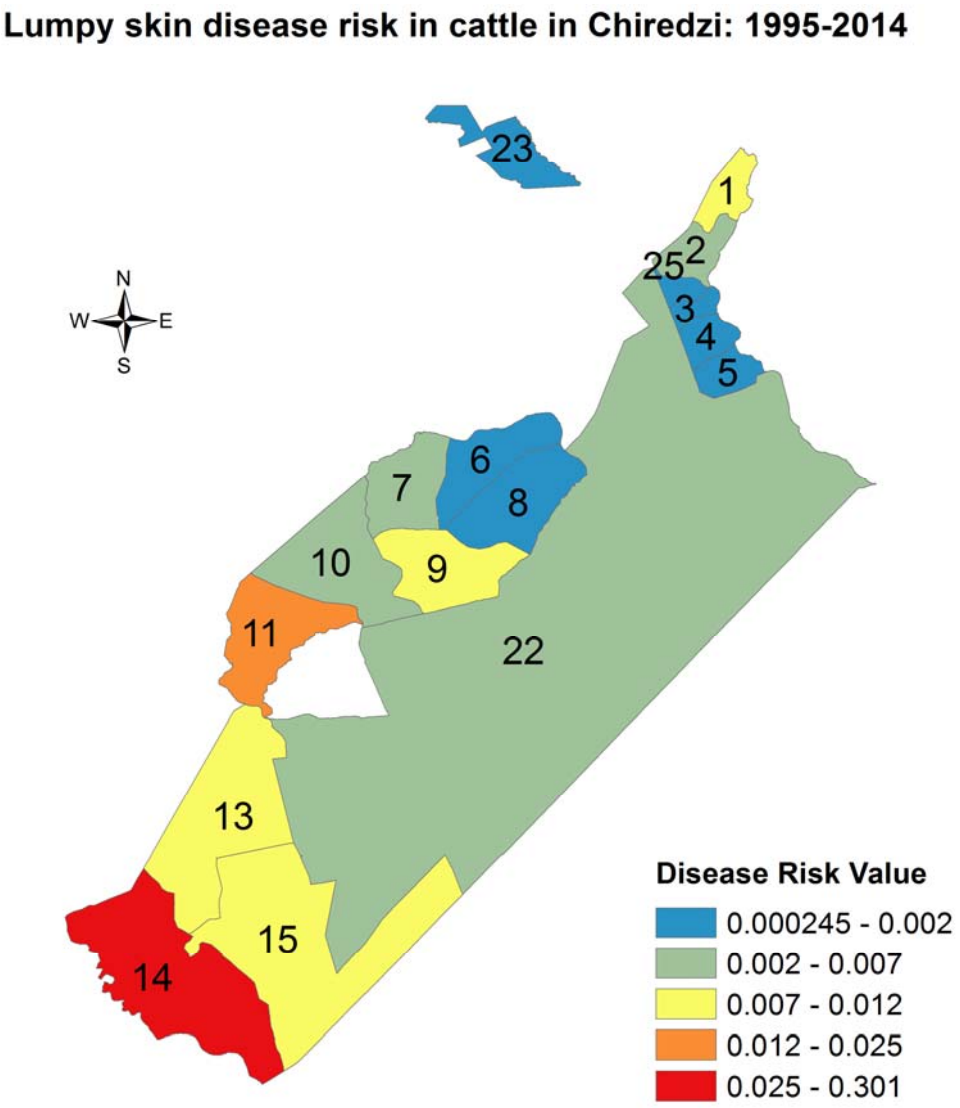


Figure 23: Spatial variation in lumpy skin disease risk among wards in Chiredzi.

Overall, the data on livestock diseases esepcially vector-borne diseases of cattle indicates the high sensitivity of communities to biological hazards that may be aggravated by climate-induced droughts which reduce forage availability and intake. This in turn, compromises the immune response of livestock resulting in numerous deaths due to disease. A cheap and sustainable way to build the resilience of the livestock sector to diseases is to raise awareness so that stock owners follow regular (annual) vaccination series dip their cattle regularly; that is once per week in summer and fortinightly during the dry season.

3.5.5. Flood hazard

In addition to drought and livestock diseases, flood also ranked as a priority hazard in Chiredzi district. Figure 24 presents the spatial probability of flooding in the project wards in Chiredzi. The probability of flooding was high in all the 17 wards but there were apparent variations in flood probability within wards. In general within wards, riparian areas had the highest flood probability. These appear as linear zones of high probability on the map. Areas of relatively low flood probability (potential safe zones), which coincided with hills and ridges, can also be observed for wards 23, 1 and 14.

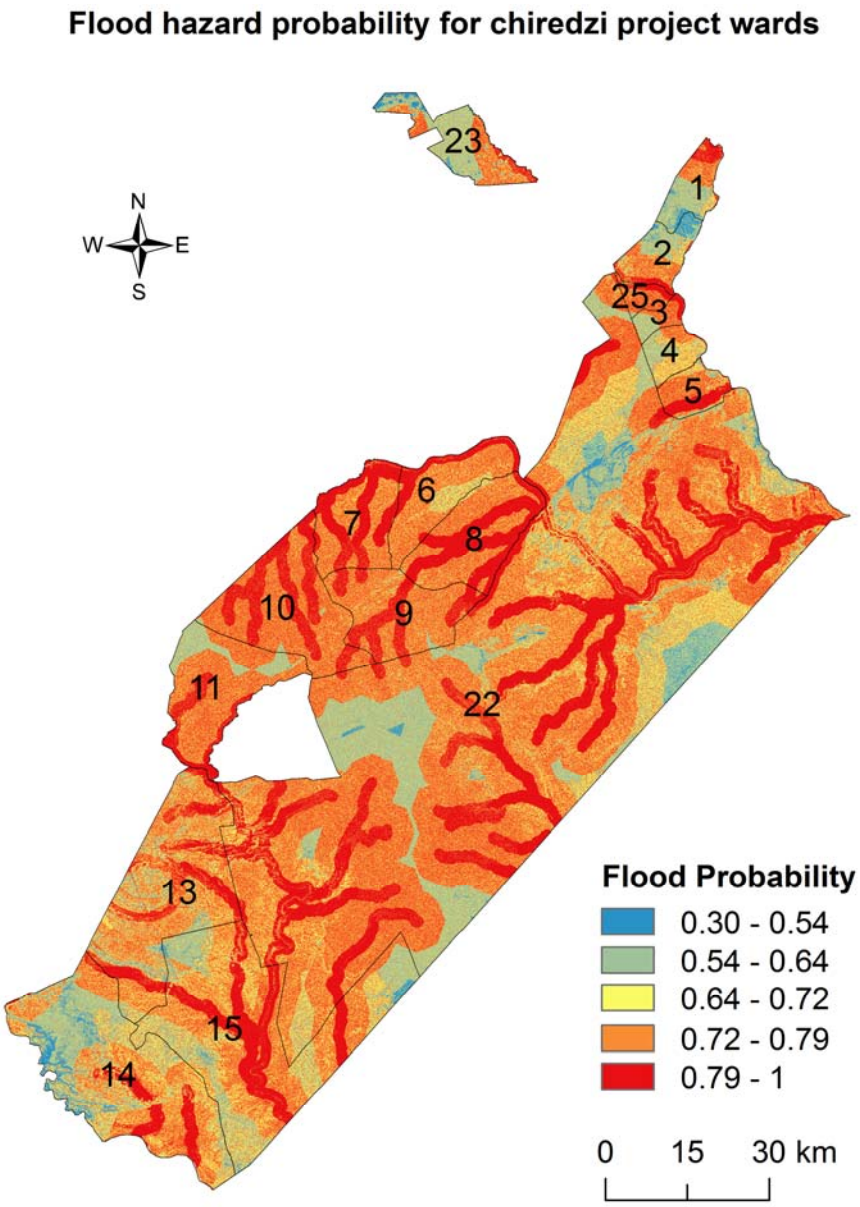


Figure 24: Spatial probability of flood hazard mapped at a grid cell resolution of 30 m throughout the 17 project wards in Chiredzi district.

At ward level, three wards namely ward 8, 9 and 13 had the highest flood risk followed by wards 5, 7, 10 and 15 with high risk. Ward 6 had the lowest flood risk as shown in figure 25. The rest of the wards faced moderately low to high risk ranging from 19% to 55%.

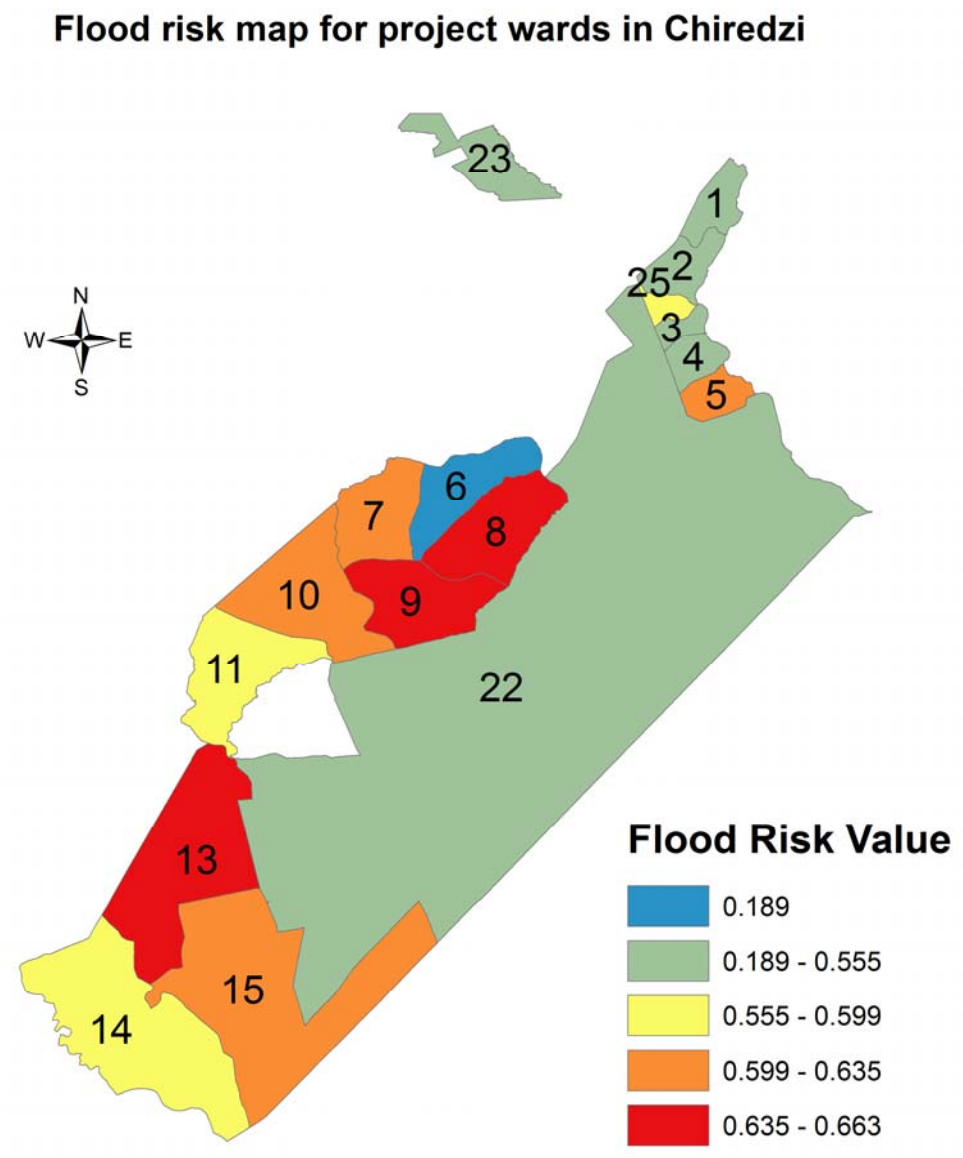


Figure 25: Flood risk map for project wards in Chiredzi.

3.6 Multi-hazard risk

Considering that different hazards often affect the same community simultaneously, the multi-hazard risk was calculated for all the wards based on the top ranked four risks, that is, agricultural drought risk, two cattle disease risks, and flood risk. The multi-hazard risk map for project wards in Chiredzi is presented in figure 26. Wards 13, 14, 15 and 22 located in the southern fringe of the district faced extreme high multi-hazard risk. The multi-hazard risk value was also high for wards 7, 8, and 6 located in the central areas of the district as well as 2, 23 and 25 located in the northern and eastern areas of the district. Ward 6 stood out as having the least multi-hazard risk value owing to its relatively low poverty prevalence and relatively low hazard exposure. Overall, multi-hazard risk ranged from high to extremely high for most wards participating in the ECRAS project.

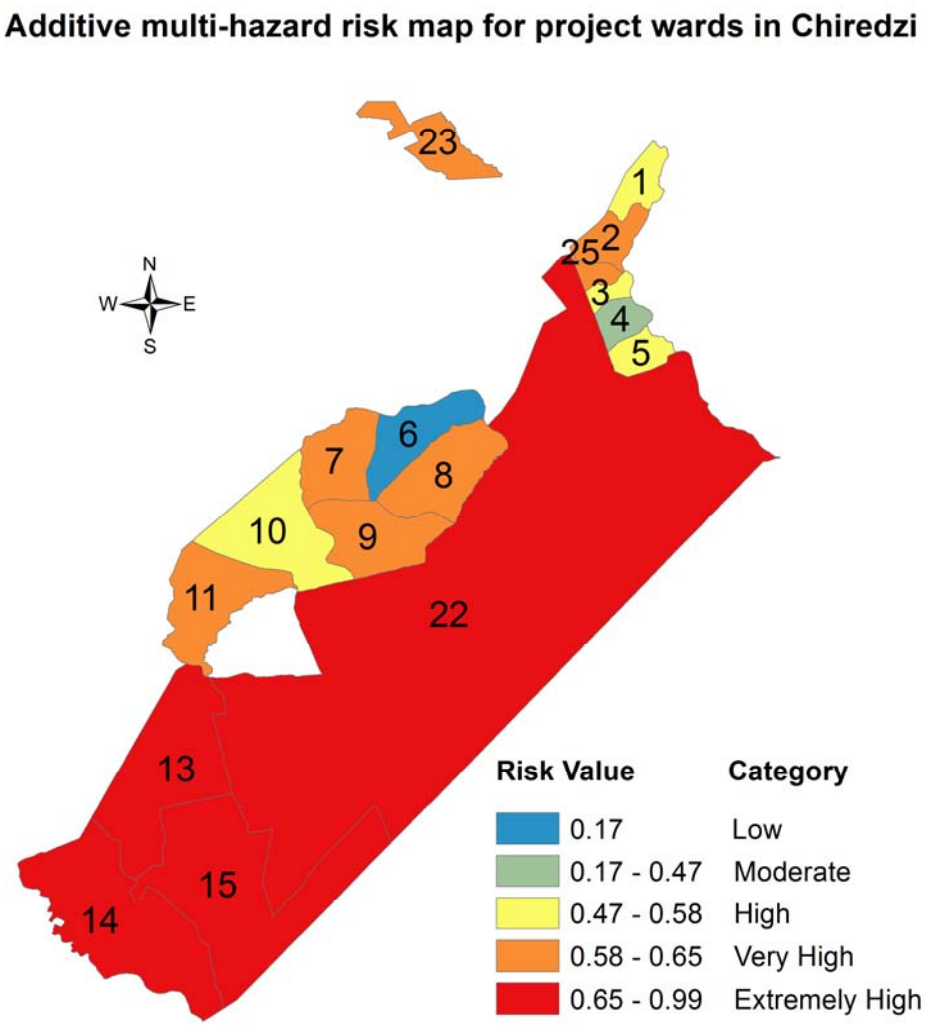


Figure 26: Multi-hazard risk map for Chiredzi wards.

3.7 Institutional capacity assessment

There are many institutions that help communities to cope with hazards such as drought. Sampled households were asked to rate the effectiveness of these institutions based on how quickly they responded when a shock occurred as well as whether the quality of the service they provided was satisfactory. Table 11 indicates that several government departments such as AGRITEX had a wide reach in all the rural wards of Chiredzi and their service was overall good. Although most institutions were rated as good by most respondents at ward level, the role of NGOs deserve 'praise' as it was rated as excellent in the majority of the wards, that is wards 1, 6, 10, 14, 22 and 23.

Table 11: Rating of effectiveness of institutions that work with communities in Chiredzi wards.

Ward	Institution	Poor	Satisfactory	Good	Excellent	*N*
1	AGRITEX	7	7	**16**	6	*36*
	Livestock Production and Development	1	**3**	2		*6*
	Department of Veterinary Services	1	9	**10**	6	*26*
	Civil protection unit	1		**5**		*6*
	Rural district council	5		2		*7*
	Environmental Management Agency	1		4	4	*9*
	Traditional leaders		5	**11**	4	*20*
	Ministry of Gender, Youth & Employment		2	2	1	*5*
	Non-government organisations			11	**19**	*30*
6	AGRITEX	3	1	**12**	**12**	*28*
	Livestock Production and Development	3	3	3	1	*10*
	Department of Veterinary Services	2	9	6	4	*21*
	Civil protection unit	3		3		*6*
	Rural district council	3		1		*4*
	Environmental Management Agency	3	3	3		*9*
	Traditional leaders	1	2	4	5	*12*
	Ministry of Gender, Youth & Employment	3	1	1	1	*6*
	Non-government organisations		1	5	**16**	*22*
10	AGRITEX		5	4	**8**	*17*
	Livestock Production and Development		1	2		*3*
	Department of Veterinary Services		**7**	4	2	*13*
	Civil protection unit			3		*3*
	Rural district council		1			*1*
	Environmental Management Agency	1	1	1		*3*
	Traditional leaders		1	3	3	*7*
	Ministry of Gender, Youth & Employment	1				*1*
	Non-government organisations		2	3	**13**	*18*
14	AGRITEX	3	6	**7**	3	*19*

Ward	Institution	Poor	Satisfactory	Good	Excellent	*N*
	Livestock Production and Development	2				*2*
	Department of Veterinary Services	2	2	**6**	2	*12*
	Civil protection unit	1	1	**4**		*6*
	Rural district council	2	1	1		*4*
	Environmental Management Agency		3			*3*
	Traditional leaders	2	1	**6**	1	*10*
	Ministry of Gender, Youth & Employment			1	1	*2*
	Non-government organisations			8	**12**	*20*
22	AGRITEX	1	1	**13**	2	*17*
	Livestock Production and Development	1		1	2	*4*
	Department of Veterinary Services	1	3	**5**	3	*12*
	Civil protection unit		1	2		*3*
	Rural district council	1	1	2		*4*
	Environmental Management Agency			3	1	*4*
	Traditional leaders	1	6	1		*8*
	Ministry of Gender, Youth & Employment	1				*1*
	Non-government organisations			7	**10**	*17*
23	AGRITEX	2	5	**13**	9	*29*
	Livestock Production and Development			4	5	*9*
	Department of Veterinary Services	5	3	**12**	7	*27*
	Civil protection unit		1	4	4	*9*
	Rural district council	1	1	**6**		*8*
	Environmental Management Agency	1	4	3	4	*12*
	Traditional leaders		3	**12**	7	*22*
	Ministry of Gender, Youth & Employment		2	1	2	*5*
	Non-government organisations		1	5	**25**	*31*

The information in table 11 suggests that the general state of service delivery in Chiredzi is good and institutions such as AGRITEX with a greater community penetration could take a leading role in spearheading resilience building efforts in the district. It is also interesting to explore why communities in most sampled wards perceived NGOs as providing an excellent service. Is it that their service delivery score card system is inherently good or the communities rated them as excellent in anticipation of continued financial and technical support?

4.0 Mwenezi district results

In this section, the results for Mwenezi district are presented following the same thematic approach and structure used for Chiredzi district. The results for the household survey are given first followed by those dealing with quantitative analysis and mapping of priority hazards.

4.1 Household characteristics and demographics

4.1.1 Gender of household head

Figure 27 presents the distribution of the sex of respondents in sampled Mwenezi district wards. The number of female respondents was lower than that of male-headed households in all the sampled Mwenezi ECRAS wards. In view of the fact that respondents were selected in a random manner, the data in figure 27 implies that male-headed households were more numerous than female-headed ones in all the wards.

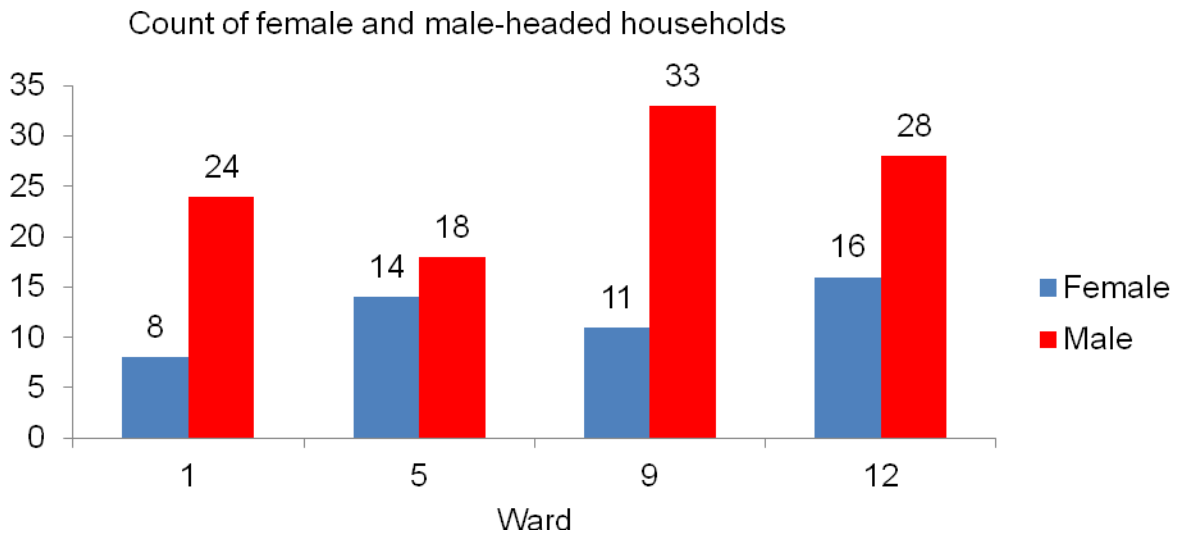


Figure 27: Sex distribution of household respondents interviewed in Mwenezi ECRAS wards.

4.1.2 Educational level of household heads

Figure 28 presents the highest level of education attained by the household head in relation to sex in the four sampled Mwenezi wards. Considering that education is a widely used indicator of human capital, it can be deduced that in wards 1 and 12, the proportion of women with no formal education was higher than that of men at household level. The opposite result was observed in ward 9.

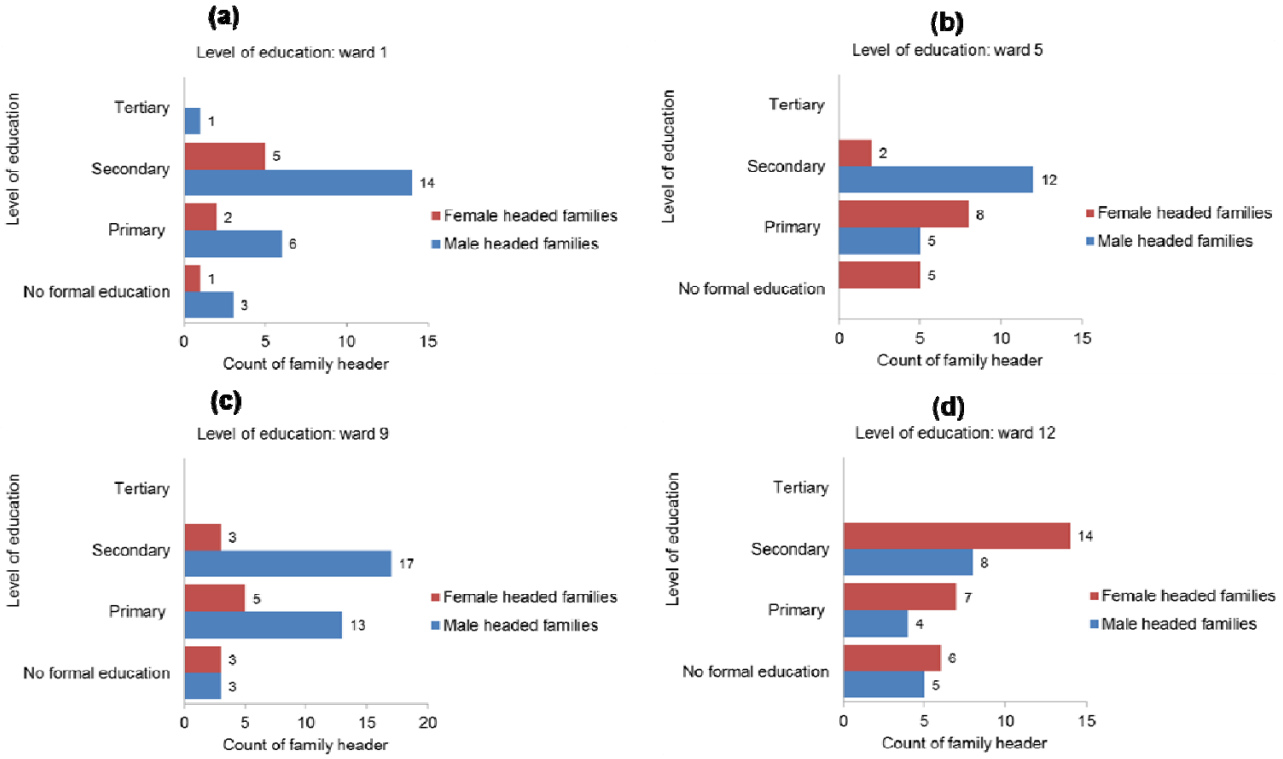


Figure 28: Multi-panel graphs showing highest level of education of the household head in relation to gender in sampled Mwenezi wards.

4.1.3 Age-sex distribution of household heads

Population pyramids calculated from data gathered during the household survey are presented in figure 29. The data shows the demographic structure of the rural population in Mwenezi district. The two main observations that can be made are that the population is youthful and women constitute a larger proportion of the population for the majority of age groups.

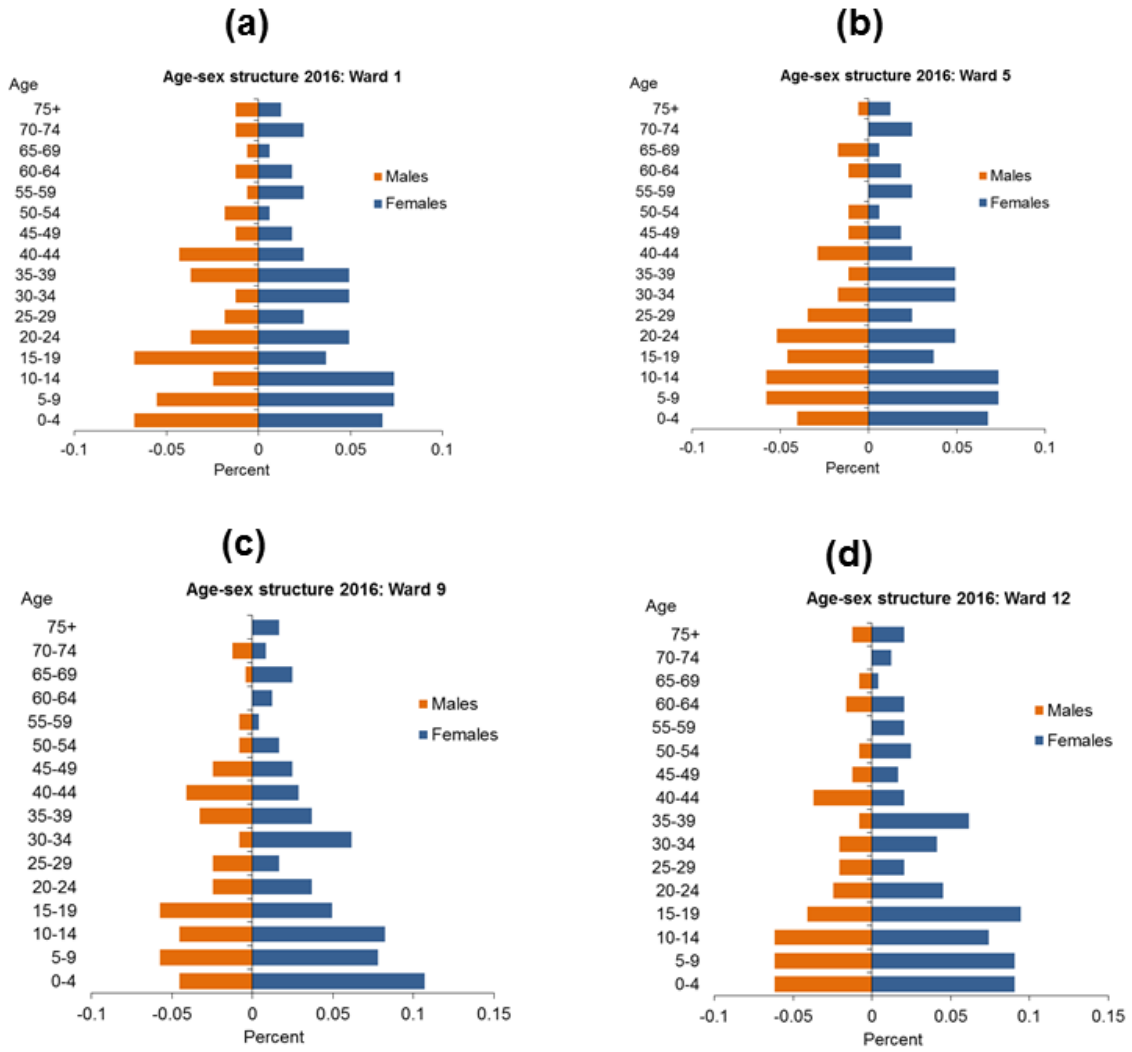


Figure 29: Age-sex distribution of the population in four sampled Mwenezi wards.

With regard to the proportion of key demographic groups, the data in figure 29 indicates that the population classified as of school-going age was 41 %, 40 %, 44 % and 49 % in wards 1, 5, 9 and 12, respectively. The percentage of the potential labour force classified in the 15-64 age category was 56 %, 55 %, 52 % and 53 % in wards 1, 5, 9 and 12, respectively. This result suggests the present of a huge labour force that could be tapped to improve livelihoods. This could be achieved through setting up new small-scale irrigation schemes that are run on a commercial basis such as the commercial-to-communal (CTC) scheme in ward 1 of Chiredzi district.

The elderly comprised 7 %, 5 %, 7 %, and 6 % in ward 1, 5, 9 and 10, respectively. This data implies that social services and social protection need to constitute an integral competent of the toolkit of measures implemented to enhance community resilience to disasters given the presence of this potentially vulnerable group. Some of the social protection services that are already implemented include provision of food relied to the elderly but the continued involvement of external donors implies the scheme lacks in-built sustainability mechanisms.

4.2 Household livelihood strategies

4.2.1 Quality of dwelling units

Table 12 presents information on the quality of housing units in sampled Mwenezi wards. The data presented in table 12 was validated by enumerators in the field. The data in the table indicates that wards 1 and 9 had the highest proportion of respondents who indicated that pole and dagga was their best dwelling unit. By contrast, ward 12 had the highest number of people who indicated that their best dwelling unit was bricks under thatch.

Table 12: Summary of the quality of dwelling units in Mwenezi sampled wards.

Ward number	Gender	Pole and dagga under thatch	Pole and dagga under sheets	Pole and thatch	Bricks under thatch	Bricks under sheets	Sample size (N)
1	Male	1	9	14	0	0	*24*
	Female	0	1	7	0	0	*8*
5	Male	0	1	1	6	10	*18*
	Female	1	0	1	4	8	*14*
9	Male	2	2	20	8	1	*33*
	Female	3	0	6	2	0	*11*
12	Male	4	0	3	10	11	*28*
	Female	1	1	0	9	5	*16*

There were significant sex differences on the quality of some best dwelling units as illustrated in figure 30. In ward 12, the percentage of female household heads who identified pole and dagga as their best dwelling unit was significantly ($Z > 1.96$; $P < 0.05$) lower than that for male household heads. This result is contrary to expectations that women tend to be worse off than men when it comes to the quality of shelter they own. Recognising gender differences in quality of housing and devising evidence-based strategies to deal with such differences is important to improving living conditions. The data presented in figure 30 assist in that goal and point toward the need to improve the quality of housing for women as an intervention to enhance their adaptive capacity to natural shocks such as strong winds.

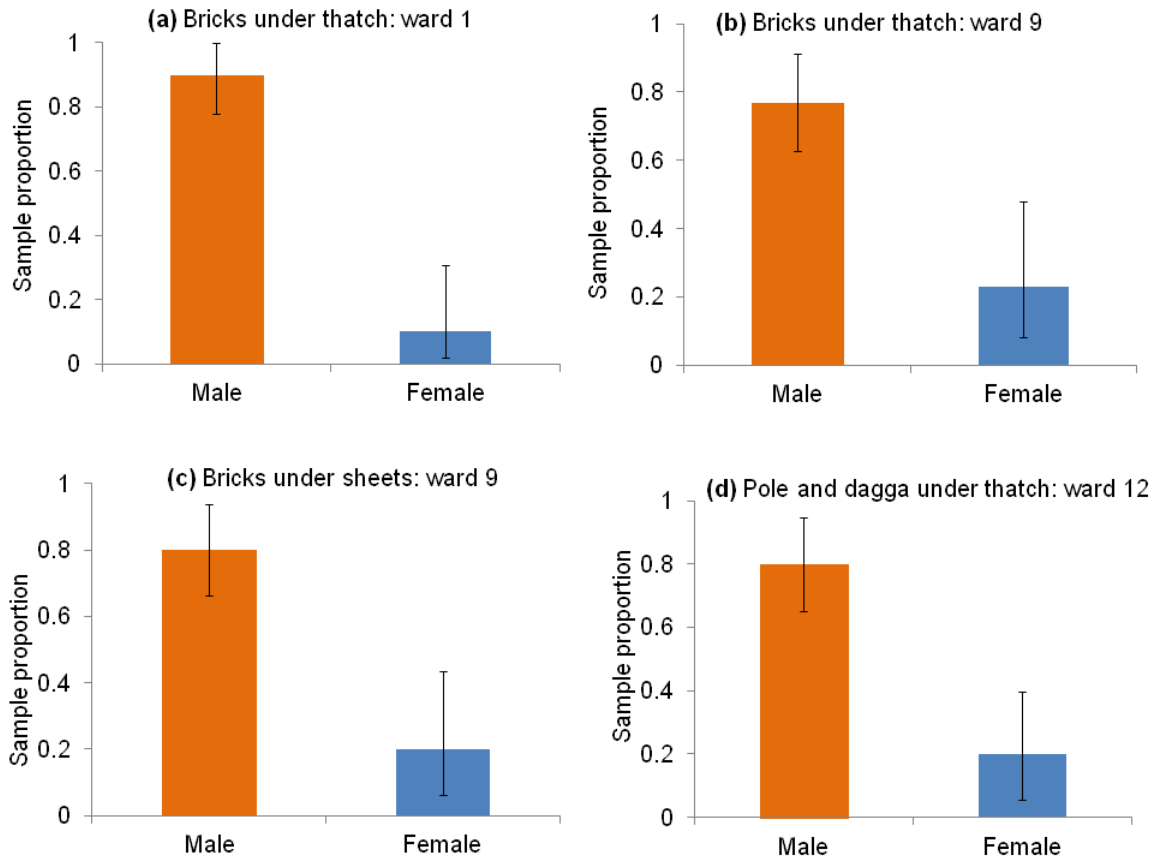


Figure 30: Gender differences in the quality of best dwelling unit in four sampled Mwenezi wards.

4.2.2 General calendar of main livelihood activities in sampled Mwenezi wards

Table 13 shows that sorghum and millet were the major crops grown in Mwenezi district. Cattle and goat production featured prominently in all the wards as the main livelihood activities. Brick moulding as well as the collection and processing of non-timber forest products in particular mopane worms was indicated as also playing an influential though seasonal role in the livelihoods of communities in ward 12. Sesame appeared to be most popular in ward 9.

Table 13: General calendar for major livelihood activities for households in Mwenezi.

Ward	Livelihood activity	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	Sorghum	9	69	78	72	69	69	53	22				
	Millet	3	34	47	63	63	63	44	9				
	Vegetable	78	81	84	75	78	75	81	84	84	84	88	88
	Cattle	59	59	59	63	63	63	63	63	66	66	59	59
	Goat	56	56	56	63	63	63	59	59	59	59	56	56
	Brick moulding	6	6						3	16	19	6	3
	NTFP	13	19	16	6	9	9	9	3	3	9	9	9
5	Sorghum	13	72	84	78	78	69	59	25	6			
	Millet	6	28	31	66	66	50	19	22	3			
	Sesame				9	9	9	3					
	Vegetable	78	69	69	50	50	53	59	63	66	69	75	75
	Cattle	56	59	59	56	56	56	56	56	56	56	56	56
	Goat	66	66	66	66	66	63	66	66	63	63	63	63
	Brick moulding	3	3	3					3	9	9	9	6
	NTFP	6	16	31	19	22	22				6	6	
9	Sorghum	11	39	75	75	75	75	73	20	5			
	Millet	5	27	48	84	82	68	45	11	2			
	Sesame	0	7	9	11	11	9	5	2				
	Vegetable	43	41	48	57	57	61	64	70	75	75	75	77
	Cattle	70	75	75	75	75	73	70	70	68	68	68	68
	Goat	61	61	61	68	68	68	64	64	64	61	61	61
	Brick moulding	2			5	5	2	7	11	23	32	32	16
	NTFP	7	11	16	39	43	50	9	2	2	7	11	5
12	Sorghum	5	32	57	68	66	59	50	18	5	2		
	Millet	9	34	59	91	82	82	61	16	2			
	Sesame		2	2	2	2	2	2					
	Vegetable	61	61	66	50	50	52	59	59	66	61	61	61
	Cattle	70	70	70	70	68	68	68	70	73	73	70	68
	Goat	64	66	66	64	64	64	64	64	64	64	64	64
	Brick moulding	11	5	2	2			7	14	41	57	50	27
	NTFP	5	2	7	20	34	43	20	11	11	14	16	

Colour shading corresponds with the period when farmers are doing activities related to the value chain. The number shown indicates % of farmers engaging in the value chain.

4.2.3 Household cash needs

Figure 31 illustrates that food dominated the cash needs of households in all four sampled Mwenezi wards. This suggests most households fail to produce enough food for their own consumption hence they resort to buying additional food. Education ranked second in terms of household cash needs. The data in figure 33 points towards food and education as priority areas for cash injection into the community.

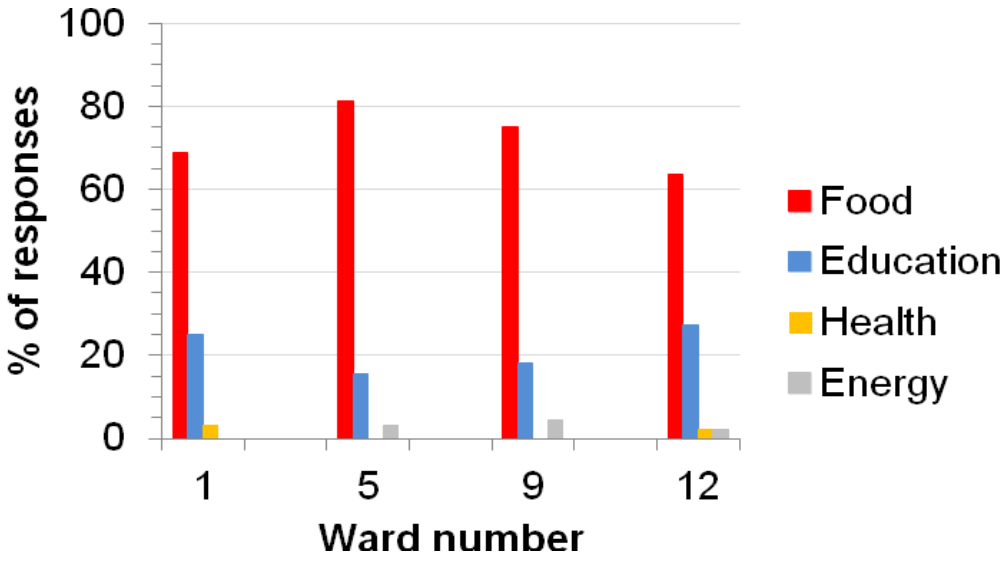


Figure 31: Main cash needs of households in sampled Mwenezi wards.

4.2.4 Priority resources for women and men in Mwenezi wards

In contrast to Chiredzi ECRAS wards, there were no statistically significant differences (Z statistic < 1.96; $P > 0.05$) with regard to whether land, water, forests, shelter, means of transport, farming equipment, access to information, income, access to credit, improved nutrition, access to health services and education were more important to men than women or vice versa. However, water, access to land for farming, improved nutrition as well as access to health care services were identified as resources by the highest number of women and men in wards 1, 5, 9 and 12.

4.2.5 Access and control of key assets in Mwenezi wards

Table 14 presents data indicating how respondents estimated the economic value of the key physical assets they own. There was a wide range in the median economic value of building structures. The median value was lowest in ward 12 (USD 500) but highest in ward 5 (USD 2,000). The median total number of heads of cattle owned by a household was 4 with a range between 1 and 24. The median economic value of cattle was USD 130 with a large range of USD 800 (ward 5) and USD 2,000 (ward 1). The percentage of respondents who indicated that they own cattle in wards 1, 5, 9 and 12 of Mwenezi was 59 %, 34 %, 43 %, 48 %, respectively. These percentages suggest more than half of the households do not own cattle in the Mwenezi ECRAS wards hence boosting the community herd there may go a long way in building community resilience as cattle can easily be converted to cash when shocks strike. The median monetary value of goats owned by a household varied between wards. It was lowest in wards 5 and 9 (USD 120) and highest in ward 1 (USD 306). The data in table 14 indicates wide variation in the valuation of productive assets at household level and this may explain wide fluctuations in prices, which tend to benefit middlemen as revealed by the value chain analysis.

Table 14: Descriptive statistics for physical assets owned by households in Mwenezi wards.

Asset	**Ward number**	**1**	**5**	**9**	**12**
Number of buildings	Mean	3	3	4	4
	Median	3	3	4	4

Estimated value of buildings (USD)	Mean	3,691	3,897	1,238	1,069
	Median	1,000	2,000	700	500
Number of cattle	Mean	8	6	5	6
	Median	5	4	4	5
Estimated value of cattle (USD)	Mean	2,931	1,123	1,378	1,614
	Median	2,000	800	900	1,500
Estimated value of goats (USD)	Mean	306	152	231	506
	Median	175	120	120	150

The data on the value of productive assets offers ECRAS an opportunity to exploit these assets especially cattle to expand household income through value-addition. In the case of cattle, value addition may be realised through centralised marketing of cattle as well as pen feeding the beasts prior to sale. For goats, the option to market them overseas needs to be explored but this requires boosting the goat population to satisfy the market. A novel way to efficiently market the livestock is 'landscape labelling'. This entails providing evidence that owing to the unique landscape (sweet veld) and hot climate in which the livestock are famed, the quality of the meat is superior to those from other regions. In other words, product differentiation must form the cornestone of the interventions aimed at increasing market penetration by farmers in Mwenezi districts. This also applies to Chiredzi communities.

4.2.6 Sex differences in ownership and control of assets in Mwenezi ECRAS wards

Table 15 presents significant differences between men and women in ownership and control of resources and productive assets such as land, vegetable gardens, and goats. The data presented in table 15 suggests that the ownership of gardens and vegetable gardens rested more with women. Significant differences between men and women in the ownership and control of mobile phones were also observed in wards 5 and 22. With regard to other assets such as land for farming, equipment and boreholes sex appeared not to matter.

Table 15: Significant sex differences in ownership and control of assets in Mwenezi wards.

Ward	**Assets**	**Owner of asset**		**Who has right to use**		**Who controls asset**	
		Male	Female	Male	Female	Male	Female
1	Goats	7^{a}	12^{a}	6^{a}	10^{a}	6^{a}	$\mathbf{12^{b}}$
	Garden	3^{a}	$\mathbf{9^{b}}$	8^{a}	9^{a}	2^{a}	$\mathbf{10^{b}}$
	Indigenous chickens	6^{a}	$\mathbf{15^{b}}$	7^{a}	9^{a}	3^{a}	$\mathbf{14^{b}}$
	Mobile phone	9^{a}	$\mathbf{17^{b}}$	10^{a}	15^{a}	8^{a}	$\mathbf{18^{b}}$
5	Goats	9^{a}	$\mathbf{17^{b}}$	11^{a}	14^{a}	11^{a}	13^{a}
	Garden	2^{a}	$\mathbf{13^{b}}$	3^{a}	$\mathbf{12^{b}}$	3^{a}	$\mathbf{12^{b}}$
	Indigenous chickens	4^{a}	$\mathbf{15^{b}}$	7^{a}	12^{a}	6^{a}	$\mathbf{13^{b}}$
	Mobile phone	9^{a}	15^{a}	7^{a}	12^{a}	8^{a}	$\mathbf{15^{b}}$
9	Cattle	$\mathbf{17^{a}}$	9^{b}	15^{a}	13^{a}	16^{a}	12^{a}
	Garden	3^{a}	$\mathbf{12^{b}}$	5^{a}	9^{a}	3^{a}	$\mathbf{10^{b}}$
	Indigenous chickens	8^{a}	$\mathbf{17^{b}}$	12^{a}	17^{a}	11^{a}	18^{a}

Ward	Assets	Owner of asset		Who has right to use		Who controls asset	
12	Garden	4^{a}	$\mathbf{18^{b}}$	8^{a}	14^{a}	6^{a}	$\mathbf{15^{b}}$
	Indigenous chickens	7^{a}	$\mathbf{29^{b}}$	7^{a}	$\mathbf{13^{b}}$	9^{a}	$\mathbf{27^{b}}$
	Mobile phone	11^{a}	$\mathbf{21^{b}}$	13^{a}	18^{a}	13^{a}	20^{a}

Note, only numbers with different small letters of the English alphabet presented as superscripts in a row ($^{a:b}$) (e.g., owner of asset) indicate significant difference between women and men for the same variable being assessed.

4.2.7 Household food security in Mwenezi

Figure 32 illustrates that many respondents evaluated their crop harvests as insufficient to meet the household needs. In particular, in wards 5 and 9, 63 % and 65 % of the respondents indicated that they did not harvest adequate yields to meet household consumption requirements presented in figure 34.

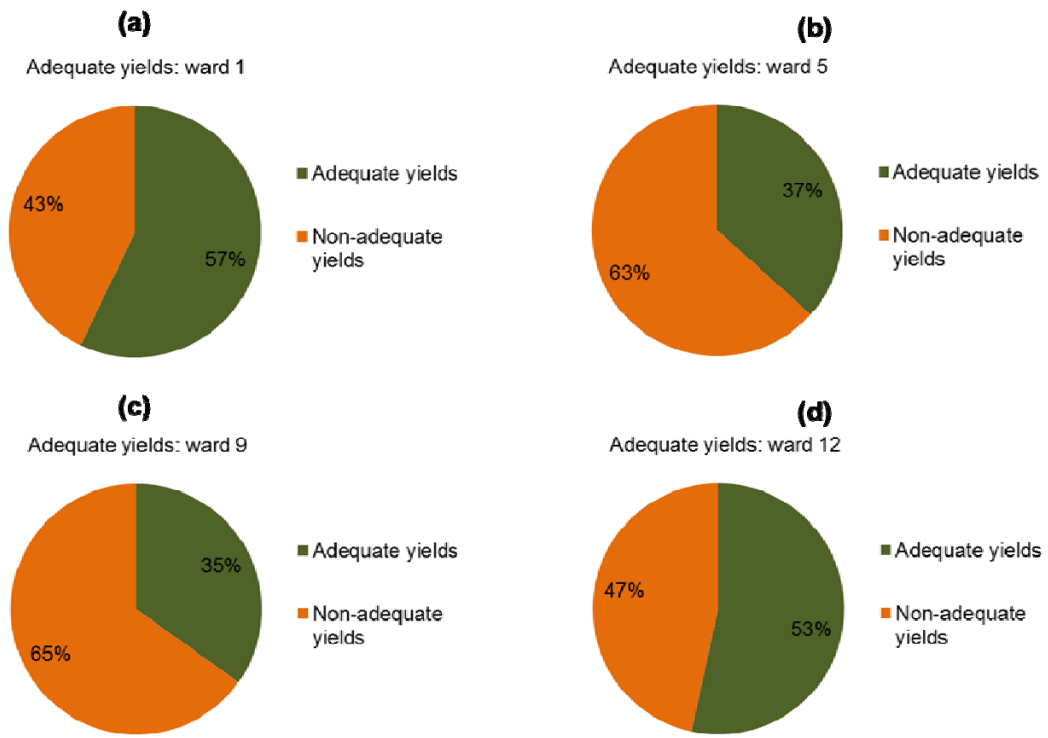


Figure 32: Adequacy of crop yields at household level in sampled Mwenezi wards.

The responses in figure 32 are in accordance with data on the daily frequency of meals consumed by households illustrated in figure 33. There was wide variation within and across wards in the number of meals consumed per day with more respondents stating that they had two meals per day in wards 5 and 12 whereas in ward 1, most respondents indicated that they had one meal per day. In ward 5, 28 % of the respondents indicated that they had on one meal.

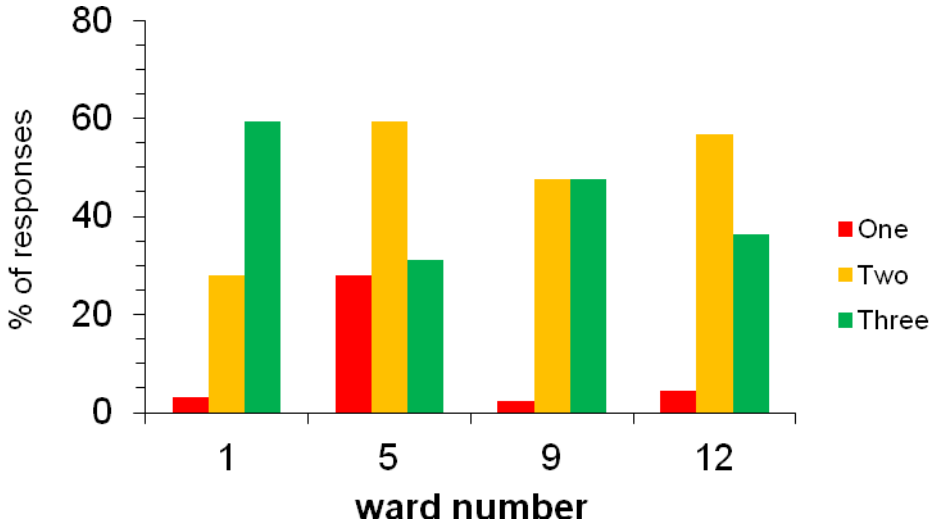


Figure 33: Variation within and across wards in the number of meals consumed by households daily in Mwenezi wards.

Figure 34 illustrates that more than 60 % of the households indicated that they spent days without food. This result was the same for all the sampled Mwenezi wards. The implication of this result is that there is widespread food insecurity at household level in rural Mwenezi. Several factors including erratic rainfall, declining soil fertility, reliance on rain-fed agriculture and impact of drought likely interact in a complex way to account for high food insecurity in rural Mwenezi. It is therefore clear that tackling food insecurity at the household deserves priority in project efforts aimed at increasing community resilience to hazards in the district.

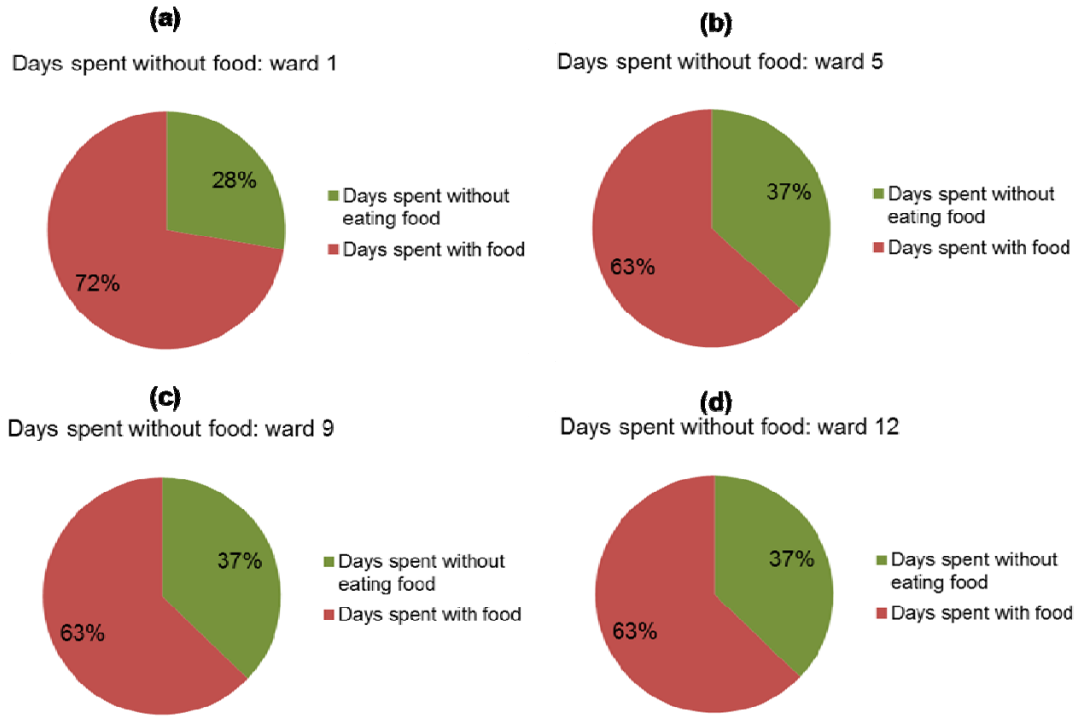


Figure 34: Variation within and across wards in the number of days spent with and without food in Mwenezi wards.

4.2.8 Membership to a community savings/lending group

Access to micro credit has been shown to help poor farming communities to diversify their income base in developing countries (Ellison 1996). This reduces dependence on farm income thereby enhancing the resilience capacity of communities to shocks. The data in figure 35 indicates that micro-credit schemes existed in Mwenezi district but the membership was variable. Over 30 % of the respondents in wards 1 and 5 indicated that they had membership to a village savings and lending (VSL) group. The membership was low in wards 9 and 12 (< 12%) and yet such membership is critical to accessing capital needed to start small businesses that could cushion households against shocks by reducing reliance on farm income. Therefore, part of the programming for the ECRAS project must include simultaneously expanding the membership of VSL groups to wards where these do not yet exist and increasing membership where such groups currently exist. From FGDs, it emerged that the current membership is dominated by women but there is great scope in building overall community resilience by promoting male membership in separately run groups.

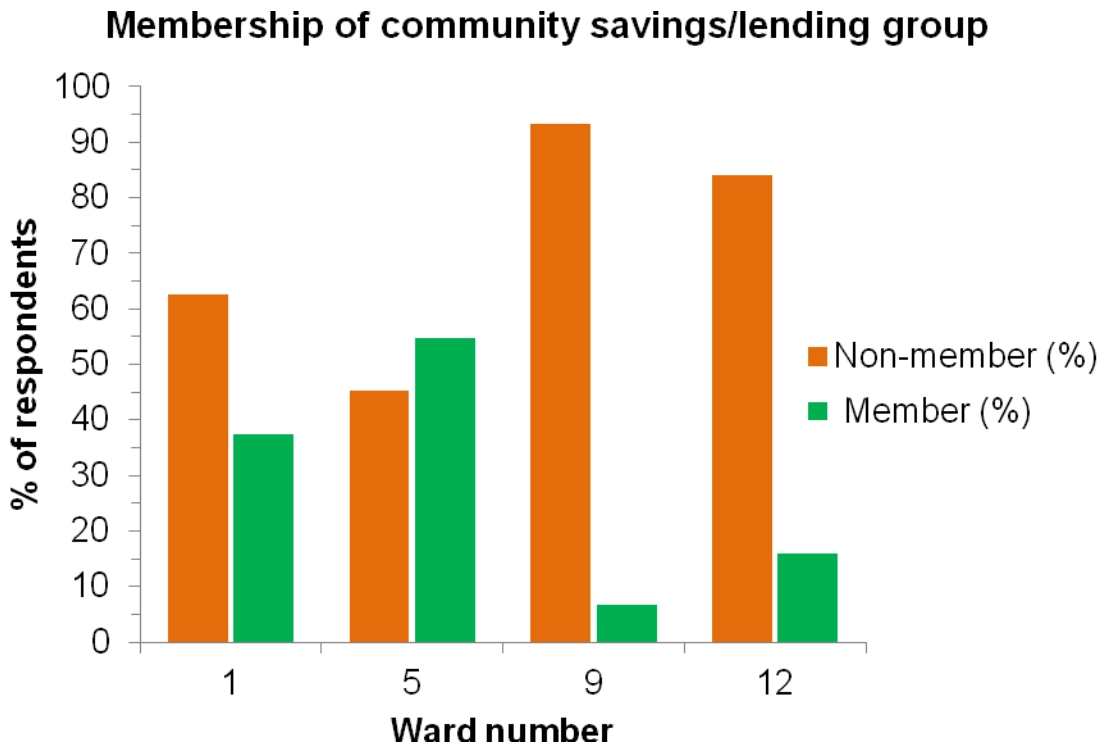


Figure 35: Membership to community savings/lending groups in sampled Mwenezi ECRAS wards.

4.3 Water supply and health services in Mwenezi

The main sources of water for domestic use and livestock watering are illustrated in figure 36. The results for ward 9 are peculiar in that both people and livestock depended on unprotected surface water (that is rivers/streams) as their main water source. In the other three wards (ward 1, 5 and 12), communally-owned protected boreholes were indicated to be the main water source. Figure 37 shows that borehole coverage in Mwenezi was low resulting in people relying on open unprotected water sources which compromises human health.

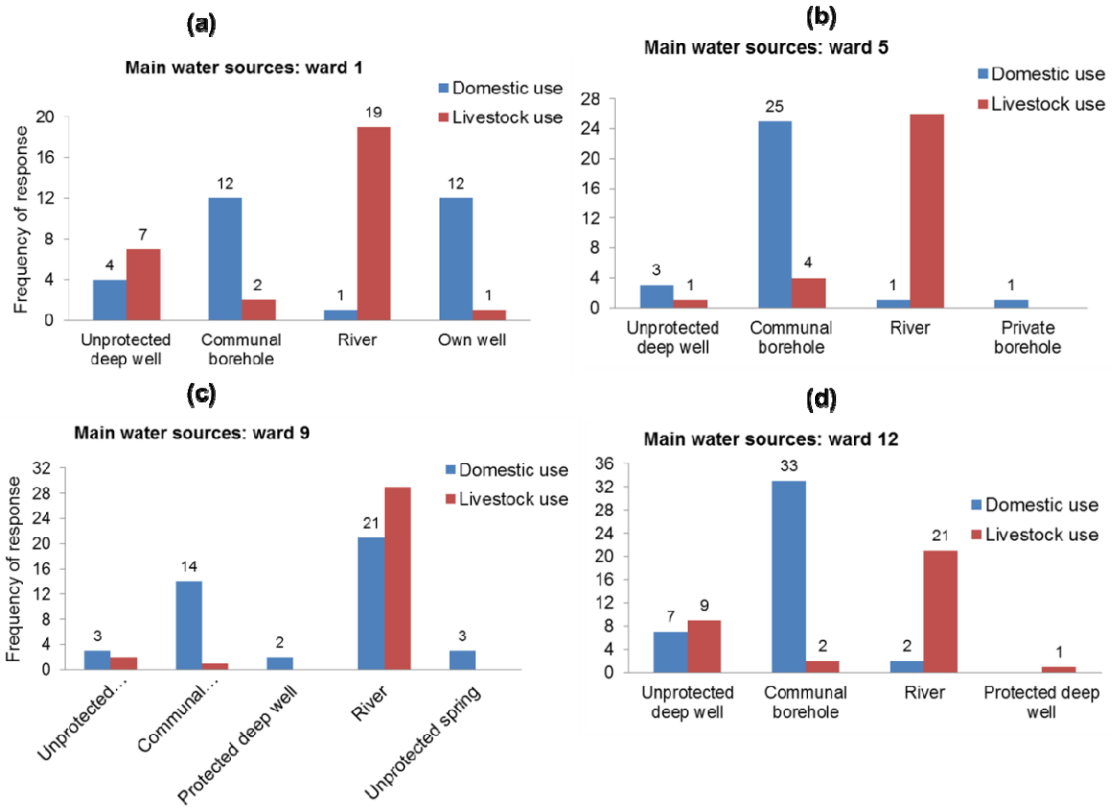


Figure 36: Variation within and across wards in the main water sources for domestic use and livestock watering in Mwenezi wards.

Similar to the observations made in Chiredzi, public clinics constituted the most important component of the health delivery system in wards 1, 9 and 12. In these wards, most respondents (> 59 %) indicated that they accessed medical services at public clinics as illustrated in figure 37. In ward 5, which is closer to Mwenezi rural district hospital, most respondents (96 %) indicated that they accessed medical services at a public health institution. It is therefore clear geography plays a role in shaping the type of facility accessed by households for health services.

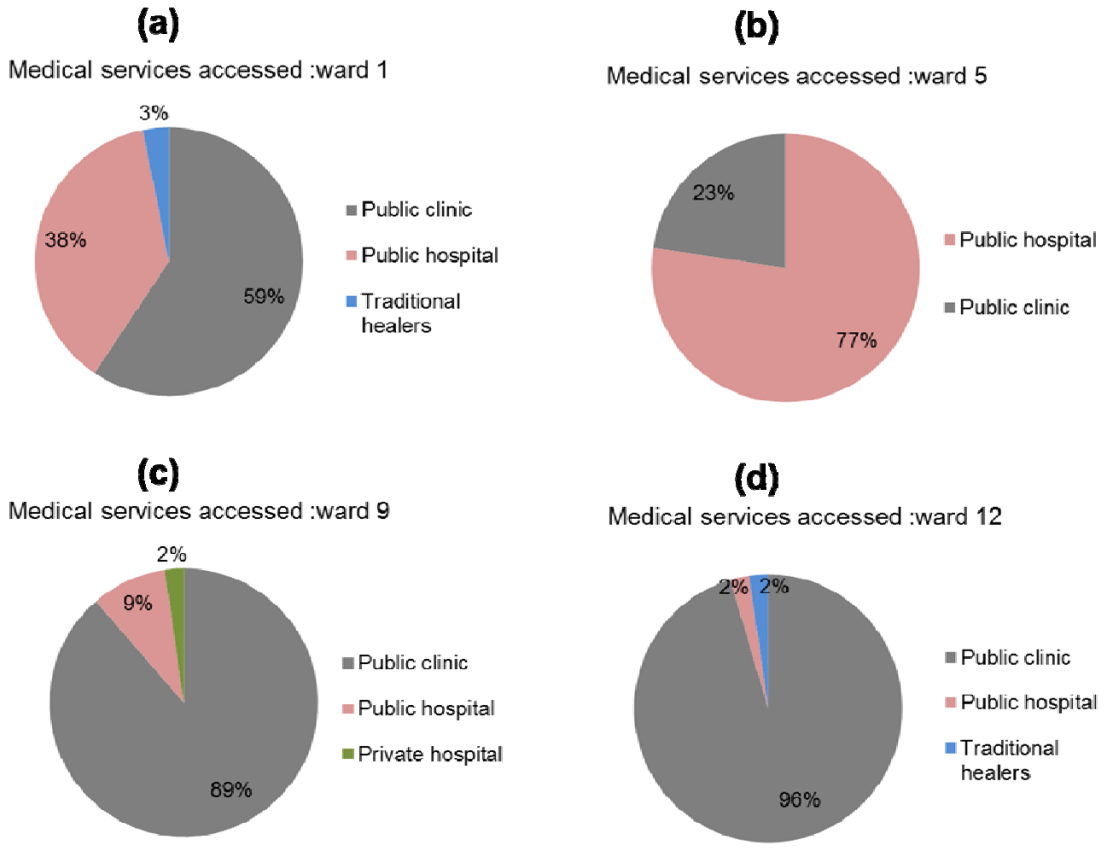


Figure 37: Major providers of medical services identified by residents in Mwenezi wards.

4.4 Vulnerability and resilience of communities to hazards

The top five ranked hazards identified by households are presented in figure 38. The overwhelming majority (> 70%) ranked drought as the number one hazard in all the four wards. In wards 5, 9 and 12 heat wave was identified as the second most important hazard by slightly more than 20 % of the respondents. Livestock diseases ranked third in ward 9 and 12 whereas in ward 1 they ranked fifth. Strong destructive winds were listed among the top five hazards in wards 1, 5 and 9. The ranking of hazards in Mwenezi ECRAS was qualitatively similar to that for Chiredzi (see figure 15) and broadly mirror the key hazards that emerged from FGDs and KIIs. The elements at most risk from these top ranked hazards were listed as: people, infrastructure such as bridges, schools and homes, crops, livestock especially cattle, goats and poultry.

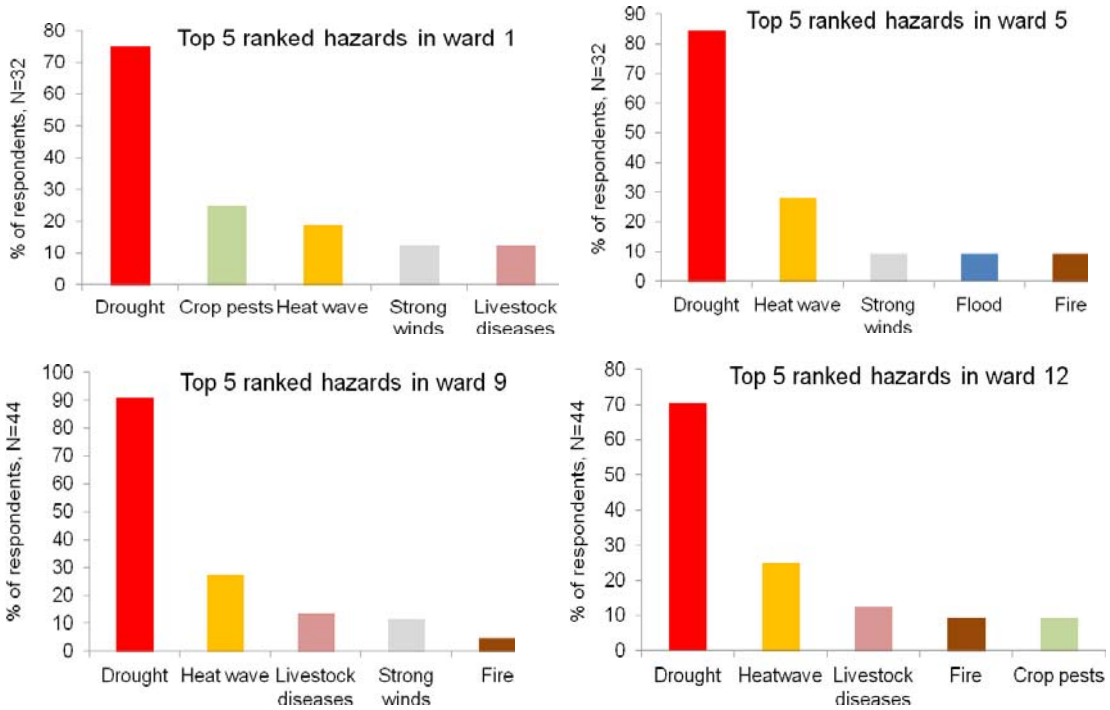


Figure 38: Top five priority hazards at household level in sampled ECRAS wards of Mwenezi.

With regard to outbreaks of livestock diseases, the specific bacterial and viral diseases of livestock that emerged as significant during FGDs and KIIs were: blackleg, FMD, lumpy skin for cattle as well as newcastle and fowl pox for poultry.

4.4.1 Hazard risk assessment profiles for Mwenezi

Table 16 presents the risk matrices for the top five ranked hazards identified at household level in the sampled wards of Mwenezi. Table 16 indicates that at household level, drought was consistently classified in the very high risk category owing to both its high frequency of occurrence and very high potential damage. The risk assessment score for livestock disease was high in wards 9 and 12 but low in ward 1.

Table 16: Hazard risk assessment matrix for priority hazards in Mwenezi district

Ward	Top 5 Hazards	N	Damage Potential	N	Likelihood	N	Risk	Sample size

1	Drought	24	VH	18	VH	16	VH	32
	Crop pests	8	H	2	VH	1	VH	
	Heat wave	6	M	1	VH	2	H	
	Strong winds	4	L	1	VH	2	ML	
	Livestock diseases	4	L	3	L	1	L	
5	Drought	27	VH	27	VH	24	VH	32
	Heat wave	9	H	4	VH	8	VH	
	Strong winds	3	L	1	VH	1	M	
	Flood	3	L	3	VH	0	M	
	Fire	3	L	3	VH	1	M	
9	Drought	40	VH	36	VH	35	VH	44
	Heat wave	12	H	12	VH	11	VH	
	Livestock diseases	6	M	4	VH	2	H	
	Strong winds	5	L	1	VH	1	M	
	Fire	2	L	2	VH	0	M	
12	Drought	31	VH	25	VH	28	VH	44
	Heat wave	8	H	5	VH	8	VH	
	Livestock diseases	4	L	4	VH	3	H	
	Fire	3	L	3	VH	1	H	
	Crop pests	3	L	1	VH	1	M	

L = Low, M = Moderate, ML = Moderately low, H = High, VH = Very High.

4.5 Hazard frequency and risk mapping in Mwenezi

4.5.1 Agricultural drought

The multi-temporal distribution of extreme agricultural drought is mapped in figure 40. The data in figure 40 shows that during the period 1999 to 2016, the worst agricultural drought occurred in 2016. All the 12 communal wards with the exception of ward 10 were equally affected by this drought. However, within each ward the areas that were affected differed and this variation must inform targeted intervention.

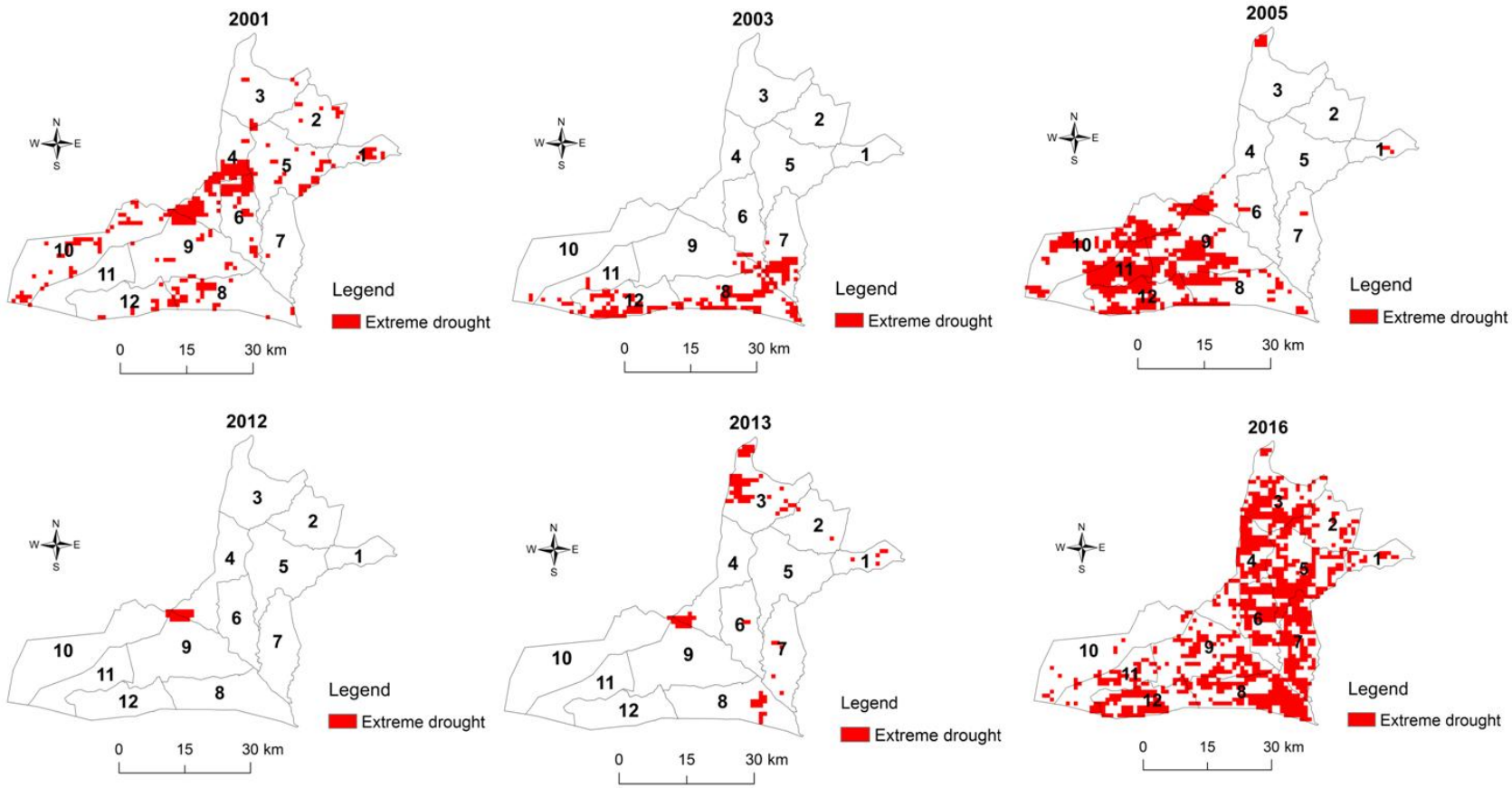


Figure 39: Distribution of extreme agricultural drought for selected years in Mwenezi ECRAS project wards.

With regard to drought risk, figure 40 indicates that ward 2 had the highest drought risk followed by wards 3 and 5. Drought risk was also high for wards 4, 6, 7, 9, 10 and 11. Only wards 8 and 12 had the moderately high drought risk in the range 44 to 45% owing to their relatively low poverty prevalence, which implies relatively high adaptive capacity.

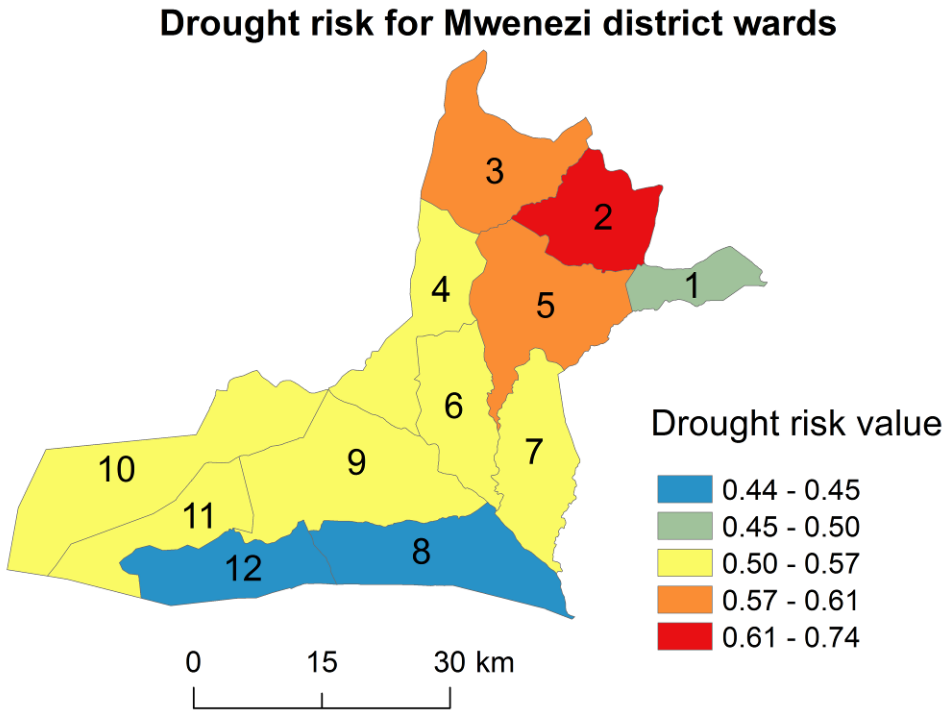


Figure 40: Variation in drought risk among Mwenezi wards.

4.5.2 Cattle disease outbreaks

The widespread occurrence of FMD in cattle (see figure 41) was also an important characteristic of the veterinary disease landscape in Mwenezi and farmers have to cope with this diseases every year. FMD was prevalent in Mwenezi owing to the proximity of the district to protected areas with 'dirty' buffalo populations as well as due to increased mixing of cattle herds in the post land reform era (Swiswa et al. 2016). The encouraging observation is that only one dip tank close to the boundary of wards 2 and 3 recorded FMD in 2015 as a result of control efforts by the Department of Veterinary Services following provision of funds by the Food and Agricultural Organisation (FAO).

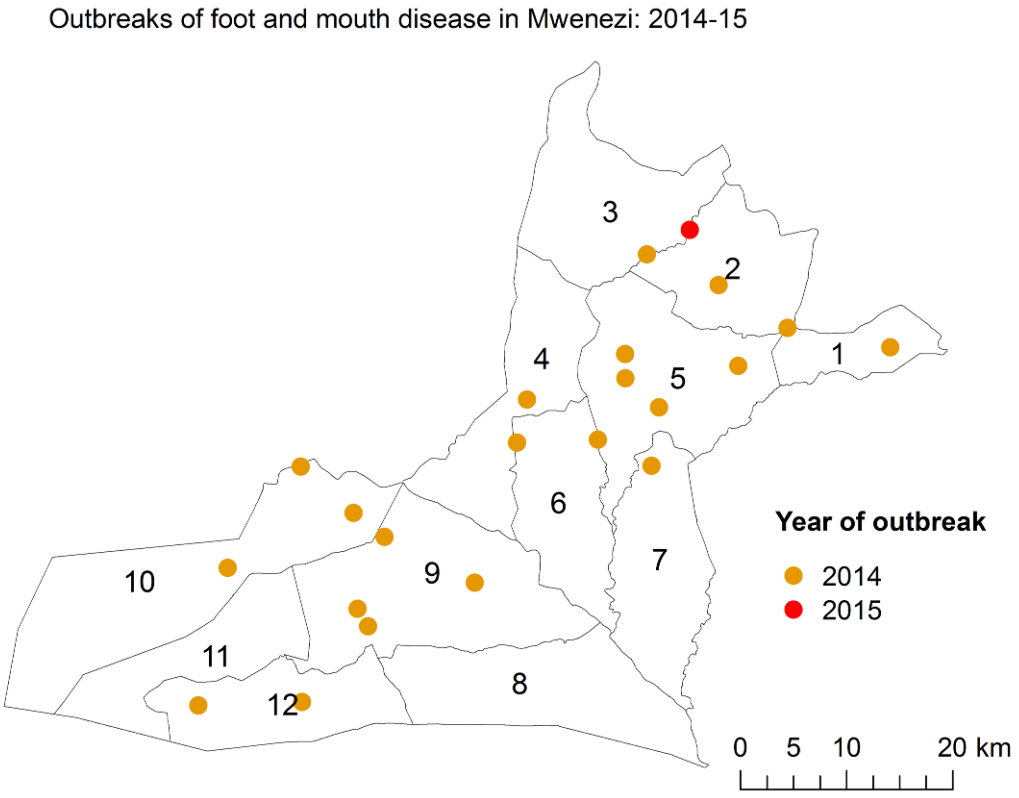


Figure 41: A point map showing location of diptanks reporting FMD outbreaks in Mwenezi between 2014 and 2015. Source: Department of Livestock and Veterinary Services.

Figure 42 shows high prevalence rate of FMD in all the project wards of Mwenezi. Ward 8 stood out as having reported no cases of FMD hence its low prevalence. In contrast, wards 2, 4 and 7 had the highest prevalence rate of FMD compared to other wards.

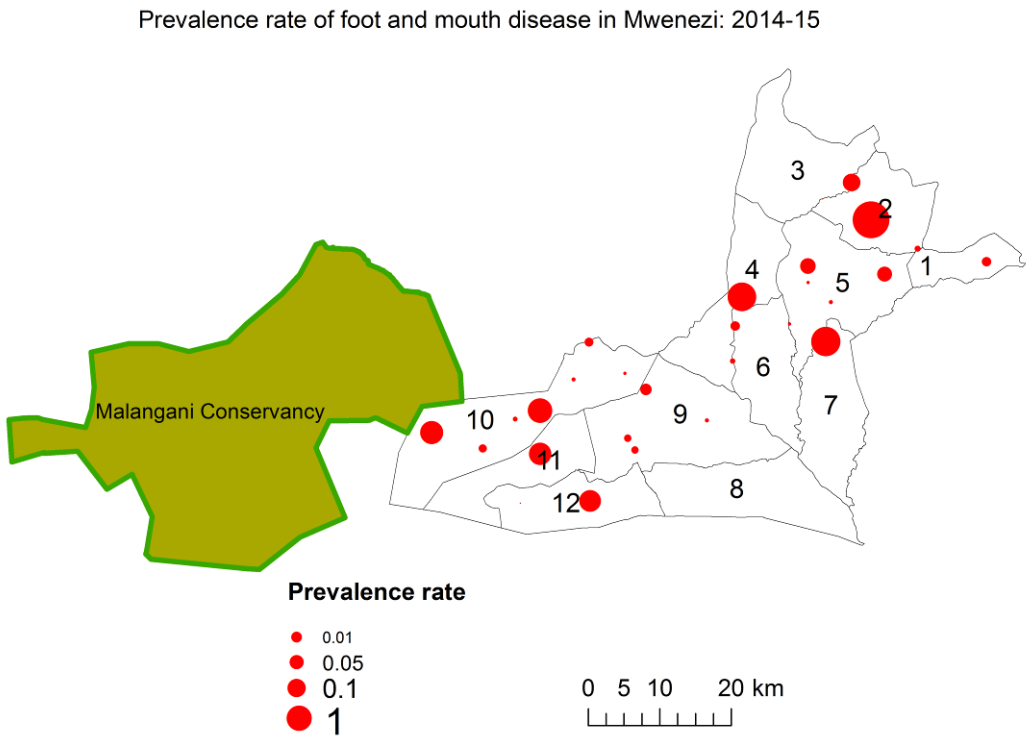


Figure 42: Spatial variation in the prevalence rate of FMD in the 12 project wards of Mwenezi district. Source: Department of Livestock and Veterinary Services.

Differences in FMD risk can be observed in the project wards in Mwenezi as shown in Figure 43. Wards 2 and 7 were characterised by the highest FMD risk value (8.5-11.7 %) compared to other wards. Three wards namely wards 3, 4 and 7 faced the second highest FMD risk in the range 3.2 to 8.5 %. Ward 8 had the lowest FMD risk followed by wards 1, 6 and 9.

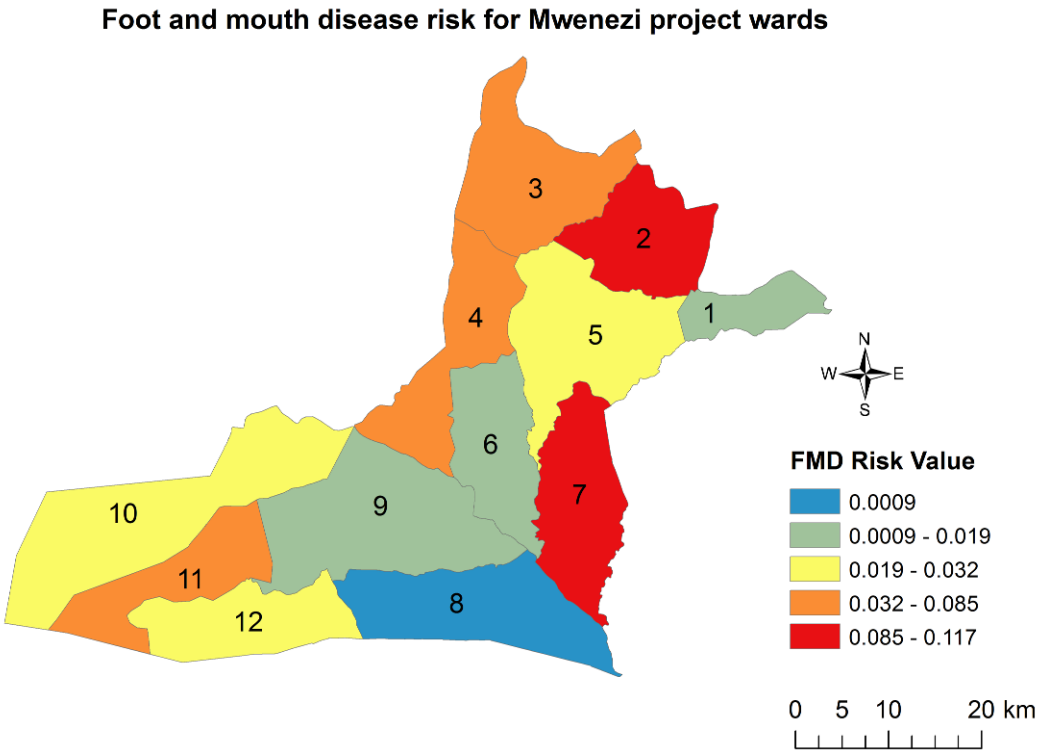


Figure 43: Variations in FMD risk among the 12 project wards in Mwenezi district. Source: Department of Livestock and Veterinary Services.

The prevalence rate of lumpy skin disease (LSD) in cattle for the period 1995-2014 in the project wards in Mwenezi district is shown in figure 44. The data in figure 44 indicates that ward 8 followed by wards 9, 10 and 5 had the highest prevalence rate compared to other wards. Ward 11 had no reported cases of LSD during the period assessed. Overall, LSD was prevalent in most of the project wards making it a priority disease affecting cattle production and performance in Mwenezi ECRAS wards.

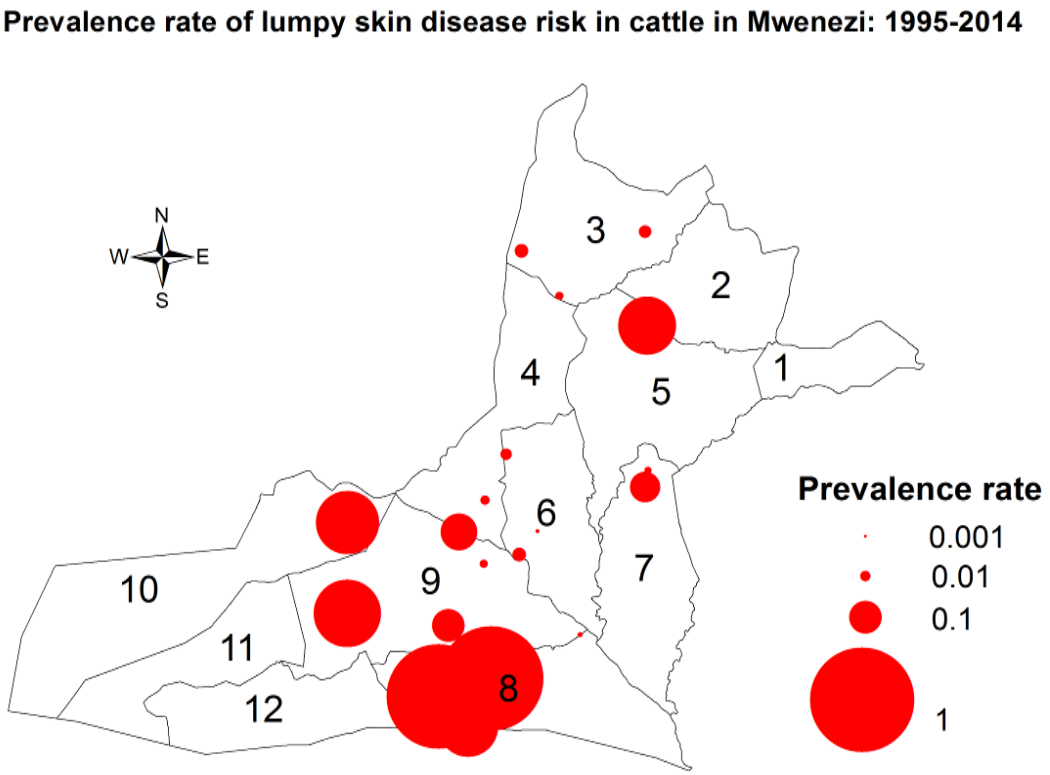


Figure 44: Variation in LSD prevalence rate in cattle shown using proportional circles among 12 project wards in Mwenezi district. Source: Department of Livestock and Veterinary Services.

Figure 45 indicates that LSD risk was highest in wards 5 and 8 followed by wards 9 and 10 with a risk value in the range 3.9 to 9.3%. Four wards namely wards 1, 2, 11 and 12 had the lowest LSD risk. LSD risk was also relatively low for wards 3, 4 and 6 as illustrated in figure 45.

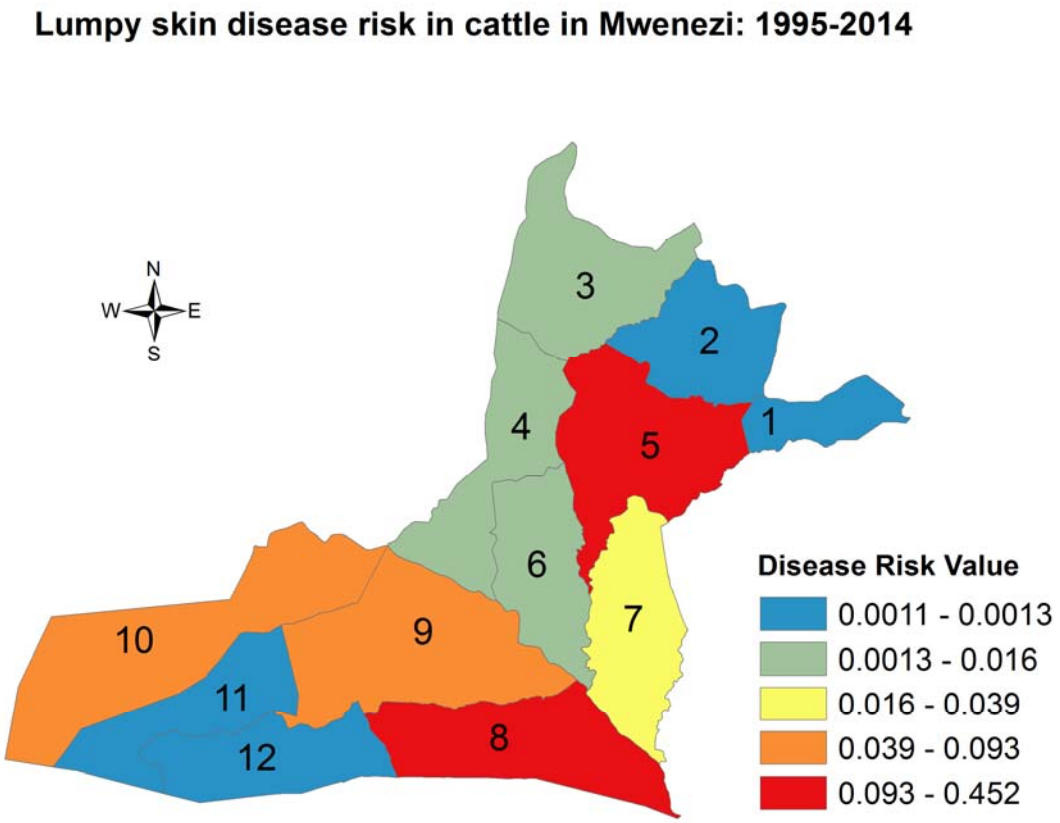


Figure 45: Differences and similarities in LSD risk in cattle among 12 Mwenezi project wards. Source: Department of Livestock and Veterinary Services.

4.5.3 Flood hazard

Figure 46 illustrates how flood hazard represented by the probability of flooding varied within and across the 12 ECRAS project wards of Mwenezi district. Numerous potential safe zones can be observed in wards 2, 4, 5 and 10. These areas were characterised by the presence of granitic mountains and ridges. In all the wards, riparian zones had the highest flood probability ranging between 7.9 to 9.8 %.

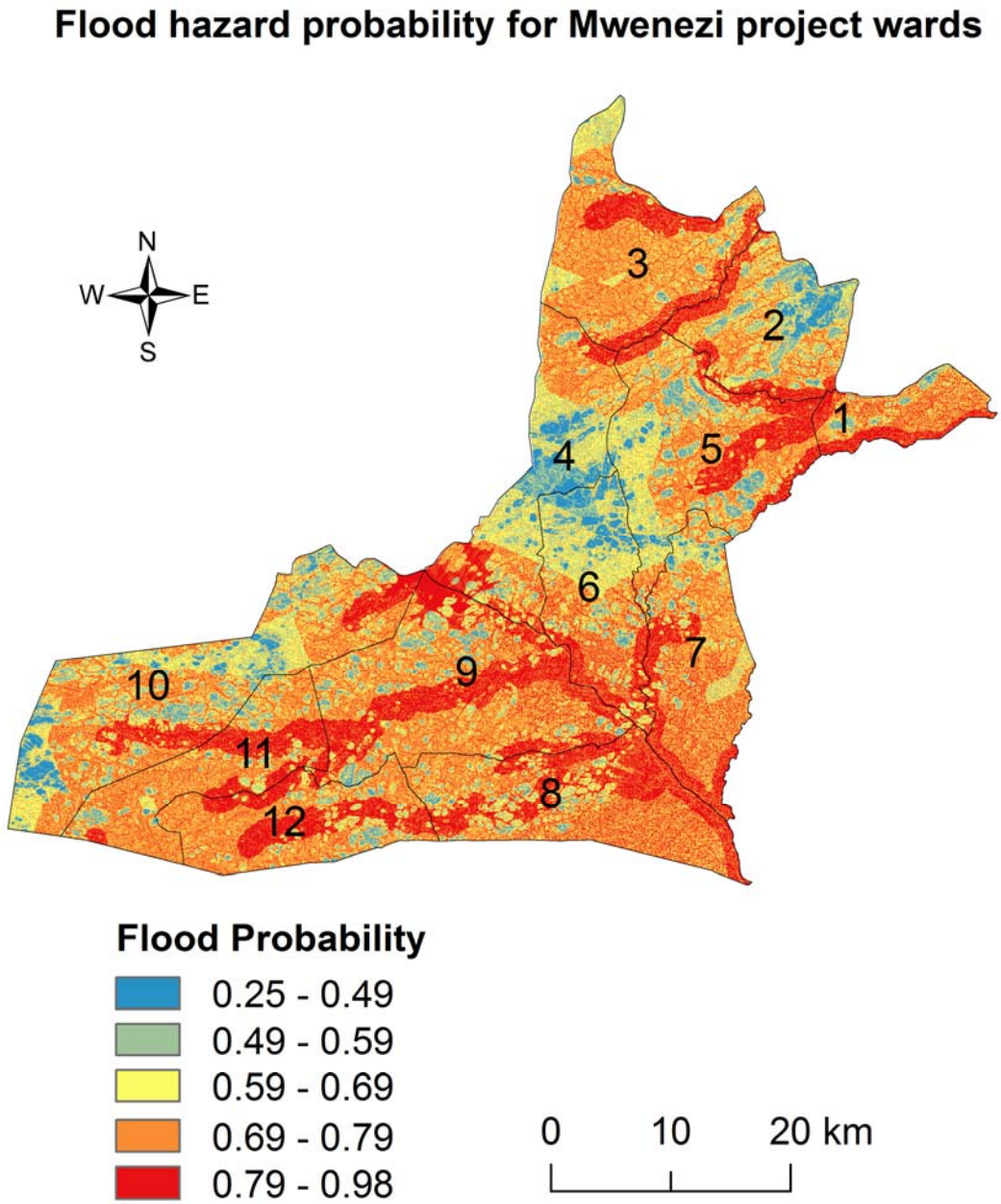


Figure 46: Spatial probability of flood hazard in the 12 project wards in Mwenezi district.

With regard to flood risk, wards 8, 9 and 12 stood out as having the highest risk exceeding 63.5 % as illustrated in figure 47. These wards were followed by wards 7 and 11 with a high flood risk in the range 57.8 and 63.5%. Wards 4 and 5 were classified as having a relatively low risk of about 52 %. The other four wards (1, 3, 6 and 10) had moderately high flood risk.

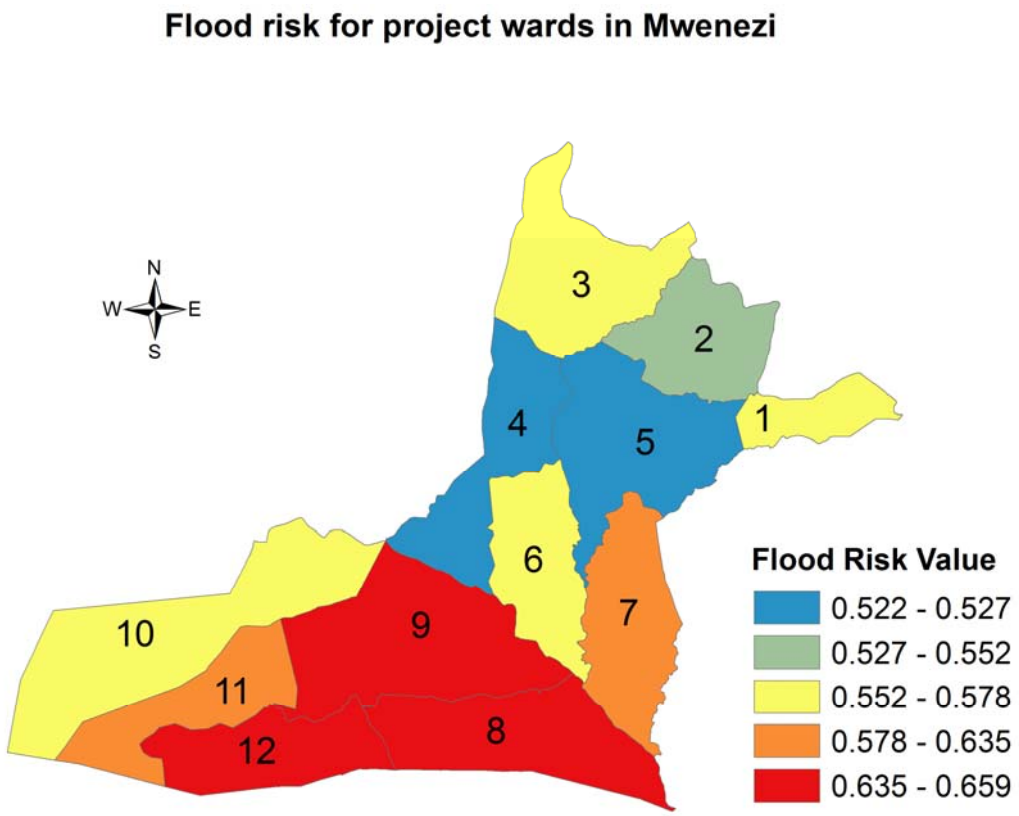


Figure 47: Predicted flood risk at ward level for the 12 project wards of Mwenezi district.

4.6 Muti-hazard risk mapping in Mwenezi

The combined multi-hazard risk map for the 12 ECRAS wards in Mwenezi is presented in figure 49. Wards 5 and 8 were characterised by extremely high multi-hazard risk followed by wards 2, 7 and 9 with a very high multi-hazard risk category. Wards 3, 10 and 11 also faced significantly high multi-hazard risk. Overall, all the 12 ECRAS wards in Mwenezi district faced high to extremely high multi-hazard risk with respect to four top ranked hazards. This justifies the need to build community resilience in all the ECRAS wards in the district. However, wards 5 and 8 deserve priority attention as they faced the highest multi-hazard risk.

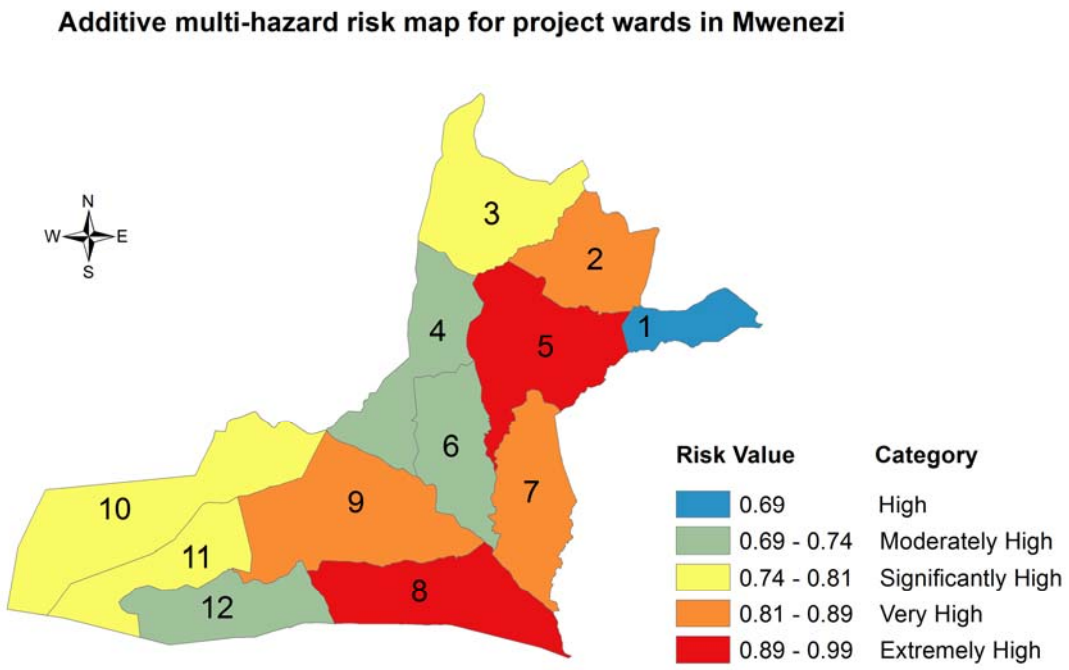


Figure 48: Predicted multi-hazard risk map for 12 project wards in Mwenezi calculated through map overlay functions in a GIS software.

4.7 Institutional assessment of capacity to manage disasters and risks

Discussions with community members and key informants focused on the role government department and other institutions play before, during and after a disaster had occurred. All the government departments in table 17 are mandated with functions ranging from the planning which consists of proposing programmes and projects on prevention; relief and infrastructure rehabilitation; production and dissemination of climatic and other disasters management information; implementation of early warning, preparedness and mitigation systems; proposing procedures for emergency situations and coordination of the implementation of relief programmes. The effectiveness of AGRITEX was rated as excellent by most respondents in wards 5 and 12. NGOs such as World Food Programme and Care International were also mentioned as playing an important complementary role hence their services were rated as excellent in wards 1 and 9. The effectiveness of the RDC was rated good overall in all the four wards.

Table 17: Rated effectiveness of institutions that work with communities in Mwenezi districts.

Ward	Institution	Poor	Satisfactory	Good	Excellent	*N*
1	AGRITEX		4	**13**	11	*28*
	Livestock Production and Development		2	**8**	4	*14*
	Dept. of Department of Veterinary Services		2	**12**	5	*19*
	Civil protection unit			1	1	*2*
	Rural district council	1	1	**10**	2	*14*
	Environmental Management Agency	2	5	**10**	6	*23*
	Traditional leaders		2	**14**	10	*26*

	Ministry of Gender, Youth & Employment		1	4	5	*10*
	Non-government organisations		4	11	**12**	*27*
5	AGRITEX		5	**8**	**8**	*21*
	Livestock Production and Development			**6**	1	*7*
	Dept. of Department of Veterinary Services			**13**	6	*19*
	Civil protection unit			2	1	*3*
	Rural district council		4	**7**	1	*12*
	Environmental Management Agency	2	3	4	1	*10*
	Traditional leaders		3	**10**	7	*20*
	Ministry of Gender, Youth & Employment		2	4		*6*
	Non-government organisations		5	**9**	5	*19*
9	AGRITEX	2	6	**12**	3	*23*
	Livestock Production and Development	2	**5**	4	1	*12*
	Dept. of Department of Veterinary Services	1	6	7	**9**	*23*
	Civil protection unit	1		1		*2*
	Rural district council	1	3	**9**		*13*
	Environmental Management Agency	2	4	**6**		*12*
	Traditional leaders		7	8	**10**	*25*
	Ministry of Gender, Youth & Employment	1	**3**	2	1	*7*
	Non-government organisations		7	6	**8**	*21*
12	AGRITEX	3	10	6	**14**	*33*
	Livestock Production and Development		4	7	4	*15*
	Dept. of Department of Veterinary Services		4	**16**	8	*28*
	Civil protection unit		1			*1*
	Rural district council		**10**	6	3	*19*
	Environmental Management Agency		2	**7**	1	*10*
	Traditional leaders	1	7	**15**	11	*34*
	Ministry of Gender, Youth & Employment	1		**3**	2	*6*
	Non-government organisations		4	**16**	14	*34*

5.0 Existing mechanisms to cope with hazards

The communities in Chiredzi and Mwenezi districts have evolved a range of coping mechanisms to deal with shocks in particular drought. In summary, the main coping mechanisms for women that emerged from both the household surveys and FGDs as well as KIIs in the two districts were:

- Self-organised money lending (*mikando*);
- Hired agricultural work;
- Buying and selling of wares;
- Making and selling charcoal;
- Reducing number of meals;
- Cracking Mobola plum (*Parinari curatellifolia*) and Marula (*Sclerocarya birrea*) nuts for domestic consumption and sale;
- Reliance on irrigation;
- Gathering non-timber forest products such as wild fruits such as Marula, madora (*Imbrasia belina*), shomwe (*Sclerocarya birrea*);
- Remittances from relatives working in urban areas and abroad; and
- Reliance on food relief from external donors support from CARE, Plan International, Lutheran World Federation, World Food Programme.

For young women, the existing copying mechanisms included:

- Working as house maids;
- Child marriage;
- Engaging in sex work especially at growth points; and
- Reliance on food relief from Plan International and Department of Social Services.

The main existing copying mechanisms for men were:

- Selling small livestock;
- Moulding and selling bricks e.g., at Checheche;
- Cutting trees and selling fire wood for curing bricks at growth points;
- Making and selling craft locally,
- Supplementary feeding of livestock using zhombwe (*Neorautanenia brachypus*)
- Sending children to stay with relatives during the duration of a disaster;
- Irrigation; and
- Reliance on food relief from Plan International and Department of Social Services.

The main existing copying mechanisms for young men were:

- Hired to herd cattle;
- Moulding bricks for sale;
- Dropping from school and crossing the border to seek employment in South Africa;
- Seeking employment in towns/cities; and
- Relying on external donor assistance.

When one considers the diversity of these copying mechanisms as well as the socio-economic and political contexts in which they occur, it becomes clear that some strategies such as seeking help from the extended family and borrowing money from relatives are rooted in the existing social nets in the

community. By contrast, other copyine mechanisms such as reliance on local and national governments as well as aid organisations can be considered to be external to the community and may represent out of control variables for the communities. Child marriages, taking children out of school and reducing meal consumption are a cause of concern requiring immediate action given the high proportion of the school going age and chronic food shortages presented earlier.

6.0 Synthesis of priority hazards

6.1.1 Drought

Drought was mentioned in all the wards and villages and ranked highest in household surveys in terms of its destruction and disruption of people's livelihoods. This was confirmed in all the FGDs and by key informants. The results of statistical analyses of long-term meteorological data as well as satellite imagery further revealed that all the communities in the ECRAS wards had high exposure to droughts. The main elements at risk as a result of drought were:

- People - Crops fail as a result of drought and these results in lack of food for people and livestock.
- Water resources- The main water sources such as rivers dry up during a severe drought. Drought also causes a drop in the water table making drinking water more scarce. When this happens, farmers travel long distances to access water. Also, during times of drought, water is often accessed from unprotected riverbeds, which pose a serious health risk, as livestock also access from the same sources.
- Livestock- Food for livestock is reduced as a result of reduction of grazing areas and depressed forage production. In cases of severe drought, cattle deaths become common.
- Crops - Crops fail due to drought. Crop failures in turn lead to lack of food for people. When high food shortages occur, food prices tend to increase beyond the reach of many people because of increased demand and low supply.
- Economy- Drought can also have significant negative impacts on the local economy. The communities in Chiredzi and Mwenezi predominantly rely on rain-fed agriculture for their livelihoods. The surplus harvest they sell during years with above average rainfall and cattle are a major source of income and these income sources dry up during droughts.

6.1.2 Heat wave

Severe heat waves directly affect human health even though no deaths have been recorded in both districts. Headaches and vomiting were some of the ailments that were stated by respondents as associated with heat wave periods. Apart from people, livestock are also a key element at risk of heat waves. For example in ward 5 in Mwenezi, death of rabbits in one of the income generating programmes targeting small livestock was attributed to the heat wave.

6.1.3 Strong winds

Strong destructive winds were mentioned in most wards. The elements that were mostly at risk were: Infrastructure- Roofs of buildings were lifted off, including the roof at Maranda School in Mwenezi and another school in Malipati. Electricity poles were also uprooted causing an electric fault that took long to rectify. If these winds occur during the dry months, they lift off the fertile top layer of soil causing loss of soil fertility and reduced crop yields.

6.1.4 Crop pests and diseases

Crop pests were defined as those pests of economic importance to livelihoods. Pests that were identified included army worm, Heliothis boll worm, and red spider. The army worm destroyed most cereal crops in both Chiredzi and Mwenezi, reducing the harvest of most crops. The heliothis boll worm was only mentioned in Chiredzi but also had similar destructive patterns as the army worm there. The white mealie bugs was another pest that was mentioned as affecting maize in ward 9 of Mwenezi. The cotton cushion was mentioned in Mwenezi ward 5 as being problematic for cotton growers. Aphids were very common in all wards mostly affecting leafy vegetables and causing mottled leaves.

6.1.5 Livestock and human diseases

Diseases of economic importance that affect livestock in the ECRAS wards in both districts included anthrax, foot & mouth disease (FMD), lumpy skin and blackleg for cattle, newcastle and fowl pox in poultry and heart-water in goats. The increased frequency of livestock diseases like FMD, lumpy skin, heartwater and newcastle occurring against the backdrop of limited funds to buy vaccines was also a priority problem among communal wards in the two districts. This problem was amplified by livestock thefts as well as frequent droughts that act in concert to cause a drop in prices for livestock. As a result, farmers tend to lose income from livestock.

From KIFs and FGDs it also emerged that people were at high risk of contracting by diarrheal diseases due to poor sanitation. Common diarrhoeal diseases affecting communities in the two districts include cholera, dysentery, and typhoid. These were mentioned mostly by health practitioners. These were linked to lack of access to safe portable water supply in most of the wards. One characteristic for a lot of the villages visited during fieldwork was the absence of toilets on most homesteads. Sanitation is obviously a major challenge as people still use the bush system.

Bilharzia was one of the diseases that was mentioned as affecting communities in Mwenezi district. The Ministry of Health and Child Welfare is implementing programmes to control bilharzia in children of school going age but the disease is still prevalent (Midzi et al. 2014). Both districts are also malaria endemic hence the Ministry of Health and Child Welfare continues to rely on indoor residual spraying programme to fight the disease.

6.1.6 Fires

Forest fires often resulted from hunting and beekeeping and on rare occasions did they start spontaneously. Elements that were mostly at risk identified during KIIs and FGDs included:

- Vegetation- vegetation in the form of trees, shrubs and grasses is lost which will in turn affect livestock and people.

- Livestock and Wildlife – Wildlife were mostly at risk and the forests provide them with shelter as well as with food. Fires would destroy the grass they feed on as well as the leaves of trees they browse from, leaving them without food sources. The trees also shelter the animals from the scotching midday heat during the hot dry season (September to November) in both districts. Therefore if they are burnt, this would expose wildlife to high temperatures with the possibility of them suffering from heatstroke. The main effect of uncontrolled veld fires on livestock were identified during KIFs as direct loss of grazing and browsing resources.

- Infrastructure- Field observations revealed that most houses in the ECRAS projects are built with pole and dagga, thatched with grass. Hence, these dwellings are at a risk of burning leaving a large population homeless.

6.1.7 Floods

Flash floods are distinguished from regular floods by a timescale of less than six hours. Flash floods were mentioned in all the wards. The main element at risk is the road infrastructure especially the small bridges that get flooded thus impeding the smooth movement of people and vehicle traffic. Damaged bridges are also significant as they restrict access to markets for various farm produce and this affects all communities in the ECRAS ward.


Plate 4: A wide gully undercutting a road through headward erosion in ward 1 of Chiredzi.

6.1.8 Other socioeconomic factors highlighted

The wards closer to the border with South Africa, represented by ward 14 Chiredzi, have experienced the serious exodus of active human capital looking for employment. The majority of them just cross the border illegally and at times crossing the flooded Limpopo River. This has caused some social challenges to the communities living in these wards. Such challenges include numerous marriage breakages and increase in STIs and AIDS due to infidelity among the remaining partners. The remaining population is also dominated by women, children and the aged. Most of the children desert schools to go and look for employment across the border. Child marriages are also on the increase as school dropping out is increase due to economic hardships and absence parents.

Wards closer to the protected areas such as wards 22 and 23 in Chiredzi have challenges with wild life intrusions. Their grazing areas have been diminished either because of illegal settlements in the areas designated for grazing, or the grazing areas they have been depending on have been fenced off by the Parks and Wildlife Management Authority. This had created strife between the communities and Park officials. The situation of shortage of grazing has been worsened by the droughts experienced over a number of years.

Wards closer to growing Growth Points such as ward 1 in Chiredzi have increased demand of wood fuel for curing bricks leading to high rates of deforestation. This contributes to land degradation. Many wide and deep gullies were observed all over ward 1 and these gullies threaten road infrastructure. People claimed that they have no other meaningful sources of raising income, hence resorting to such activities.

It was clear in all the discussions with the youths that opportunities for employment in the wards were almost non-existent. Unemployment has caused urban to rural migration. A lot of young people have moved from cities and town due to lack of employment options. Those in the rural areas have also not left

their homes as there are not job to go to. This has resulted in the over-reliance of agricultural activities for income opportunities

Livestock prices tended to vary throughout the year and between seasons. A change in livestock prices refers to the inter-seasonal price changes between June and October prices, mainly for cattle. Prices also varied according to who the buyer was. Middlemen were the easier option for many sellers considering that they buy directly from the farmers and paid sellers cash. As a result, farmers incurred no transport costs.

7.0 Value Chains

Markets are crucial for household economic welfare. Access to credit facilities for households to finance income generating activities, to help households cover income shortfalls, and insurance markets help protect households and communities from unexpected income and socio-economic shocks. Only 22.4% and 22.5% households in Chiredzi and Mwenezi respectively belong to a community saving and lending group. Two prominent advantages of membership in a community saving and lending group are: immediate access to funds in case of unexpected emergencies and increased savings. Membership to these community groupings is imperative for households in the two districts especially in an environment with dwindling markets and limited self-sufficiency.

In Chiredzi, 62.8 % households indicated that they have access to market information in contrast to 49 % in Mwenezi. For both districts, word of mouth (38 %) is the main source of information followed by community farmers group (11.5 %) and radio (3.5 %). It should be noted that without good access to markets and information, households cannot market their produce, obtain inputs, sell labour, obtain credit, learn about or adopt new technologies. In view of the fact that most households do not usually have good yields, lack of market access and information can have catastrophic effects on households when disasters and shocks strike.

7.1 Small grains

Sorghum and millet are the main small grains grown by the farmers. Farmers grow these mostly for their own consumption. Sorghum and millet are both sold to traders who sell it at urban markets in Chiredzi and Mwenezi. One trader in Mwenezi collects sorghum and millet from farmers in Mwenezi and trades it as far as Beitbridge and Masvingo.

On enquiry with retail outlet buyers at supermarkets such as OK/Bon Marche, TM/Pick and Pay and Spar, it was established that small cereal grains do not have as wide a market as white maize even though their consumption in urban markets was noted to be as being on the increase. This was attributed to the increase of lifestyle diseases such as cancers, hypertension, diabetes, and obesity resulting in doctors recommending small grains instead of the white maize and other refined products. However, small cereal grain products were priced highly. Only small millers such as Utsanzi, Savanna Foods, Osha Foods, AfriDeli, and KSK Foods were trading in small cereal grain meal. On enquiry with the larger millers, it was discovered that small cereal grains were less attractive to them as they were over-priced and could not be considered as commodity products like maize and wheat. They were viewed more as speciality foods. The quality of small cereal grains was also poor due to the presence of sand and grit. Post-harvest handling and pre-processing would also need to be improved to make them suitable for food.

7.2 Livestock

Small butcheries in both Chiredzi and Mwenezi buy livestock directly from the farmers and send them to the abattoir for slaughtering. Retail chains such as Spar also buy directly from farmers as well as buying through the meat wholesalers like Sabie Meats, Koala, Triangle Meats and Montana meats.

Cattle and other livestock animals go through screening by the Veterinary Department before slaughter at the abattoir to protect public health. Farmers said that they sell their livestock to traders who come to the villages. These traders tend to offer low prices so that they can make a good margin when they sell to abattoirs. The traders take over the responsibility to transport the beast and that add value to the beast and some fatten the cattle to add value. Value addition by the trader was mainly in two forms:

- Improving the quality through pen fattening; and
- Bulking by buying beasts from several farmers and therefore offering more beasts to the final buyer, whereas farmers have a tendency to offer a single of a small number of beasts.

Farmers indicated the need for support in pen fattening of their animals before they offer them to the buyers whether the buyer is a middlemen or an abattoir like Sabie meats. Abattoirs like Sabie meats indicated that they would like to have direct relationships with farmers instead of buying through middlemen. Direct relationships would enable them to directly influence the quality of beast they receive.

7.3 Poultry

Poultry produced by farmers is either sold locally within the villages or to traders who transport the poultry products to urban centres for resale. Both indigenous chickens and broilers were seen on sale at markets such as at bus termini. Retailers buy indigenous chickens from the urban traders and rarely go to the farmers directly. Farmers preferred not to transport their poultry to the market. Transport costs were too high and would consume their profits.

7.4 Fish

Fish was informally traded in market places. Small butcheries also said that they bought fish from informal traders as well as from Koala and Lake Harvest. In the large retail chains such as TM, OK and Spar the fish brand that dominated was Lake Harvest. Large retails have so far not been buying fish from small scale producers as none have approached them so far. They are however keen to buy from anyone as long as they meet the basic requirements for volumes and hygiene as required by the Ministry of Health for meat processors.

8. Recommendations to ECRAS and stakeholders

8.1.1 Building community resilience against drought

This assessment has identified drought as the most significant natural shock affecting communities all the rural ECRAS wards of Chiredzi and Mwenezi districts. In this section specific recommendations to increase both the adaptive and absorptive capacities of the communities to deal with drought are suggested. First, at the operational level, farmers in all the wards in consultation with resident AGRITEX officers must stagger planting dates to minimise the risk of crop failure in the event of drought. This recommendation is based on the observation that crop production anchored on small grains (i.e., sorghum and millet) forms a key component of the livelihood system as summarised by typical crop calendars presented for both wards.

From a strategic viewpoint diversifying crop cultivar/type in favour of production of more drought-tolerant varieties is critical for enhancing community resilience to hazards. This recommendation is common knowledge but hard to implement for a variety of reasons. For instance, discussions with some farmers in ward 23 of Chiredzi revealed that some of the new sorghum varieties being promoted by research institutions as more drought resistant yield mealie-meal which is inferior to that of varieties currently being grown. It therefore makes sense to bring on board the views and perceptions of farmers before new varieties are introduced. Still on the subject of diversifying the crop base, promoting the production of sesame is also a potential viable intervention strategy. In view of the differences among wards in the crops currently grown, it is recommended that in Chiredzi, model households already

registered for the ECRAS project in wards 1, 22 and 23 could pioneer the growth of sesame as a cash crop. In Mwenezi, model farmers in wards 5, 9 and 12 could play a lead role. Targeting these wards is advantageous given that some farmers in these wards are already growing the crop. Thus the knowledge they have already acquired is thus critical to assessing the potential contribution of this crop before rolling it out to other farmers.

With regard to livestock in particular cattle and goat production, improving the hardiness of existing local breeds to drought is vital. The way to achieve this is to first identify bulls and bucks (uncastrated male goats) that can survive an extreme drought such as the 1991-92 drought. Then breed from these adapted animals on account of their high survivability and adaptation. The current widely used intervention strategy involving supplementary feeding of cattle is expensive and not sustainable as it results in the perpetuation of less adapted cow and doe (female goat) lines. The LPD could play a coordinating role in line with its official mandate.

The result of the multi-hazard assessment also uncovered high prevalence of vector-borne and tick-borne disease. To increase the resilience of livestock to these shocks, careful selection of animals with high parasite resistance and/or culling those with less resistance is a recommended long-term intervention strategy for the ECRAS project since disease and parasite resistance is highly heritable. However, for tick-borne diseases such as heartwater, regular dipping and annual vaccination using combo vaccines should remain the cornerstone of a viable disease control strategy. It was therefore encouraging to observe a new dip tank erected in a village just close to the wall of Manyuchi in Mwenezi.

During the onset of the drought, animals with low body condition scores can be identified and sold. The funds generated can then be set aside and used to rebuild the herd after the cessation of the drought. This recommendation offers a direct pathway to bouncing back from drought. AGRITEX and LPD could play a leading role in teaching farmers how to body condition score their animals and select which animals to cull based on performance records.

With regard to the reducing the sensitivity of crop production to drought, establishing more small-scale irrigation schemes and resuscitating those not functional is critical. Apart from reducing depending on rain-fed agriculture irrigation can build overall community resilience to drought while simultaneously improving food security. Considering the fact that not all areas are potentially irrigable, selection of suitable sites using multi-criteria evaluation techniques is necessary. Since, it is cheaper to resuscitate existing irrigation schemes than establish new ones, it is recommended that reviving non-functional existing irrigation schemes be undertaken first before establishing new ones as this is more cost effective. All the factors underlying the cessation of irrigation farming must be evaluated and addressed prior to resuscitation. The department of irrigation development working in partnership with local and international funders must play a key role towards implementation of this recommendation.

8.1.2 Widening and diversifying household income options

The findings of this report have also demonstrated a strong dependence by the communities in rural Chiredzi and Mwenezi on the natural resource for their livelihood especially at household level. This over-dependence on natural capital puts households at high risk of natural shocks such as drought, strong destructive winds, and floods. To reduce the sensitivity of households to such natural shocks, the household income earning options must be widened and diversified. To diversify the income base and build household resilience to shocks, access to credit loans (capital) is critical. Out of the many different models in micro-credit provision that exist (Ellis 1999) indigenously run VSL groups that do not depend heavily on the continued involvement of NGOs for their sustainability are recommended for the ECRAS project. The membership to such groups need not be restricted to women but should also accommodate men as well as the youth who are projected to constitute at least 25% of the project beneficiaries.

When involving the youth in the programming, project staff must be aware that migration to South Africa in search of employment was identified as one of the main mechanisms to cope with shocks such as drought and economic distress. Therefore, there is a risk that mid-way through project activities emigration to South Africa or migration to urban areas in search of employment may undermine project viability. To address this potential problem, a business-concept approach that focuses on delivering profit when one accesses micro-credit loan must be promoted by project staff. This involves training beneficiaries in basic bookkeeping and on how to prepare financial statements so that loan repayments are properly credited. The merit of this recommendation is underpinned by the recognition that the reliance on ad hoc project finance from donors cannot be relied upon to keep resilience projects running beyond ECRAS' tenure and yet the communities will still face hazards and shocks long after ECRAS. To improve the financial literacy of beneficiaries, project staff as well as local school teachers specialising in Accounting may team up and provide the training. The training must be basic and it must recognise that women in the ECRAS wards have less formal education than men as reported earlier.

8.1.3 Managing heat waves

The occurrence of heat waves is beyond human control. However, heat waves causes stress to livestock and stress aids selection. In that regard, it is once again recommended that identifying livestock better able to cope with heat stress and multiplying them is a potential viable long-term strategy that can be implemented in all rural wards of Chiredzi and Mwenezi. At the household level, the recommendation to ECRAS is for spearheading tree planting at homesteads. This ameliorates high temperatures endured by people during a heat wave. The trees also act as windbreaks which minimises wind damage.

8.1.4 Building adaptive capacity against destructive winds and floods

With regard to increasing the resilience of communities to the impact of strong destructive winds and floods, the specific recommendation to the ECRAS project is to explore how the existing building designs for key infrastructure at risk such as schools, bridges and dwelling units can be improved to strengthen the structures. Modifying the current design also applies to bridges that were observed to be at high risk of flood damage. The nature of such designs and their cost needs proper consideration by experts.

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Focus Group Discussion *[Women, Men, Girls, and Boys]*

1. Looking at the past 5 years, what hazards have threatened peoples' lives in this community?

Hazard type	Elements at risk [e,g., people, infrastructure]	Frequency of occurrence	Impact [destructive, significant, moderate, minor, negligible]

2. Which ones are likely to recur in the next 12 months? [Rank]

Hazard type	Explain ranking

3. Which ones are likely to recur in the next 24 months? [Rank]

Hazard type	Explain ranking

4. Which ones are likely to recur in the next 2-5 years? [Rank]

Hazard type	Explain ranking

5. Which hazards affect women more than men?

6. Which hazards affect girls more than boys?

7. Are hazards in this community likely to change over time as a result of climate change? [1] Yes [2] No

8. In what ways.
   ……
   ……

9. What elements are mostly at risk in this community when hazards occur *[Probe for which groups within the community are most vulnerable to disasters]*

Element at risk	Level of vulnerability

10. Do people in this community have adequate knowledge about disasters hazards, shocks and vulnerabilities? *[Record number of raised hands per women, men, girls and boys]* [1] Yes [2] No

11. Explain response above.
……

12. Is the community best placed to deal with these hazards, shocks, and vulnerabilities? *[Record number of raised hands per women, men, girls and boys]* [1] Yes [2] No
13. What are the coping mechanisms for young people boys and girls in times of disasters or shocks?
14. What are the coping mechanisms for women and men in times of disasters or shocks?

15. Which institutions work with people in this community in cases of emergencies. [*Probe for local institutions (governmental and non-governmental) capacity to monitor and analyze information on current and future climate risks*]

Group	Institution	Service rendered
Women		
Men		
Girls		
Boys		

16. What are the current capacity gaps in these institutions [*Probe for what new capacities may be needed to address changing circumstances due to climate change]?*

Gap	Suggested Solutions

17. What indigenous knowledge systems exist in this community relevant for managing risks?
……

18. Are women and girls, young people and minority groups making use of indigenous knowledge to manage risks? [1] Yes [2] *[Record number of raised hands per women, men, girls and boys]*

19. If Yes, how and if No, what could be the challenge and what would you recommend
……
……
……

20. Are local planning processes participatory? [*Probe for do women and other marginalized groups have a voice in local planning processes*?] [1] Yes [2] No

21. To what extent are their views taken into consideration? At what levels?

22. Please feel free to share any other information relevant to this assessment.
……
……
……

ANNEX 1

Questionnaire Code_____

Household Sample: [1] Model, [2] Participation [3] Non-participating_____

Name of Enumerator_____Date_____

SECTION 1: HOUSEHOLD CHARACTERISTICS

1. Site (*x,y* coordinates) _____
2. Ward _____
3. Village _____
4. Household Number _____
5. Sex of respondent.

   [1] Male [2] Female
6. Sex of household head [1] Male [2] Female
7. Who is the decision maker in your household?

   [1] Father [2] Mother [3] Sibling [4] Extended relatives [5] Other
8. Household demographics.

Age group (years)	Sex		Resident	Non-resident	Total
	Female	Male			
0-4 years					
5-9					
10-14 years					
15-19					
20-24					
25-29					
30-34					
35-39					
40-44					
45-49					
50-54					
55-59					
60-64					
65-69					
70-74					
75+					

9. Household head highest educational qualification

   [1] Primary education [2] Secondary Education [3] Tertiary Level [4] No formal education

10. Observed and record type of dwelling unit.

[1] Pole and dagga under thatch [2] Pole and dagga under sheets

[3] Pole and thatch [4] Bricks under thatch

[5] Bricks under sheets [6] Bricks under tiles

[7] Wooden cabin under asbestos [8] Mixed (describe)

11. Observe if the most dwelling units are sited on flat land, gently-sloping or steep slope?

Steep [1] Terraced [2] Gently sloping [3] Flat [4].

12. What are the main sources of income for this household?

1= Income Savings & Lending group
2= Own business
3= Fishing
4=Farming
5= Vegetable sales
6=Agric Casual labour
7= Petty trade
8= Non agric casual labour
9=Beer brewing
10=Livestock raising
11=Formal wages (salary, etc)
12= Other _____
88=Don't Know
99=No Response

13. What were the households' main cash needs in the past 12 months?

[1] Food [2] Education [3] Health [4] Energy [4] investment [5] Housing: repairs & improvements [6] Consumer goods [7] Loan repayment [8] Other, specify…….

14. List the most important resources needed by the household to sustain itself for the entire year.

	Gender group			
Resources	Women	Men	Girls	Boys
Land				
Water				
Forests				
Shelter				
Means of transportation				
Equipment				
Access to information (media, new technology)				
Income				
Access to credit (loans)				
Improved nutrition				
Access to health care services				
Education				
Other (specify)				

15. Which physical assets does the household own? For each asset listed, probe the barriers women, men, boys and girls usually face with regard to the control and ownership of assets/resources.

				Who has access				**Who controls access**				
Assets	Number/area	When acquired	Estimated current value (USD)	Women	Men	Girls	Boys	Women	Men	Girls	Boys	Barriers to access and control (why)
Buildings												
Land (area)												
Cattle												
Goats												
Cash crops												
Garden												
Small grain												
Indigenous chickens												
Scotch cart												
Hoes and ploughs												
Pots/ kitchen utensils												
Wheel barrow												
Well												
Borehole												
Tractor												
Motor vehicle												
Mobile phone												
Others (specify)												

SECTION 2: HEALTH

16. Where does your household get water for domestic use?

[1] Unprotected well [2] Communal Borehole [3] Protected well

[4] Stream/ River [5] Own tap [6] Tapped communal other (specify)

17. Who usually collects the water? [1] Women [2] Girls [3] Men [4] Boys

18. Is the water enough for your household's needs?						
Dry season	Yes	No	Never (1)	Rarely (2)	Sometimes (3)	Often (4)
Wet season	Yes	No	Always (5)	No dry season in our area (6)	Few, or no, crops grown (7)	

19. Where does your household get water for livestock?

20. Is there usually enough water for your livestock?							
Dry season	Yes	No	Little, or no, livestock (1) [skip to question]			Never (2)	Rarely (3)
Rest of the year	Yes	No	Sometimes (4)	Often (5)	Always (6)	No dry season in our area (7)	

21. How do you cope when you do not have enough water for the house hold?

……
……
……
……

22. Where do members of the household go for medical services?

[1] Public Hospital [2] Public Clinic [3] Traditional healers

[4] Faith healers [5] Private hospital [6] none (specify)

23. In the last 5 years what diseases have affected your household as a result of hazard?

[1] Vector borne diseases [2] Water borne diseases [3] Other

24. Who was affected most? [1] Girls [2] Boys [3] Women [4] Men [4] Other

25. Explain your answer:

……

26. Do you know or use any herbs to alleviate symptoms of some of diseases that are common in your household? [1] Yes [2] No

27. Explain

……

28. Are you always in good health to do your work? [1] Yes [2] No

29. If NOT, explain.

……
……

SECTION 3: LIVELIHOOD STRATEGIES

30. During which months do you undertake these activities? (Tick)

Activity/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave. Income
Crop production: sorghum													
millet													
sesame													
sugar beans													
Other(specify)													
Livestock production: cattle													
goat													
indigenous chickens													
Commercial (poultry)													
Other (specify)													
Hunting													
Fishing													
Vegetable production (gardening)													
Beer brewing													
Collecting NTFPs													
Processing NTFPs													
Selling NTFPs													
Craft production													
Brick moulding													
Mineral extraction													
Formal employment													
Drought relief (food aid)													
Trading/ buying and selling													
Village Savings and Lending													
Other activities													

31. What soil type covers the majority of your household agricultural land?

    Don't know [1] Stony-gravely [2] Clay [3] Loamy [mixed clay, sand &/or silt] [4]

    Sandy [5] Wet [6] Other, specify [9]

32. Which crops do you usually grow as a household? List top five.

1.	2.	3.	4.	5.

33. From the list which crops do the following gender groups prefer to grow?

Women	Men	Girls	Boys

34. Have you used the following farming techniques in the last two years? If yes, how effective were these techniques?

Farming technique	Yes/No	Effective/Not effective	Reason for being effective or not effective
Use of manure			
Use of herbicides			
Weeding by hand			
Use of pesticides			
Use of natural/biological pest control			
Use of traditional/cultural pest control			
Use of fertilizer			
Use of hybrid seeds			
Use of retained seeds/OPVs			
Diversification			
Use of machines in farming			
Irrigation			
Water harvesting			
Intercropping			
Contour ridging			
Terracing			
Mixed cropping			
Crop rotation			
Alley farming			
Organic farming			
Market gardening			
Honey farming			
Mulching			
Minimum or zero tillage			
Rotational grazing			
Animal breeding			
Paddocking			
Pen fattening			
Other (specify)			

35. Do you usually get adequate yields? [1] Yes [2] No
36. If No, explain why:
……
……
……
37. Do you usually have get adequate crop yield to last the entire year? [1] Yes [2] No
38. If No, explain, months and times of the year when your supply runs out, why you run out of supply and how does the household cope.
……
……
……
39. How do you usually store your produce?
……
……
……
40. How many meals do you have in a day? [1] One, [2] Two, [3] Three [4] More than three.

41. Have you ever spend a day without eating food? [1] Yes [2] No [3] Don't Know [4] No Response. State reason…….
42. Have you ever gone to bed without having supper in the last 12 months? [1] Yes [2] No [3] Don't Know [4] No Response.
43. How often does this happen in the household? [1] Once a week [2] Twice a week [3] Once a month [4] Twice in a month [5] More than three times a month [6] Other specify…….

44. During which months did you not have enough food last year?

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

45. State reason…….
46. How does your household cope with such food shortages? …….
47. What does each meal typically comprises?

Breakfast	Lunch	Supper

48. List the main food items…….
49. Does your household have a farmers' insurance scheme? [1] Yes [2] No
50. Does any household member belong to ay community saving/lending group? [1] Yes [2] No
51. What activities does the member undertake?

……
……
……

52. Do you own any livestock? [1] Yes [2] No
53. Livestock ownership

Type	No. of animals	Uses	Income
Chickens			
Turkeys			
Ducks			
Rabbits			
Goats			
Sheep			
Pigs			
Donkeys			
Cattle			

1. Meat (consumption)
2. Milk/eggs (consumption)
3. Meat (selling)
4. Milk/eggs (selling)
5. Manure
6. Saving
7. Animal traction
8. Social Obligation
9. Slaughter to hire labour
10. Other (Specify) _____ _____

54. What strategies do you use for livestock production? [1] Pen fattening [2] Fodder [3] Supplementary feeding [4] Targeted feeding [5] Other, specify
55. What commodities do you usually sell at the market? Note the Top five below.
……
56. Where do you sell your crops?----------
57. What crops do you usually sell at the market----------
58. Where do you sell your livestock? ----------
59. What livestock do you usually sell at the market_____
60. How far do you live from the nearest market? [1] < 500 m [2] 0.5-1 Km [3] 1 to 2 Km [4] 2 to 5 Km, >5 Km

61. How far do you live from the nearest market? [1] < 500 m [2] 0.5-1 Km [3] 1 to 2 Km [4] 2 to 5 Km, >5 Km
62. What transport system do you use to transport your products to the market? [1] Buses [2] Trucks [3] By foot [4] Animal drawn cart [5] Wheelbarrow [6] Other, specify
63. Do you have the potential to sell more? [1] Yes, [2] No. Please explain ----------
---

---
64. If Yes, what prevents you from selling more?----------

---
65. What can be done to enable you to sell more?----------

---

66. How do you get marketing information? [1] Brochure [2] e-Market [3] Radio/Television [4] Community farmer's groups [5] Word of mouth [6] Print media [7] Other, specify

SECTION 4: VULNERABILITY AND RESILIENCE ASSESSMENT

67. Of all the possible shocks, hazards and risks; natural or socio-economic, which ones occurred in the last 24 months. 68. Which five are you most worried about (as far as negative impacts to your household, household members' livelihoods and/or the household's agriculture/livestock)? *List up to five hazardous events, and rank them on a scale from "most worried about" (1st) to "less worried about".*
69. For these hazardous events, **how damaging** would each be for your household? *["destructive, moderate impacts, minor impacts, negligible impacts"]*

70. For these events, **how likely** is it that the event will recur in the next 12 months? *["very likely, likely, least likely"]*

Don't know (-1)	Not very worried about any negative events (-2)		
Likely severity=	Low-minor (1)	Medium-moderate (2)	High-major (3)
Likely frequency=	Unlikely (1)	Likely (2)	Very likely (3)

1st				Event # =		Likely severity=		Likely frequency=	
2nd				Event # =		Likely severity=		Likely frequency=	
3rd				Event # =		Likely severity=		Likely frequency=	
4th				Event # =		Likely severity=		Likely frequency=	
5th				Event # =		Likely severity=		Likely frequency=	

1. Drought	2. Dry spell	3. Flood	4. Erratic rainfall
5. Heat waves	6. Frost	7. Hail	8. Strong winds
9. Fire	9. Livestock disease	10. Insect outbreaks	11. Crop pests
12. Lack of fertilizer &/or too expensive	13. Bad seeds	14. Soil problems	15. Livestock disease
16. Debt	17. Labor shortage	18. Theft (specify)	19. Low market prices for crops/livestock
20. Poor market access	21. Corruption	22. Unemployment	
23. Other, specify:			

71. If two or three of the five hazardous events you just mentioned were to recur in the next 12 months, what are the three main ways your household would likely react (cope)?

Don't know (-1)	Primary strategy		Secondary strategy		Tertiary strategy	

1.Seek off-farm work	2.Children help more than usual with household work	3.Ask friends to help with farm labor or business	4.Ask family to help with farm labor or business
5.Reduce healthcare spending	6.Reduce alcohol consumption	7.Reduce meat consumption	8.Reduce fuel consumption
9.Use savings	10.Sell livestock	11.Sell stored grain	12.Sell durable goods
13.Plant fewer crops next growing season	14.Postpone payment of debts	15.Borrow money from relatives	16.Borrow money from friends
17.Send children to work outside the household	18.Borrow money from bank or other financial service provider	19.Borrow money from cooperative or village fund (community-based source)	20.Take children out of school so they can work
21.Lease farmland	22.Sell farmland	23.Sell business	24.Beg for money/food
25.Sell/leave home (live with relatives in area)	26.Sell/leave home (move to another area)	27.Rely on group insurance	28.Rely on private insurance
29.Rely on local government	30.Rely on national government	31.Rely on aid organizations	32.Seek technical assistance
33. Work two jobs	34. Start a business	35. Seek medical treatment	36. Other, specify:

72. If one or two of the negative events you just mentioned *[in question 43]* were to occur in the next 12 months, how long do you think it would take for your household to return to a satisfactory situation? *[Record answer in months (for example, 2 years = 24 months)]*

Don't know (-1)	Less than one month (-2)	Months=		Our household could not recover (-3)

73. If in an extreme disaster (of any sort) your household's home was completely destroyed, but your family members were not injured, how long do you think it would take for your household to rebuild your home? *[Record answer in months (for example, 2 years = 24 months)]*

Don't know (-1)	We would move (-2)	Months =		Our household could not rebuild (-3)

74. Who has helped you during the times that hazards have occurred?
……..

75. In what ways did the mentioned offer assistance?
……
……
……

76. If one or two of the negative events you just mentioned *[in question 43]* were to recur in the next 12 months, who do you think would be most likely to assist your household?

No one (1)	Family (2)	Friends (3)	Insurance company (4)
Financial institution (5)	Local government (6)	National govt. (7)	Government (general) (8)
Aid organizations (9)	Don't know (10)	Other, specify (11):	

77. What scenarios do you think have made you most vulnerable? (Hazards, shocks, risks)
……
……
……

78. What were the effects of these hazards (deaths of livestock, people, damage of assists, infrastructure, land degradation, forest degradation)?
……
……
……

79. What did you do to cope?
……
……
……

80. What is your understanding of climate change?
……
……
……

81. Which group of people do you think is most vulnerable to climate change? [1] Women [2] Men [3] Girls [4] Boys [5] The elderly [6] Physical disabled [7] Chronically ill

82. Explain response above.
……
……
……

83. What changes in climate have you observed in the past 5 years?

1. Early onset of rain season	2. Delayed onset of rain season	3. Short rain season	4. Prolonged rain season	5. Heat wave	6. Temperature drop	7. Strong destructive winds
8. Frost	9. Snow	10. Other, specify.				

84. How has these affected your livelihood?
[1] Low yields [2] Death of livestock [3] Poor quality crop [4] Reduced income [5] Reduced access to market

85. How do you cope with these climatic changes?
……
……
……
……
……
……

86. Have you received any information about seasonal forecasts and other climate information? [1] Yes [2] No

87. State source of information. [1] Mobile phone sms [2] Community meeting [3] Local school [4] Community focal person [5] Local NGO [6] Government department [7] Church [9] TV/Radio [10] Other, specify

88. State any three aspects you still recall.

……
……
……

89. How often do you receive information about seasonal forecasts and other climate information? [1] Daily [2] Twice a week [3] Weekly [4] Fortnight [5] Monthly [6] Other, specify

90. What indigenous/traditional knowledge systems exist for predicting weather patterns in this community?
……
……
……

91. Do you face any challenges/gaps in accessing information about seasonal forecasts and other climate information? [1] Yes [2] No

92. Explain response.
……
……
……

93. Do community members generally help each other during situations of emergencies? [1] Yes [2] No

94. Explain response.
……
……
……

95. Are there other social, political or economic factors which make particular people within the community more vulnerable to climate change factors than others?

Group	Social	Political	Economic
Women			
Men			
Girls			
Boys			
People living with disability			

96. Please kindly share with me any other information you consider useful for this assessment.
……
……
……

SECTION 5: INSTITUTION CAPACITY GAP ASSESSMENT

97. Can you list institutions that work with your community to enhance community resilience to disasters

Institutions	**Specify their roles (with regard to increasing community resilience to disasters)**	**What is their current capacity**	**What is the required capacity**	**Suggest measures to increase institutional capacity**
Agritex				
LPD				
Department of Veterinary Services				
Civil Protection Unit				
Rural District Council				
EMA				
Traditional leadership				
Ministry of Gender, Youth & Employment Creation				
NGOs (specify)				
Others, specify				

Key informant Interview Guide

1. Looking at the past 5 years, what hazards have threatened peoples' lives in this community?

Hazard	Comment (Severity, frequency, intensity)

2. Which ones are likely to recur in the next 12 months

Hazard	Comment

3. Are hazards in this community likely to change over time as a result of climate change? [1] Yes [2] No

4. In what ways.
   ……
   ……
   ……

5. What elements are mostly at risk in this community when hazards occur
   [Probe for which groups within the community are most vulnerable to disasters].

Element	Severity

6. Are community best placed to deal with these hazards, shocks, vulnerabilities? [1] Yes [2] No

7. Explain response above. [*Probe for how communities are coping with these hazards, shocks, vulnerabilities*]

……
……
……

8. Do people in this community have adequate knowledge about disasters hazards, shocks and vulnerabilities? [1] Yes [2] No

9. Explain response above.
……
……
……

10. Which institutions work with people in this community in cases of emergencies. [*Probe for local institutions (governmental and non-governmental) capacity to monitor and analyze information on current and future climate risks*]

Institution	Service rendered

11. What are the current capacity gaps in these institutions [*Probe for what new capacities may be needed to address changing circumstances due to climate change]?*

Gap	What can be done

12. Is there a functioning early warning system/center established in this community? [*adequately staffed (or on-call) and well resourced (power back ups, equipment redundancy) in your community*] [1] Yes [2] No

13. How are the early warning signals shared with the community (Probe for frequency and by who)? [*Probe for a. local institutions access to information on current and future climate risks b. local plans or policies to support climate-resilient livelihoods c. local government and NGO extension workers*

understanding of climate risks and promote adaptation strategies]
……
……
……
……
……

14. What indigenous knowledge systems exist in this community?
……
……
……

15. Are community members making use of these knowledge systems to manage risks? [1] Yes [2] No
……
……
……

16. What are some of the negative community behaviours that have contributed to climate change?
……
……
……

17. What positive community behaviors have resulted from the effects of climate change?
……
……
……

18. Are local planning processes participatory? [*Probe for do women and other marginalized groups have a voice in local planning processes*?] [1] Yes [2] No

19. What are the other factors constraining adaptive capacity of the most vulnerable groups? [*Probe for vulnerable communities and groups influence over these factors]*
……
……
……

20. Please feel free to share any other information relevant to this assessment.
……
……
……

Key informant guide for Value Chain Players

1. Who are the key players in the value chain for marketable crops and livestocks?

2. Is there a shared understanding of community perspectives and interests in value chain in a changing climate? [1] Yes [2] No

3. Explain response above.

4. What information/tools are available to help you and the community in value chain analysis in the context of climate change?

5. Which hazards, risks and shocks are affecting value chain in this area?

Hazards	Risks	Shocks

6. What are the new prospects for technologies, products or services to help build climate resilience in the community?

7. Is there any protocol that has been considered for assessing climate change vulnerabilities, risks and opportunities? [1] Yes [2] No

8. Explain response above.

9. What value chain support is required in this area? [Probe for specific groups: women, men, young women and men].

10. Which institutions are involved in value chain and what challenges do they face in a changing climate?

11. Which products/commodities are usually sold on the market?

12. What challenges are faced in accessing markets by community members in this area?

13. What can be done to improve market access in a changing climate in this area?