Building Resilience to Natural Disasters in Populated African Mountain Ecosystems

The Case of Tropical Cyclone Idai in Chimanimani, Zimbabwe

A Report on Environmental Impact & Climate Resilience Building Strategies

Produced by TSURO Trust, Zimbabwe

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DISCLAIMER

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The project generated six separate Research Reports/Papers. This paper/publication consolidates key insights from the six Research Reports/Papers.

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FOREWORD

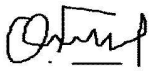
Zimbabwe is experiencing unprecedented climate change impacts as climate change proves to be a present reality in addition to being a persistent future challenge. Despite having an insignificant contribution to causing global warming and climate change, Africa and Zimbabwe remain highly vulnerable to the frequent climate change induced extreme weather events such as Tropical Cyclone Idai. These are increasing the risks of record flooding, strong winds, hailstorms which result in loss of many precious lives, property, infrastructure, food and livelihoods. Whole communities as well as social and economic structures are being impacted, as seen during the case of Tropical Cyclone Idai.

The geographic position of Zimbabwe in the sub-tropics and proximity to the Tropical Cyclone active region of South-Western Indian Ocean exposes the greater part of the country to the Tropical Cyclone activity. This vulnerability is greatly aggravated by underlying poverty, reliance on climate-sensitive livelihoods options and the limited adaptive capacities of communities in most parts of Zimbabwe.

Whilst this research study focused largely on experiences from Chimanimani, the susceptibility of most parts of Zimbabwe to tropical storm activity demonstrate the need for adequate climate risk profiling which must act as an early warning triggering early preparedness and action. Both climate observations and projections have noted an increase in Tropical storm activity in terms of intensity and frequency. Sectors sensitive to Tropical Cyclone impacts therefore need to be re-mapped, broadened and prepared to effectively deal with the previously 'low probability- high impact storms'. Tropical Cyclone Idai is a classic example of the need for stronger and effective systemic approaches and frameworks such as the localised National Framework for Climate Services as espoused by the Global Framework for Climate Services (GFCS). Such a framework, if in place and effective, would assist the whole Disaster Risk Reduction (DRR) value chain to better project occurrence of such weather and climate extremes and provide climate products and services which inform sectoral planning including land-use planning and infrastructure design. It will also prepare various socio-economic sectors, communities, development partners and the Civil Protection to anticipate such events and deal with them without high loss of life, property, food, livelihoods and infrastructure.

I therefore recommend the findings of this operational research for uptake and application in planning, programming, practice and policy making by all Districts and provincial development coordinators, Civil Protection Units at various levels, government departments and development partners. Business communities, technical development partners, climate change managers and households will also find this operational research informative. Occurrences such as Tropical Cyclone Idai can also be possibly taken as a negotiating issue at global climate change negotiations for the Conference of Parties as they further provide evidence of the devastating impacts of climate change as well as demonstrate that adaptation has limits. This necessitates the need for loss and damage funding in addition to climate funds and climate technologies designed to adapt to climate change or reduce the climate change-causing greenhouse gasses.

The research is a product of a collaborative effort, with contributions and reviews from government departments, academia, civil society and the private sector. It is hoped that the research will be of use and assist DRR players, development partners, policy implementers, planners and decision makers from all sectors of Zimbabwe in attaining climate resilience and reducing climate and weather induced disaster risks.



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Executive Summary

Eastern Zimbabwe is a mountainous area, which mostly lies in Agro-ecological Regions I and II. These regions receive the highest rainfall amounts and have the best natural suitability for the production of specialised crops and trees. The regions provide the most diverse ecosystem services in the country since they are at the top of a five-tier agro-ecological characterisation. However, population growth, rapid land-use and climate change are increasingly degrading the regions' ecosystem. These complex factors are putting pressure on this highly productive mountain region, with significant impacts on the wider ecosystem services thereby constraining the wellbeing and livelihoods of the local community.

On March 15th 2019, Chimanimani and eight other districts were plunged into disarray by Cyclone Idai, leaving a trail of destruction and human casualties of unprecedented magnitude. Cyclone Idai's impact became the most devastating natural disaster Zimbabwe has ever faced. It resultantly required the highest humanitarian response ever mobilised in the country's modern history. The epicentre was predictably in the mountainous highly fragile parts of Chimanimani District. This exposed an extremely vulnerable region to the might of the Cyclone, resulting in a natural disaster that highlighted the urgency of resilience building.

Following the disaster, stakeholders led by TSURO Trust initiated a research to understand the causes and impacts of the disaster as well as to inform recovery and development options. The research, from which this paper arose, assessed the district's pre-Cyclone conditions as part of explaining the extent of the disaster's impact while also answering some questions that district stakeholders had. It also broadly sought to inform future resilience policy and practice in Zimbabwe and other countries. The research project was organised by TSURO Trust and executed by local and international researchers working within Universities, government agencies, civil society and the private sector.

The study was both multi-disciplinary, participatory, action-oriented and considerably comprehensive. This was necessary given the multi-pronged nature of disasters and their impacts. Practical delivery and management of the research was organised into six key thematic areas (KTAs) as follows:

1. Humanitarian impact;
2. Climate change and environment;
3. Agroecology and land-use management;
4. Livelihoods, political economy and governance;
5. Topography, infrastructure and settlements; and
6. Disaster risk reduction, relief and recovery.

Overall Impact of Cyclone Idai in Chimanimani

The cyclone struck Chimanimani District hardest. 157 peopled died while 300 were declared missing. Many others were left deeply traumatised. Farmers' fields were degraded, while farm produce was swept away in the on and off farm infrastructure local communities relied on, whole settlements were severely affected by landslides. Some homes, food stocks and livestock were swept away by muddy floods. Commercial activities were severely dislocated while the community was isolated from the rest of the country for a dark two weeks when roads were impassable, electricity and telecommunication infrastructure were rendered out of service.

The dislocation affected all facets of local community livelihoods. This compounded an already fragile humanitarian situation that was underlined by pre-existing factors like poverty, lack of adequate basic infrastructure and amenities, a struggling economy, weak institutions and other hazards principally driven and exacerbated by climate change intensification. As such, Cyclone Idai's impact was heavily felt in the socio-economic sphere. Displacements increased the psycho-social burden on families

and children. Disruptions to education services as well as water, sanitation, health and irrigation infrastructure left some survivors homeless and vulnerable to health risks and food insecurity. Cases of sexual abuse and gender-based violence rose during the search and rescue as well as humanitarian response phases.

The massive humanitarian response that followed aided many survivors to slowly recover. National Government led the response with the active participation of citizens, national and international organizations in the civil society and private sectors. Coordinating the response exposed both policy and practical institutional frailties. Technical, political and traditional officials in the district expressed a sense of feeling initially abandoned and later overwhelmed. At the same time, they remained anxious regarding the causes of the disaster and at the prospects of such events recurring. These anxieties informed the demand for and actual design of the research.

Factors explaining the high degree of Cyclone Idai's devastation

The causes of the heavy destruction in the district was due to a combination of fragile institutions, a progressively bare and rugged relief, systematic degradation of the ecosystem as populations encroach into sensitive areas, and pre-existing social risks in a context of worsening climate change. The cumulative effects of these factors on the local economy and livelihoods predisposed both people and their environment to the force of the Cyclone. The shortest distance to the district from where Cyclone Idai made landfall on the Mozambique coast, which is less than 200km compared to other districts, meant that the westward moving decaying inland Cyclone reached the region whilst having a relatively stronger strength. The unprecedented intensity of the Cyclone itself culminated in increased vulnerability of the district. The rugged relief that slowed the speed of the Cyclone, allowed the increased dumping of more rainfall per unit time which increased the susceptibility of the underlying steep slopes to trigger landslides.

Further, the sudden rise in topography that is presented by the local Chimanimani Mountains, facilitated the upward vertical motion which resulted in accelerated vertical cloud development thereby enhancing the intensity of the precipitation. The impacts were compounded by the speed of the Cyclone itself, which was slow moving and even momentarily stagnated on several occasions, hence inducing successive outbreaks of heavy rain over the same area. As such, the resulting torrential rains dumped more than 400mm in just 24hrs. This record-breaking rainfall amount caused flooding and triggered landslides of unprecedented strength in the region. The extremely low occurrence probability of such high intensity tropical cyclones in the region meant that the district did not anticipate such a magnitude and as a result, was generally not prepared. Hence even infrastructure that was built by observing the required standards like roads and bridges was overwhelmed and succumbed to Cyclone Idai's strength. This high intensity was also responsible for the destruction of settlements in areas of urban and rural Chimanimani, especially where these had been sited on waterways or were in areas cleared of vegetation that could have acted as a buffer.

The flow of and acting on both scientific and indigenous knowledge regarding the Cyclone was slow. Pre-Cyclone effectiveness of development planning, coordination and actual performance of strategic institutions was highly inadequate. Years of economic decline had left most state agencies without operational resources. On the social front, Cyclone Idai hit an already fragile social and political economy that was barely able to cater for the demands of a growing population. The national economy has been very weak and not been performing well at household, ward, district, provincial and national levels for more than a generation. The community early warning systems designed to prepare and respond to unfolding hazards like Cyclone Idai were very weak and disjointed. As a result, the communities together with their institutions were critically unprepared for the event and unsurprisingly overwhelmed. As such, though a forecast was issued three days before the catastrophe by the Zimbabwe Meteorological Services, it was delivered to an under-resourced and unprepared community. On the other hand, the forecast itself had a lot of limitations which

constrained its effective use by the intended recipients. Combined, these factors explain why Chimanimani was hit hardest by Cyclone Idai.

Key Findings

The findings are presented below by key thematic area (KTA) as follows:

Humanitarian Impact

The study captured Cyclone Idai's humanitarian impact in terms of various dimensions of loss and psycho-social ill-health, with 56.7% and 37.6% of respondents indicating very severe and severe psycho-social trauma respectively. A number of individuals at community level as well as officials working for different organizations in Chimanimani expressed helplessness, enhanced economic vulnerability and an increased burden. Families that lost male breadwinners were particularly in a more vulnerable position with dampened recovery prospects. Children were particularly traumatized by the horrific scenes they witnessed including loss of parents, guardians, friends and neighbours. Lives lost included those of learners, educators and health personnel, which affected these specific services as well as the societies in which they are delivered.

Those who were internally displaced reported lack of safety and security in the tents in which they had stayed for nearly a year at the time of fieldwork. They also lacked adequate basic services and longed for permanent resettlement citing increasing absence of social harmony within the camps. In the delivery of the humanitarian response cases of corruption, gender-based violence, human rights and sexual abuse were recorded. Young women and girls were most vulnerable to abuse at the temporary shelters, during aid distribution processes and within the community. The study learnt of strained social and marital relations.

Cyclone Idai galvanised a huge humanitarian response. The local community including volunteers and business organizations provided assistance to neighbours and distressed members of society. They were directly involved in search, rescue and recovery missions as well as burying those who died in the disaster. National government, local and international development organizations, the private sector and local governments mobilized a very considerable response. They provided aid to displaced families in terms of food and non-food items in the immediate aftermath of the disaster and for those in camps long after the disaster had passed. Aid tailored to the needs of special groups was also made available e.g. 'dignity packs' for women and girls and support to young people. Water and sanitation services that had been disrupted were restored as was infrastructure at schools and health facilities.

Climate Change and Environment

There is a general decrease in rainfall amounts during the rainfall season. The frequency of seasons with anomalous rainfall is increasing resulting in a rising number of meteorological droughts. Households' climate-experience tallied with trends from observed climate data with over 60% of the survey respondents confirming rising frequency of droughts. There was an equally high number of respondents reflecting considerable knowledge of climate change issues. Flooding in areas that are prone to their occurrence is increasing. The study concluded, among others that Cyclone Idai's intensity falls into a category of very low probability (<5%) and long return period (>30 years) and thus was a very rare event for Chimanimani.

The extreme 24-hour rainfall event with an amount of >400mm measured at Chisengu has very low probability with a return period of >35 years, which explains the shock with which the event was experienced. Focus group discussions also confirmed that while weather extremes of such magnitude have been experienced being transmitted through oral tradition, they did not occur that frequently.

The types of hazards known to be and experienced as becoming more frequent were extreme temperatures, droughts and strong winds. Responses also indicated that cyclones have rarely adversely affected Chimanimani. Analyses of climate data conducted as part of this study also confirm this.

The higher impact experienced in Chimanimani relative to other districts was explained by a shorter distance travelled from when the cyclone made landfall in Mozambique. Further, Cyclone Idai initially approached from Mozambique coast on a 'smooth, flat track' but later on wind speeds were markedly decreased by the mountains and forests in Chimanimani, which 'impediments' resulted in concentration of heavy rains in the district. Scientific predictions and observed cyclone track strongly agreed while the projections overstated the western reach of the cyclone perhaps explainable by the impeding effects of the mountains and forests. Field data noted discrepancies between observed and predicted rainfall amounts, coverage (including areas likely to be hit hardest) and impact fuelled a sense that science had been wrong, which was further explained by the less-than-effective early warning and practical guidance regarding responding to Cyclone Idai in Chimanimani. The study also found that some residents did not fully heed the early warnings and did not act appropriately because past cyclones had manageable effects/benefits.

The cyclone led to land degradation, water pollution, loss of vegetation cover including forests, adversely altered landscapes leaving scars and dumping boulders on flat land. This modified river and stream courses with some new surface features being exposed in some areas. Deep weathering which resulted in sedimentation with rocks underneath as well as fluvial processes may have led to deposition of rocks with smooth surfaces along streams. Communities reported hearing rumbling sounds accompanied by vibrations. This could be explained by the heavy boulders that were moved by flooded rivers and mudslides. These added to the hazards experienced during the peak of the cyclone.

Agroecology and Land-use Management

Cyclone Idai seriously impacted the district's already-ailing agricultural sector, due to poor service connectivity and previous droughts. Grazing areas were reduced by mudslides as some pastures were washed away and others covered by large boulders. Deep gullies were created in grazing lands such as in Chikukwa, with animals lost in gullies. Cropping land, particularly riverine gardens, where niche crops are planted, were also washed away - reducing crop diversity and exposing farmers to further food and seed insecurity. Excessive rains falling on compacted and denuded soils resulted in rapid run-off, exacerbating downstream flooding. Nutrient leaching also occurred with reports of smaller fruits and seeds in the following season being destroyed. Soil organic matter that holds nutrients, moisture and hosts organisms critical for healthy soils, were washed away.

Agroecology and land-use management investigations were done in order to establish resilience of different farming landscapes and factors which exacerbated social vulnerabilities amongst farming communities by using the impacts of Cyclone Idai as a case study. This was achieved through assessing landscape resilience to extreme weather events, so as to establish optimal soil conditions for moisture and nutrient retention on farmland, rangelands and forest. It was noted that forested landscapes, followed closely by those managed using agro-ecological practices contained the most soil organic matter, able to absorb more excess run-off, and retained more nutrients in the upper layers, making it more available to plants. These findings were reinforced by observations of agro-ecological and neighboring conventionally managed farmlands, with the former containing more agro-biodiversity and showing signs of better plant health - with implications for food diversity, quality and availability, as well as yields.

The study also established explanations of Cyclone Idai's impact from a soil and landscape perspective. Thin and patchy ground cover of 50-60% resulted in increased surface flow leading to the observed washing away of grazing and cropping lands. Uneven litter and plant residue from

undesirable (less foliage) plant species could not cushion grazing lands from rainfall impact (erosivity power). Moderate soil compaction resulting from animal movement reduced infiltration rate resulting in excessive surface flow. Reduced forage production due to high stocking rates led to overgrazing and creation of bare surfaces. Farmers' loss of trees and ground cover heightened their vulnerability to impacts. Furthermore, in the low veldt the study found an alarming disconnection between resource users understanding of the relationship between water and soils, undermining mitigation efforts and further exposing farming landscapes and livelihoods to future rapid- and/or slow-onset disasters. On the resilience of social farming systems, the study observed a renewed sense of the importance of lost social-ecological connections and relationships. This arose during discussions around causal reasoning and solution-building for improved responsiveness. An improved sense of social cohesion was reported in specific wards stimulated by the sense of urgency and collective efficacy in the face of institutional failures by NGOs and government. These failures have serious ramifications for at-risk communities. Yet, the collective mobilisation, particularly effective where traditional knowledge-based farming systems remain strong, saw local people joining together into first responder units to aid recovery of people, homes and infrastructure. These mutual aid and solidarity networks provide an indication of where future investment in adaptive capacity development might focus.

A number of factors explain the degree to which Cyclone Idai affected farming systems. One of the study's observations is that, despite evidence of its effectiveness in absorbing the worst impacts, agro-ecological practice remains sparse, with the majority of farmers subscribing to a combination of destructive farming methods. These methods are understood in the context of land-use pressures, and ready cash incentives from GMB that promotes monocropping hybrid maize with the use of synthetic fertilisers – all of which denude soils and agrobiodiversity that would otherwise build resilience and stabilize soils and landscapes. Cash incentives also encourage traditional leaders to sell off access to more fragile land, which include permissions to denude landscapes of trees that are important for effective ecosystem functioning and so protect farmers against climate and environmental shocks.

Furthermore, in wards where decision-making is highly politicised, solution-finding had become confused, resulting in inadequate and unclear planning capabilities (and capacities) amongst decision-makers. Neither traditional leaders nor government officials were adequately aware of the difference between by-laws and environmental regulations adding to the confusion about roles and responsibilities. High levels of mistrust in community leaders and neighbours were reported, resulting in people being unwilling to use their granaries or to participate in community activities to produce and store grain for the most vulnerable. This had the effect of undermining the value of community safety nets, with implications for resilience and recovery. Local cohesion was particularly eroded by concerns over inappropriate or non-existent 'settlement design' that places migrants in exposed or ecologically fragile areas. This resulted in assumptions that it was an influx of 'others' that are responsible for land/resource degradation, rather than the failures of decision-makers. A correlation was found between high levels of politicization and migration - prominent in areas with high-value resources, which were attracting more inward migration for forestry and mineral resources.

Livelihoods, political economy and governance

The strong Cyclone Idai hit an already fragile social and political economy, which has not been performing adequately at household, ward, district, provincial and national levels for nearly a generation. Key economic sectors had shrunk considerably being severely outpaced by the rising population together with its needs. The strain on livelihoods was amplified in many ways due to the local-national governance performance which has been regressing. The ability of governing institutions to effectively regulate the economy of Chimanimani so that it generates decent work and sustains livelihoods has been faltering. Food security data reflect increasing deficits from local production, reduced tree cover with negative impacts on related livelihoods and a number of unresolved conflicts across the district economy over land and other resources. This is in a context

where livelihoods are still dictated upon by agro-ecological regions with the eastern side being better-off than the western side (except around irrigation schemes).

As such these pre-cyclone disruptions to neighborhood, meso and macro political economies pre-disposed households and communities to the negative impact of Cyclone Idai. Stressed pillars of the local economy like forestry and large scale commercial agriculture had been in decline more precipitously from 2000. This dislocated connections with and contributions to up and downstream livelihood activities including employment undermining whole-of-economy sustainability. Consequently, at district level, local governance institutions were unable to track, influence and take account of micro-to-meso economic trends in their decision-making. In essence, livelihoods were inadequately supported by government and community institutions. Additionally, allocation of land for agricultural activities and homestead establishment did not follow established rules resulting in some homes and farmlands being inappropriately located. Independent Zimbabwe's cumulative layers of policies, laws and local to national organizations created without sufficient analysis of how these work in practice have caused institutional contradictions that compromise performance in the face of ever-evolving development challenges.

The study found considerable asymmetries in knowledge and understanding regarding decision or rule making, application and the actual capacity of institutions to deliver on their roles and responsibilities. Formally powerful public institutions lack practical or operational capacity resulting in most development planning and management activities circumventing the local authority for the area, Chimanimani Rural District Council. This built on pre-Cyclone arrangements where Council has little to no control over the local economy being unable to resolve conflicts between miners and farmers while effectively not the regulator of the small to medium enterprise sector. The study learnt of corruption in mining areas before and since Cyclone Idai as well as a perception that allowances meant for public servants involved in the response had not been equitably and transparently administered.

Before and since Cyclone Idai, external development agencies have not built the capacity of local governance institutions. They have worked in numbers that are unwieldy placing demands on coordination that disarrayed and under-resourced state agencies have failed to meet more so in the absence of a Development Plan. This severely weakened the effective planning for any eventual disruptive events such as weather extremes. In the absence of such a plan, multiple fragilities have become prominent that are straining livelihoods and institutional relations thereby significantly eroding any efforts that could be created to build resilience of the local communities. At the same time, it is suggested that a follow-on analysis for purposes of informing an appropriate set of policy and practical responses should be based on a shared understanding of the district economy regarding its strains, unresolved matters, performance and relations amongst key institutions, strategies tried previously, and policies needs given that climate change-induced risks remain firmly anchored.

Topography, Infrastructure and Settlements

The impact of the cyclone on infrastructure and settlement was extremely devastating and was predominantly due to landslides. The moving debris also affected telecommunication networks and electricity supply but with the road network being most affected resulting in inaccessibility to most parts of the district due to destruction of several bridges, shelvets and culverts. The damage was concentrated in the eastern and southern parts of the district. Two localities in particular – Ngangu Township and Kopa Business Centre were severely impacted by landslides, flooding, loss of life and damage to property. Through detailed observation of the geology and physical landscape two landslide mechanisms were identified - 1) debris flow in areas with steep slopes, shallow soils and impermeable quartzite mountain tops and 2) slope failure in areas with deeply weathered dolerite and gabbro sills with deep porous soils. In this regard, areas drained by channels from upstream had the most severe impact on both settlements and road infrastructure especially in Chimanimani urban.

Here, those slopes which are quite steep, with thin soils and relatively low vegetation cover were the areas which were deeply cut by the storm and had more pronounced landslides. Of note was the flood plain around Kopa business centre where the Nyahode River flows out from a steep gorge where significant damaged was inflicted. Most of these landslides were "debris flows" where a mixture of boulders, cobbles, sand, mud and water flowed down a hillside in a fluviatile fashion. This effect was heightened by the geology of the district such that the incessant rains due to Cyclone Idai which, coupled to the combination of an impermeable floor and steep slopes, caused large amounts of water to flow at a rapid rate downslope. This fast-moving torrent, which is the erosive phase of the landslide where the flow of water is at its highest power, picked up mud, sand, cobbles and large boulders along the way. The materials and debris from the slopes were flushed down the mountainside as a flood driven by the extreme precipitation which then destroyed most infrastructure and settlement along its paths.

However, in the rehabilitation stage, it was noted that progress on road rehabilitation is slow and no concrete reasons for the delay were given save for the effect of rains and fuel shortage. Poor workmanship and poor material quality were observed. Some of the road appurtenances, commissioned still revealed incompleteness, for instance absence of rails on bridges and hanging cliffs by the roadside. The many displaced settlers have not been resettled. Some of those not displaced still live in their houses, despite visible deformities on their houses. About four sites were proposed for resettling the displaced people, however, and Nhedziwa Growth Point has been surveyed and stands have been pegged. However, the greater part of the residential location is in a wetland.

As a matter of urgency, slopes and hanging cliffs have to be stabilized, road infrastructure rehabilitation be expedited using good quality materials and at improved workmanship. More land should be made available to resettle displaced people in areas which are habitable other than in wetland areas. Otherwise the communities remain more at risk should a cyclone of similar nature visit the region.

Disaster Risk Reduction, Relief and Recovery

Cyclone Idai left immeasurable destruction and casualties of unprecedented magnitude. As such two mutually inclusive questions that immediately come to mind are: Was the country ready to manage the disaster? and: Was the response really effective? The disaster resulted in loss of human lives, livestock, agricultural land and produce, infrastructure damage and trauma among the survivors. Women, girls, and children were more vulnerable as evidenced by cases of sexual abuse and gender-based violence. The occurrence of Cyclone Idai exposed capacity and policy gaps in Zimbabwe's disaster risk management system and overall governance. For example, people got information of the pending disaster but did not know how to use the information, since it was not properly packaged. The local institutions proved to be very weak. They lacked the capacity to prepare and respond to climate related hazards.

Politics was also found to negatively interfere with land management policies and implementation. Based on the pressure and release (PAR) model, the study found the root causes of the devastating impact of the cyclone to be i) lack of effective DRM systems, ii) politicisation of governance, iii) lack of DRR training and awareness, iv) inadequately planned and controlled population growth in mountainous areas, v) climate change, vi) local beliefs and attitudes, and vii) unsafe conditions (e.g. settlements in dangerous locations like waterways, lack of disaster preparedness at all levels and household vulnerability attributes). These factors caused Chimanimani district to be vulnerable to the kind of devastation that Cyclone Idai brought with it.

Besides highlighting the deficiencies in the disaster management system, the magnitude of this disaster also exposed deficiencies in community factors that increased household vulnerability to hazards. These include negative community attitudes, household sensitivity and exposure. Using the

resilience framework, results indicated that generally local response systems and the structures that are expected to deploy them during and after disasters have long collapsed. There is need for rehabilitation and reconstruction in order to restore the community-based systems. This could be achieved through building capacity of government institutions and traditional leaders (cascade to households) and to set up effective and efficient early warning systems. The framing focus would be building community resilience to natural disasters.

Conclusion

This multi-dimensional analysis of the causes and impacts of Cyclone Idai in Chimanimani district drew a number of lessons. Some of the critical ones relate to the reality of an inadequate framing and delivery of development in or overall governance of mountainous areas specifically but in other areas as well. This weakness created a situation of pre-cyclone social vulnerability and economic fragility seen in an underperforming economy, unresolved conflicts in all key sectors, poor land and broader environmental governance, inadequately coordinated and capacitated institutions.

This stressed and inadequately prepared institutional context without clear disaster risk reduction policy instruments and response mechanisms is one to which early warning information about Cyclone Idai was sent. Considering that the district is expected to experience other extreme weather events like heavy rainfall up to 2050 it is imperative that lessons drawn from Cyclone Idai are applied. The building of resilient and accountable institutions, effective development plans that embed disaster risk reduction and a general observance of the rule of law is critical. This enables the designing and applying of sustainable, evidence-based social and economic development innovations.

Overall Recommendations

Identifying and effectively following pathways towards resilient individuals, households and communities requires the following:

i) A Council-led development planning and land administration system that is clear, accountable and adequately resourced (financial and technical capacity);

ii) Designated DRM Office that leads on collating or receiving and analyzing relevant information for use in development plans that embed DRR (including research and administering early warning systems);

iii) Meaningful engagement of resource users in preparing, adopting and implementing land use plans at village, ward and district levels; and

iv) Ongoing development of community resilience and active citizenship.

Given the observed multitude and high levels of vulnerability in Chimanimani, a way forward towards sustainable recovery needs to build on social empowerment towards disaster preparedness. This also needs to include hazard and risk reduction capacity. In the wake of projected increase in hydrometeorological extremes, e.g. floods and droughts, it is apparent that building resilience to natural disasters in mountain ecosystems already under pressure from climate change needs more concerted effort than before. There is a need to develop and execute a disaster risk reduction and management framework in an integrated manner.

Chapter 1: Research Background and Context

1.1 Study Background

The recent climate change-induced devastation linked to Tropical Cyclone Idai of March 2019, has brought to the fore the need to urgently consider building sustainable resilience to natural disasters. This is especially critical in the more vulnerable mountain ecosystems, the societies and economies that rely on them. Mountains are among the most fragile environments on earth and yet are rich repositories of biodiversity, water and providers of ecosystem goods and services on which communities rely. At the same time, mountains double up as home to some of the world's most threatened and endemic species. They are also home to some of the poorest people who are dependent on the available diverse biological resources.

The Chimanimani Mountains in the Eastern Zimbabwe face enormous pressure from climate change and other resource use and user-related factors. This is exacerbated by geographical location as the area lies in the path of almost all westward moving tropical cyclones that make landfall from the Mozambique Channel. The intensity and frequency of cyclones is projected to increase. Given the reality of climate change, mountains are likely to experience wide ranging environmental effects that impact natural resources (including biodiversity) and socioeconomic conditions. However, little has either been documented or is known about the vulnerability of the Chimanimani Mountain ecosystems to climate change. This explains the surprise that met the intense devastation inflicted by Tropical Cyclone Idai on the region.

The Chimanimani Mountain area has fragile and poorly accessible landscapes. Areas that used to have sparsely scattered settlements now have growing populations engaged in social and economic activities that are altering these landscapes. At the same time the rugged terrain has also meant that available infrastructure was poor. These factors imply high vulnerability of the region's ecosystems to climate change as a result of ecological fragility and economic marginality. Observations indicate that in Chimanimani, global warming induced temperature changes are rapidly making particular mountain altitudes inhabitable to most living organisms that had for the past thousands of years been able to thrive under cooler environments. At the same time, the complex topography characterised by extreme slopes have relatively high agro-ecological variability over small distances. A combination of these factors induces protracted impacts on biodiversity, water availability and agricultural viability while exacerbating potential impacts of the already increasing frequency and intensity of climate change induced natural hazards. This increased exposure is already taking its toll on people by particularly eroding their livelihoods as a result of depreciating ecosystem services. As such, the Chimanimani region with the highest mountains in Zimbabwe, is a typically conducive action research setting on building resilience to climate change induced natural hazards in the country.

1.2 Researching on Chimanimani's Vulnerability to Cyclones and Learning from the Impact of Cyclone Idai

Tropical Cyclone Idai was classified as intense on making landfall on the coast of Mozambique. As it moved westwards and ripped through the eastern parts of Zimbabwe the cyclone left a trail of destruction. Its effects were unprecedented in the modern history of tropical cyclone impacts in the Southern Hemisphere. The storm caused catastrophic damage in Mozambique, Zimbabwe, and Malawi leaving more than 1,300 people dead and many more missing. In Zimbabwe, Chimanimani District was hit hardest. This exposed the high vulnerability of mountain ecosystems to natural hazards. Mudslides and widespread flush floods loosened multitone rock boulders that blocked river channels and destroyed settlements found in their paths. This caused extensive damage to the physical infrastructure worth more than 622 million USD and killing more than 300 people, with about 150 either buried or washed downstream to neighbouring Mozambique. The cyclone also extended its

impact to destroying large tracks of arable land, plantations, crops and livestock including severely disturbing local ecosystem functions.

Because climate change-induced disasters are poised to intensify and increase in frequency mitigation plans are needed. The district will continually be affected more severely during and after future tropical cyclone occurrence, with higher number of casualties and greater damage to livelihoods and economy if a plan is not developed and implemented. An effective mitigation action plan informed by well-coordinated or systematic research can greatly reduce the severity of loss to future hazards. In this regard, the impacts of tropical Cyclone Idai, exposed the need to close the research and action gap in view of the vulnerability of Chimanimani District to climate change induced natural hazards, particularly to tropical cyclones. The desire to learn from this disaster in a systematic way to allow the people of Chimanimani and their institutions to be better prepared and thus be more resilient in the face of potentially recurring events such as Cyclone Idai informed the present study. At the same time, the study also sought to draw lessons from the event to aid informed planning and responses to future similar events. For the district to reduce the associated risks while building resilience to the climate change effects, research-driven planning and action cannot be overemphasised.

1.3 Study Area Characteristics

Chimanimani District in Eastern Zimbabwe is one of 10 local authorities in Manicaland province (Figure 1.1). Its topography is characterized by highly rugged terrain with the highest mountain ranges and the lowest valleys in the country. Altitude rises to above 2000 m in the east and drops to 400m above sea level in the Save and Odzi valleys to the west. The district has all five of Zimbabwe's agro-ecological regions within an area of 3450 square kilometres. Being situated less than 200 km from the Indian Ocean, makes it prone to effects of recurring tropical cyclones from the Mozambique Channel. This increases the risks of damage to infrastructure, livelihoods and ecosystems of significant biodiversity.

The district has 23 wards and is mainly rural with predominantly agro-based livelihoods. Eighteen of the wards are in communal land, one in a resettlement area, three are in commercial farming areas and one is urban and peri-urban. Settlement patterns in communal areas are generally random given the rugged terrain. Most of the areas where plantations dominate the settlements have well defined patterns due to an inherent high level of land use planning. However, in western Chimanimani where it is very dry, the settlements follow major sources of water and communication e.g. major rivers and roads.

The vegetation is classified into i) a dry region with mixed deciduous woodland dominated by Baobab and Mopani trees in the low-lying areas, ii) savanna woodland to Montana grassland and broad-leafed evergreen forests on the escarpment, and iii) broad-leafed Montana exotic tree forests of pine, wattle and eucalyptus trees. In 2017, Chimanimani Rural District Council adopted a District Climate Change & Watershed Management Policy. This followed research and participation by all key District stakeholders. The district is one of three pilot districts in Zimbabwe where adaptation of the National Climate Change Policy was tested.

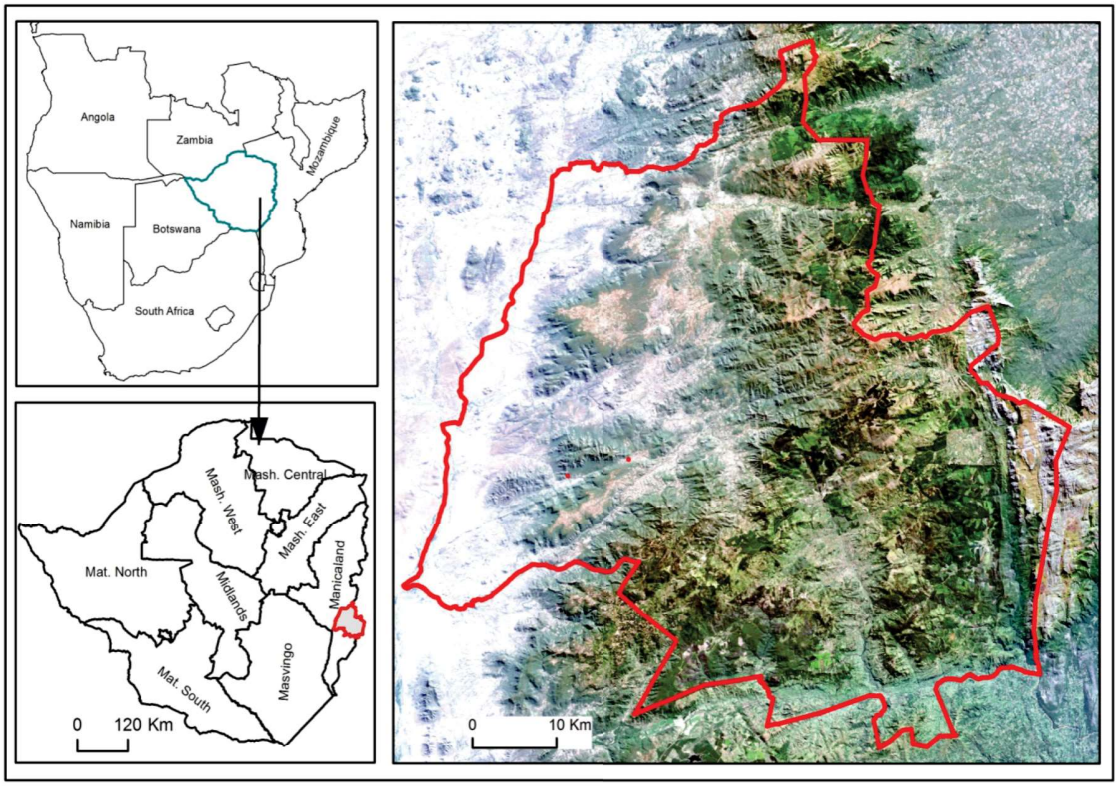


Figure 1.1. Locational and Topographical Characteristics of Chimanimani District

Chapter 2: Research Scope and Overall Approach

2.1 Introduction

The research from which this paper arose is divided into two phases. This paper is a consolidation of Phase I, a short-term, six-month period from October 2019 to April 2020 whose deliverables are summarized here. The Phase began with a TSURO-conducted post-Cyclone reflection and widespread consultation of survivors. This yielded a number of insights and provided a grounded justification for further research on the events that had just befallen the district. Participants to the TSURO-convened reflections and consultations raised questions and expressed a desire to have adequate knowledge on climate change and related aspects leading to Cyclone Idai and its effects. TSURO consolidated a report, which it used to develop the proposal for the present research. These findings were shared with strategic research institutions through the organization's longstanding peers at key Universities and institutions in Zimbabwe and outside. A workshop was held in early July 2019 to discuss the draft research proposal, agree thematic areas and research questions, teams and the overall research methodology.

In late October 2019 the assembled team met in Chimanimani for an Inception Workshop and field reconnaissance mission. Additional work undertaken after the July workshop was shared and teams took time over two days to visit three sites in Wards 10, 16 and 17 holding meetings with communities and making observations of the environmental impact of Cyclone Idai. The workshop and field visits helped the teams to refine their thematic research questions and methodology. They also initiated identification of local research participants (co-researchers) that later contributed to the development of data collection tools including actual questions and refining of processes at a two-day workshop in December 2019 in Chimanimani (Biriiri). The selected co-researchers were trained in actual data collection and deployed after the December workshop for the Agro-Ecology thematic area while for the questionnaire survey for the other thematic areas training, tool piloting and deployment were done in February 2020 in Chimanimani. Summaries of thematic methodological processes and insights are discussed in subsection 2.4.

2.2 Overall Research Problem

Consensus is rising that the strength and number of major cyclones from the Indian Ocean may be increasing because of higher sea surface temperatures associated with global warming. The increased intensity and frequency of tropical cyclones due to climate change are enhancing the vulnerability of the already accelerated environmental degradation of Zimbabwe, more so in the mountainous regions of Chimanimani District. As a result, the impacts of tropical cyclones in the region are becoming more and more disastrous, each time characterised by unprecedented casualties and loss due to damage to the environment and infrastructure. This is severely crippling the national economy whilst significantly hindering and further setting back development. The scenario is compounded by the fact that local communities are dependent on subsistence agriculture.

Geographical factors such as lying within easy proximity of tropical cyclones from the Mozambique Channel also put Chimanimani in a more disadvantaged and vulnerable state while the fragile mountainous conditions exacerbate the situation. In addition to the immediate death and suffering caused by such disasters, cyclones also have direct and indirect impacts on general public health, livelihoods, infrastructure and sociocultural foundations. They also affect access to food and drinking water, and increase the transmission risks of infectious diseases, such as diarrhoea, cholera and malaria, thus contributing to the interruption of livelihoods. There are also indirect impacts such as damaged infrastructure, population displacement, reduced food production and the release of contaminants into the water (e.g. from storage and waste disposal sites).

The study focused mostly on inadequacies identified in key thematic areas. These were identified in the district as hindering resilience building efforts in terms of the following:

1. Little knowledge of the humanitarian impact and poor coordination of the response institutions;
2. Lack of knowledge of potential of tropical cyclone impacts to the environment;
3. The climate proofing potential of agro-ecology and land use management;
4. The building of resilience to the changing environment through strengthening livelihoods, political economy and governance performance;
5. Information on local topography that can be utilised for planning purposes regarding building more resilient infrastructure and settlements; and
6. The role of disaster risk reduction, relief and recovery in sustainable management of natural disasters in the district.

2.3 Research Approach and Questions

A multi-sector or multi-dimension action research approach was adopted. This was justified on the basis that effectively building community resilience to natural disasters is complex and should be informed from different perspectives. Since exposure to disasters is interconnected but experienced differently by various groups a multi-actor response allows consideration of integrated pathways towards resilience building. The research framework followed a systemic approach based on information derived from layers of participants from individual, household to national actors. The study also sought to determine how governance capability to direct various interconnections can be used to build resilience necessary for reducing the economic, environmental, social and cultural impact of cyclone induced natural disasters.

To manage this complexity holistically, the impact of Cyclone Idai was analysed according to six Key Thematic Areas (KTAs). These were i) Humanitarian Impact, ii) Climate Change and Environment, iii) Agro-ecology and Land Use, iv) Livelihoods, Political Economy and Governance, v) Topography, Infrastructure and Settlement and, vi) Disaster Risk Reduction, Relief and Recovery. Across all of these the investigations focused on i) economic, ii) environmental, iii) social and cultural, as well as iv) governance impacts (see Figure 2.1). KTA analyses varied according to the specific research angle. However, overlapping sub-themes were deliberately pursued to enrich the overall analysis. Considerable effort was put into making the inquiries participatory with a focus on gathering on-the-ground experiences and capacities of different actors. This is because the design of the study was inspired by the understanding that research processes, recovery efforts and long-term mobilisation for social change are integrated components in resilience building.

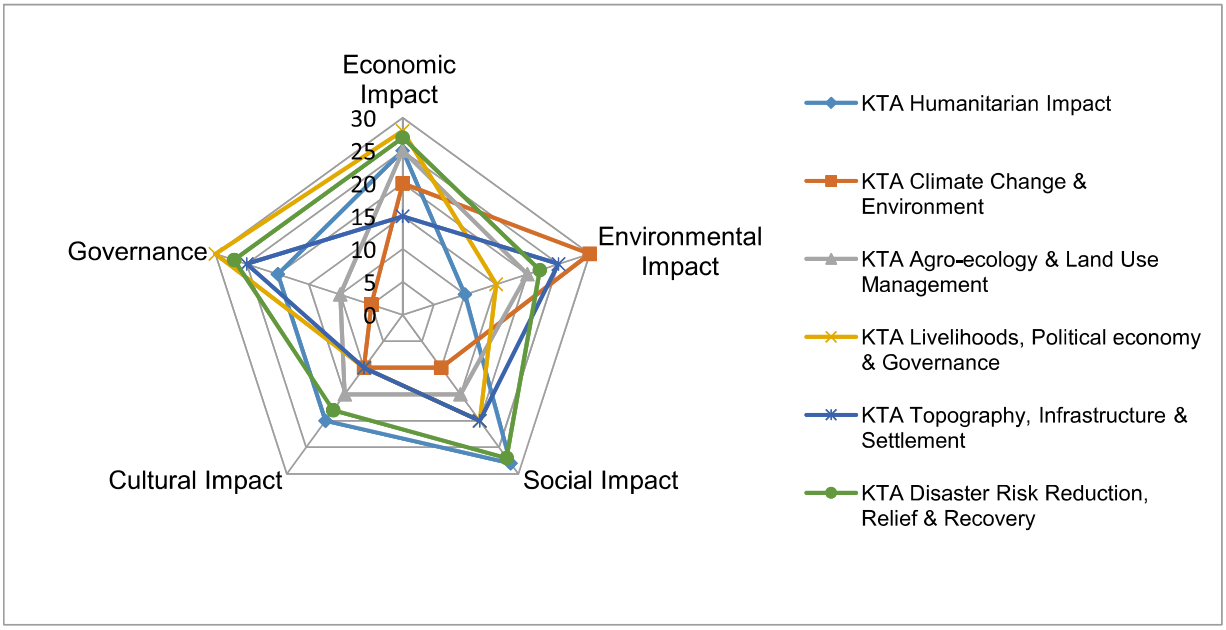


Figure 2.1: Adopted Research Framework

2.3.1 Research Questions

The overall research question for the study related to 'how impacts of increasing climate change induced risks on human lives, livelihoods and eco-systems in Zimbabwe could be reduced through action research by using Chimanimani District as a case study?' The specific questions at a strategic level that thematic areas further elaborated for operationalization were as follows:

1. What is the Humanitarian Impact following Cyclone Idai in selected communities of Chimanimani?
2. In what ways has climate change contributed to the tropical cyclone vulnerability of the environment, biodiversity and ecosystems in Chimanimani District in the current and future?
3. What is the resilience differential between how agroecologically and conventionally managed farming landscapes performed during and after Cyclone Idai?
4. In what ways do livelihoods, political economy and governance circumstances (and performances) contribute to resilience (or its absence) in the changing environment?
5. How did Cyclone Idai impact topography, infrastructure and settlements in Chimanimani?
6. How adequate were the DRM policy, legislative and administrative systems for disaster reduction in Chimanimani?

2.4 Synopsis of the Thematic Research Methodology Applied

2.4.1 Humanitarian Impact

The theme adopted a guiding philosophy of multi-disciplinary and multi-method participatory action research. Key methods used included a household survey that had questions from four other themes. Specific questions inserted into the joint questionnaire targeted humanitarian impact, responses and the assessment of the responses provided. Addititonally, the theme secured insights of community leaders, youth (aged 18 to 35), the elderly and women through Focus Group Discussion (FGD) sessions at Charleswood, Ndima area and with internally-displaced persons at the Garikai and Nyamatanda Camps in Chimanimani Village. Key Informant Interviews were also conducted heads and senior officers of government departments in Chimanimani with a focus on agencies in charge of social services.

2.4.2 Climate Change and Environment

The questions for the theme were answered based on data from historical meteorological/climate data analyses used to identify the trends in rainfall and temperature in the district at grid level. This allowed comparative ranking of Cyclone Idai in relation to other extreme rainfall events involving high rainfalls in the district. Additional methods used included Key Informant Interviews and Focus Group Discussion sessions to undertstand issues regarding previous extreme climate events and their impacts. These built on evidence from discussions with communities and stakeholders at the inception and other joint meetings, which helped the team align objectives to specific needs. The theme also contributed questions to the joint questionnaire. Flood and landslide hazard mapping was also done using multi-layer spatial overlays in GIS complemented by hazard exposure projections based on climate model predictions. The team also obtained climate data from AGRITEX which augmented other sources (Meteorological Services Department, Remote Sensing).

2.4.3 Agro-ecology and Land Use Management

For this theme an *ex-post facto and purposive research design* was used within an interdisciplinary and intersectoral context combining extension (research and practice - Agritex), social ecology, soil science, natural resource management and agricultural systems innovation (NGO) researchers. Additional to non-community researchers the thematic team actively and meaningfully facilitated the participation of 35 farmers as co-researchers (Co-Rs). The process was expanded through workshops that brought in traditional and elected leaders, officials from CRDC and government ministries to complete a mixd-method participatory action research. Co-Rs and other participants were purposive identified to ensure gender and generational responsiveness.

The specifc data collection processes included site selection of 8 wards of varying cyclone impacts where agroecological NGOs have been active. These were Chikukwa, Martin, Nyahode & Ngorima A and B (high potential NR1); Biriiri (middle veld NR2), Chakohwa and Chayamiti (lowveld NR4). The selected wards alsorepresented the different agro ecological regions from wet/upland to the dry/lowland. Focus Group Discussion sessions were used to co-generate and of rank ‘resilience’ indicators with the World Café ‘tool’ being applied. The indicators fell into landscape, livelihood and social categories. To complement the qualitative methods the team also conducted a household survey based on co-developed questions using the agreed indicators. The Co-Rs were) trained and surveyed 821 (60% female and 40% male with 17% youths) farmers across the 8 wards targeting households practicing both ‘agroecological’ and ‘conventional’ farming practices. Selection of households was purposive with bith Co-Rs and local Agricultural Extension Workers (AEWs) assisting in the process. Survey findings and insights from other qualitative methods were discussed at two Feedback Workshops to consolidate problem identification and solutions with some action planning. The workshops involved some respondents and local decision-makers and were attended by 146 people (88 women and 58 men).

The team also conducted soil and veld analyses with Co-Rs in 4 wards. Soil samples were taken from 3 (low veld), 17 (middle of the escarpment), 10 and 13 (upland and epicentre of the cyclone); Pit codes - 50 pits (10 p/ward - 5 AE and 5 CF) + 10 in Ward 17 forested areas; Veld assessments - 5 sites p/ward (X 100 points per assessment) = 20 samples. Additionally, exchange visits focused soil and veld analyses took place with farmer co-researchers (16 people made up of 8 women and 8 men) in 4 wards namely Chikukwa, Nyahode, Biriiri and Chakohwa. These were purposively selected from the original sampled villages based on highest performing in terms of responses in the formal survey (Chikukwa and Biriiri) and lowest performing (Nyahode and Chakohwa) selected from survey data for deeper dive. Soil samples were collected at 10 sites per ward (Biriiri 20 sites including a forested area with massive scars from landslides) at 0 to 15 cm, 15 to 30 cm and 30 to 45 cm for nitrates and pH. A total of 10 pits were dug to the parental bedrock level (Horizon C) per ward (Biriiri with an extra 10 pits in the forested area). Nitrates and pH per horizon were measured. Veld assessments were also done at 5 sites per ward (X 100 points per assessment) = 20 samples. Any incidental information arising

during field work, workshops and FGDs that could have a bearing on the impacts of Cyclone Idai were recorded through transect walks.

Key Informant Interviews (KIIs) as Semi-Structured Group Interviews reached 20 people made up of 8 AE farmers and 8 CF farmers (6 women, 10 men and 4 traditional leaders at the above 4 wards). were selected randomly from survey respondents for questions on effects of Cyclone Idai on the landscape, social systems (collective decision making; food and sovereignty and clubs) as well as livelihoods.

Data entry and analysis was done using the Statistical Package for Social Sciences (SPSS), which is user friendly and reduces data entry errors through coding thus enhances data quality. SPSS has higher data analysis capabilities. The Survey Team developed a data analysis plan which was shared among the core research team for their input before data analysis began. Data cleaning was done by running frequencies of selected key variables to identify misplaced data to be rectified before data analysis began. Data on soil nitrates and pH was done using MS Excel for descriptive statistics such as means, median and ranges.

2.4.4 Livelihoods, Political Economy and Governance

Data for the theme were gathered using mixed methods. These included review of relevant development, academic and policy literature, conducting 17 Key Informant Interviews with 5 Traditional Leaders (Chiefs Ndima, Muusha and Saurombe, Headman Katiya and Village Head Muusha), the Council CEO, Finance, Planning, Social Services & Admin, Office of the DDC and Assistant DDC, Ministries responsible for Education, Women's Affairs, Social Welfare, Environment (EMA and Forestry Commission), and two Business Association representatives at Chimanimani and at Rusitu Valley Trust. Additional data came from three FGD sessions at Chikukwa, Nyamusundu and Biriiri as well as attendance of 4 Civil Protectin Unit (CPU) meetings at Council between October 2019 and Macrh 2020. These qualitative methods were complemented by the joint household survey for themes 1, 3 and 4 to 5 adminsitered to 1031 respondents from 8 wards. Seven development agencies (2 NGOs and 5 government Ministries) also completed a capacity assessment form that focused on staff numbers, staff competences, coordination and development planning, outreach/extension capacity and operational resources.

2.4.5 Topography, Infrastructure and Settlements

Data to answer the thematic questions were gathered using i) key informant interviews and observations, ii) desk study, which was specifically GIS mapping (Impact Mapping of Cyclone Idai, Risk Analysis of Landslides, Flood Risk Analysis and Settlements and Infrastructure Risk Mapping), iii) use of the Topographic Wetness Index (TWI) as a risk analysis tool for mapping drainage channels associated with landslides, iv) manual digitizing of flooding/landslides by comparing before and after images, and v) use of Sentinel-2 satellite data from February 2019 (before the cyclone) and April 2019 (after) used to map flooding & landslides from Cyclone Idai. The team also did ground-truthing at Kopa/Rusitu Valley, Chikukwa, Biriiri, Nhedziwa, Bumba, Ngangu Plateau and Aerodrome. Estimates for area affected per ward were generated using digitized landslide data

2.4.6 Disaster Risk Management

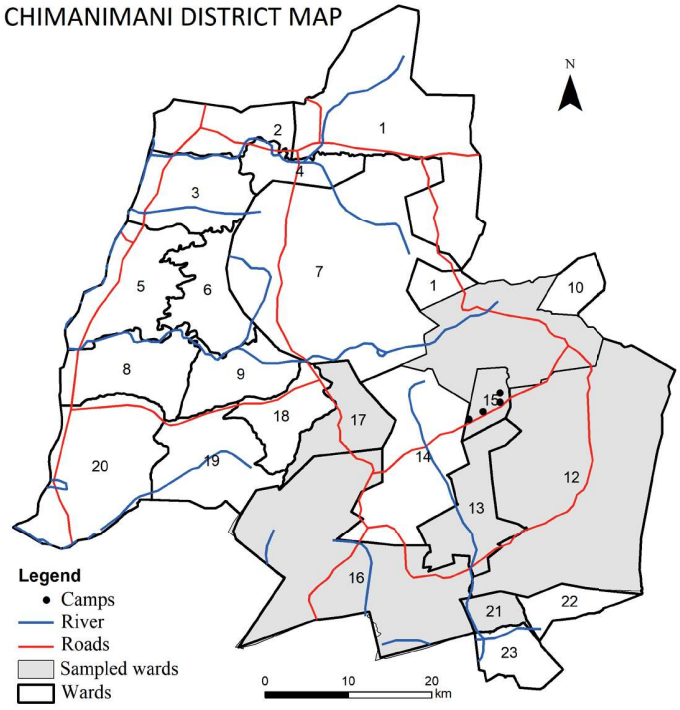
The theme used both qualitative and quantitative methodology. Qualitative methods used included in-depth interviews, institutional analyses, document review/analysis, focus group discussion (FGD) sessions, impact qualification of Cyclone Idai, and field observations. Quantitative methodology involved the joint household survey, budget reviews (local, provincial and national) and impact quantification of Cyclone Idai.

2.4.7 Methodological convergence

Cross-team convergence was deliberately facilitated with the coordination of TSURO. This was through two principal instruments of i) a Coordination Team and ii) Team Workshops. A Coordination Team was set up during the first meeting (July 2019) with a remit of steering the technical aspects of the study while TSURO led on logistical aspects including budgets. The Coordination Team used monthly reports to support team coherence. This separation of roles and the commitment of the two 'pillars' to this coordination ensured smooth implementation of the study.

Regarding team workshops, there were five instances where the whole team met (physically on three and virtually on two occasions) over the duration of Phase I. The sessions incorporated i) discussions on the research focus/scope, methodology and actual process, ii) participatory indicator and tools development, iii) presentation of preliminary findings and iv) planning of activities. Presentation of findings and reflections via two online conferences/workshops allowed synthesis of issues. This process had originally been organized for face-to-face interaction, but that plan was affected by the advent of the COVID19 pandemic.

Convergence was also fostered through a WhatsApp platform that subsisted over the duration of Phase I. alongside email communication the platform provided for sharing documents and insights. As such, TSURO and member-inspired coordination - explored key-facets participants considered important to 'resilience' in their context, related to landscape management, food and seed systems, and social farming for mitigation and post-impact rehabilitation. For teams 1, 2 and 4 to 5 the joint questionnaire also allowed convergence as was the mixed teams that administered qualitative tools. Figure 2.2 shows the coverage of the household survey.



Sample Size per Ward

Ward (name-number)	Sample Size
Chikukwa -10	70
Ngorima -21A	174
Nyayode -13	267
Gwindingwi 16B	132
Chimanimani 15	160
Martin -11	46
Biriiri -17	132
Tilbury -12	180
Total	**1 161**

Figure 2.2: Chimanimani District Map showing the coverage of the household survey Reserch Cites(left panel) and sampling of participants of the 8 most affected wards selected by the community members during the Biriri workshop (right panel)

2.4.8 Ethical considerations

Although the study was at the invitation of the TSURO Trust in consultation with Chimanimani District stakeholders, the research team followed ethical clearances from their institutions and secured the informed consent of research participants in the field. At the workshops held as part of this study standard informed consent processes were followed (see Annex 7: Ethics/Consent Form) including explaining the purpose of the research, the institutions involved and the roles of individual researchers, what was expected of the participants and their rights particularly the freedom to withdraw as well as to withhold responses to any questions asked as part of the research. Further, the team worked closely with Co-Researchers in shaping the research instruments including actual questions. Trained Co-Researchers and Enumerators were involved in the collection of data. The training sessions focused on ethical as well as technical aspects of data gathering including respectful interaction with study participants, emphathy and focusing on the study purpose without promising support. Senior national and local government officials took part in key processes as key informants but also to learn making the study a very participatory endeavour.

Chapter 3. Evaluating the Humanitarian response following Cyclone IDAI in Chimanimani District, Zimbabwe

3.1 Introduction

The Humanitarian Impact Key Thematic Area (KTA) was framed as an overall assessment of the extent of the humanitarian impact and the quality of the response to the disaster. The overall research objective was to explore the overall humanitarian impact of Cyclone Idai on selected communities and to assess outcomes of the actions taken to address the effects of the disaster, draw lessons and make recommendations to address gaps in building the resilience of affected communities in Chimanimani. The study harnessed both Dunantist and Wilsonian definitions of humanitarian action, which refer to actions designed to save lives, alleviate suffering, maintain and protect human dignity during emergencies. These actions are in the immediate aftermath and in situations that warrant prolonged assistance for optimal human life and health outcomes[1]. The study used this conceptualisation to address the objectives within a multi-method and multi-disciplinary research.

It is imperative to point out that the present study commenced several months after the emergency phase. As such, it assessed humanitarian experiences, impacts and quality of actions taken (and ongoing) with a thrust on building resilience of communities to future disasters. The specific objectives of the theme were to:

- Document the humanitarian impact or experience of Cyclone Idai among the selected communities in Chimanimani district;
- Establish the type of humanitarian assistance received by people in the affected communities of Chimanimani area;
- Assess the quality of the humanitarian response; lessons learnt and recommendations that can be drawn to address any gaps and to build resilient of communities.

3.2 Extent of Destruction and Loss

Study results indicate that the Cyclone Idai disaster inflicted significant destruction and caused serious loss in Chimanimani. It had far reaching consequences on the physical and mental health across age, gender and social background. The conceptual framework developed by Puri et al (2015) for use in impact evaluations of humanitarian emergences was instructive in this case. The model (see Figure 3.1) proposes the t_{-2} phase a period immediately before the emergency whereupon some vulnerable households may already be experiencing a downturn due to various factors like a drought or a poor economy. This is the **baseline** which refers to the pre-disaster phase where most agencies wrongly assume that no data exists for this phase. This highlights the need to note the salience of pre-existent factors in affected communities for instance levels of poverty, inequality, lack of basic amenities and previous droughts, which increase the vulnerability of the population when a disaster strikes.

The current study factored into the analysis the impact of national economy in comatose status and a fragile state unable to offer basic necessities. This was built into understanding of the magnitude of the cyclone-induced humanitarian situation. World Bank et al (2019) reported the general and sector specific pre-cyclone situation in Chimanimani. Of note, the report highlights statistics from the PICES survey which indicate that 70.8% of households in Chimanimani were categorised as poor while 25.9% were in the extremely poor category (World Bank et al 2019:68-69). As such, the social and economic impact of Cyclone Idai was profound in Chimanimani due to pre-existing factors of poverty and a poorly performing economy.

[1] Puri et al (2015:2).

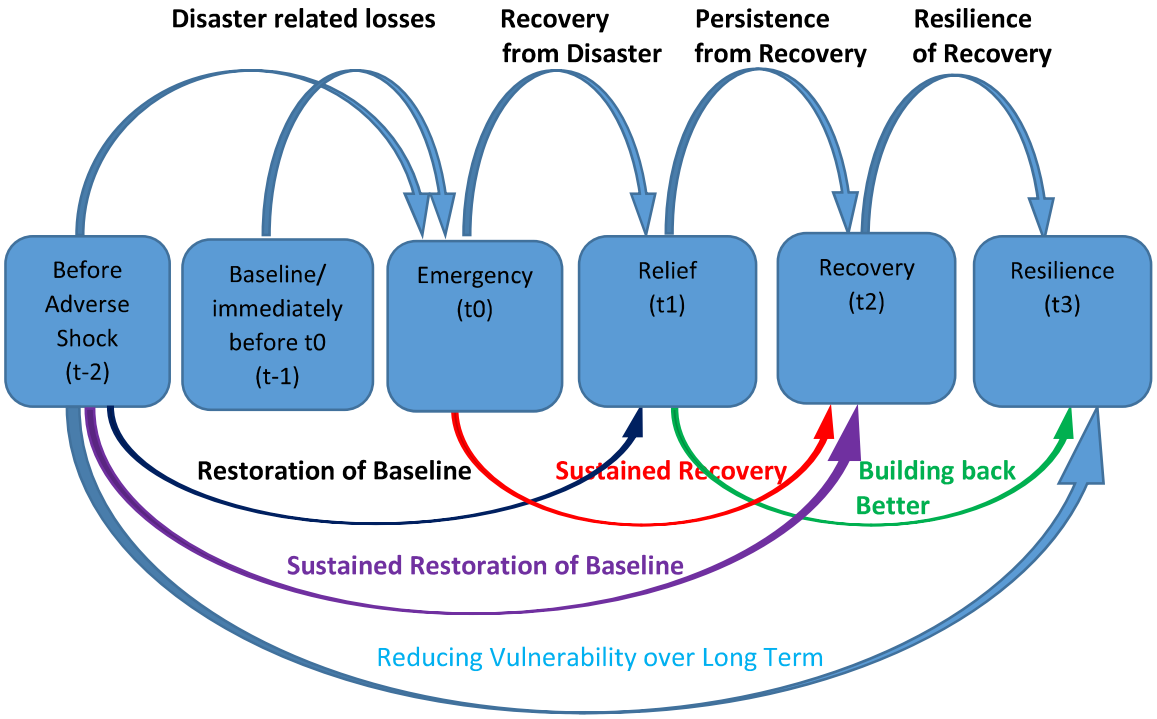


Figure 3.1: Conceptual Framework Source: Puri et al (2015:22)

The disaster triggered far reaching negative mental and physical health challenges for the general population who witnessed the horror unfolding and among families who either lost their members or have several still missing to date. This shows the long-term impacts of disasters on mental health (Puri et al 2015) while the World Bank et al (2019) identified immediate and long-term health effects of the cyclone as physical and emotional trauma (including mental health) requiring medical management. This present study revealed that poor health outcomes become long term in the post-disaster period. Affected individuals and communities still find themselves in the same humanitarian situation they entered into during and in the immediate aftermath of the emergency.

Lack of a sustainable humanitarian management system which would usher people into the recovery path results in cases that could be managed developing into long-term mental health problems. This was a prominent narrative especially among Internally Displaced People (IDPs) still in temporary shelter more than a year after the disaster. For IDPs the environment in temporary shelter is a compelling reminder of the disaster. Poor health indicators affect productivity and dent the quality of life of populations. Mapping of physical and mental health needs in the post disaster phase ought to be prioritised during transit to recovery and building resilience.

One of the key areas in assessing the humanitarian impact of a disaster used was observance of human rights. Professional ethical conduct on the part of staff and service providers in an emergency is a necessity. The core humanitarian principles of independence, impartiality, and neutrality by aid providers and governments are widely recognised (Harvey et al 2009). Both beneficiaries and humanitarian organisations must observe human rights on dignity, freedom and equality in order to improve the quality of assistance and reduce vulnerability. Some 63.9 % (n=1161) acknowledged awareness of their human rights during disaster response and a minority of 36.1% expressed limited knowledge.

Study findings revealed that 27.1% alleged human rights violations during and after the cyclone that were with respect to denial of food aid due to political affiliation. This occurred even in a context where most aid was distributed directly by development partners and independent organisations with little government interference. It suggests community structures involved in these initiatives may be polarised. In fact, conflicts were mainly reported between the internally displaced (living in tents) and

the surrounding communities over resources. In Ngangu, the surrounding communities were reported to be vandalising campsite resources and, hence threatening the survivors.

In addition, a significant 39.7% confirmed some sexual violation of women and girls and abuse in exchange of relief support. Sexual harassment and sexual violence and exploitation of female youths at the hands of some army personnel, construction companies' personnel and staff involved in distributing aid was reported. This was corroborated in KIIs with personnel from the Women's Affairs Department and during FGD sessions at community level. This is a key area where lessons ought to be drawn and measures taken to prevent any abuse in future disasters.

Furthermore, any assessment of the humanitarian experience post disaster would need to pigeonhole vulnerable groups like women, girls, youths, the elderly and IDPs at the level of policy. Women and girls are vulnerable in a patriarchal system where men dominate in decision making both in communities and government institutions. Results showed reported incidences of gender-based violence suffered by women in the case of cash transfers or sexual assault of girls by men. Youths are vulnerable in the context of the cultural practice of gerontocracy and high unemployment. IDPs living in temporary insecure tents suffer more pronounced humanitarian crisis given their limited mobility, limited access livelihoods, dependency on donor or government aid, lack of own shelter and vulnerability to manipulation by politicians who keep promising relocations.

3.3 Quality of the Humanitarian Actions of Different Actors

International and regional support was coordinated from the Office of the President and Cabinet (OPC) cascading down through structures of the Ministry of Local Government (Department of Civil Protection/Civil Protection Unit). At district level a Civil Protection Committee was chaired by the office of the District Development Coordinator with Council as the secretariat. The Committee had a multisectoral representation of government agencies with a disaster response remit, donor partners, NGOs and the private sector worked together meeting daily in the immediate of the disaster and every Tuesday thereafter. In addition, line ministries and specific government were involved in infrastructural rehabilitation.

Results from the survey confirmed that national and international NGOs dominated the provision of food aid and non-food items including cash transfers, health, shelter, education, farming inputs including livestock restocking, search and rescue missions while government was significantly visible in roads and power services. This division of responsibilities created perceptions regarding who provided humanitarian aid (see Table 3.1.1). Though the government is mostly visible in coordination it is significant to note that its agencies lack capacity to provide relief during and after a disaster situation. This underlies the fragile nature of the state which is no longer able to provide basic necessities like food, shelter, health and water even in a non-disaster situation (World Bank et al 2019). Of note, most of aid provided to health sectors and schools was direct aid comprising materials by CBOs, NGOs and private companies.

Table 3.1: Humanitarian response by agency type

Type of support	Type of supporting agency		
	CBO	NGO	Government
1. Relief and psycho-social	5.7%	88.2%	6.1%
2. WASH	3%	92.5%	4.5%
3. Shelter	7%	87.5%	5.5%
4. Health	3.1%	71.2%	25.8%
5. Search and rescue	21.2%	46.5%	32.3%
6. Infrastructure (roads etc.)	4.6%	35.9%	59.5%
7. Power/energy	3.7%	43.5%	52.9%
8. Agricultural inputs	8%	67.5%	31.7%
9. Education	2.5%	58.4%	39.1%

Source: Fieldwork 2020

A lot of Cyclone Idai aid was organised by individuals and churches comprising ordinary local citizens and the Diaspora, which may not have been documented for research and impact assessment purposes. It is possible that there is inadequate transparency and accountability regarding such aid from government records. This creates a gap (missing data) in assessing humanitarian impact from individual philanthropic work. This is a key lesson to be drawn from general disaster situations and response in Zimbabwe and calls for development of information and institutional systems.

The lack of sustainability of nongovernmental aid is well documented. Government needs strong institutional and financial capacity to deal with disasters. This is not to downplay the need for foreign assistance in the context of disasters of this magnitude. Insights from a CPU meeting and from KIIs with national government and Council officials pointed to challenges with making NGOs accountable regarding periodic reports on recovery and resilience building work. A recurring issue was lack of capacity across government and communities in responding to the emergency due to lack of operational resources and relevant technical knowledge. It was also noted that CPU activities were mostly dormant in the absence of disaster.

Long-term recovery assistance aids recovery to a pre-disaster 'condition' and to strengthen resilience. This phase usually starts six months after an emergency (Puri et al 2015) while the t_3 phase is a period way after disaster. This is characterised by planning to reduce vulnerability of a population. The pace and nature of recovery and resilience is premised on pre-existing factors and the quality of the humanitarian system in place. Notably, soon after the relief phase when most development partners wind up operation, government systems are expected to take over and direct recovery and resilience building. In the context of Chimanimani some communities still need relief aid, more than a year later. It appears that government has moved attention away from the affected populations since it is no longer an emergency. This could be due to lack of capacity and possibly lack of political will to address what still seems to be a humanitarian situation particularly among displaced people and those who lost livelihoods. Key priorities for recovery and building resilience are relocating or resettling the displaced, assisting communities and individuals to restore livelihoods or to start new ones and restoring basic infrastructure like social services and roads.

3.4 The Quality of Aid provided

Support provided was in general assessed as good by affected communities (see Table 3.2). Government and its partners were rated lowly on restoration of livelihoods, provision of shelter, attending to the needs of the vulnerable, making health facilities accessible and available, rehabilitation of road and communication infrastructure and access to education. Essentially, there was low progress towards recovery. Presenting challenges reflected a relapse to the relief stage. This was particularly the case with those displaced and still in tents. The inability to restore disrupted livelihoods for many was thus a key indicator of failed response to the disaster. This also meant that it would take longer to build resilience given the challenge of funding. Potential in recovery efforts and in developing resilience in the context of Chimanimani could come from communities themselves and the activities of community-based organisations while the government is charged with restoration of basic infrastructure and addressing macroeconomic fundamentals. Pre-existing factors like inadequate health facilities, poverty, inequalities, a fragile economy and weak institutions unfortunately stand in the way of resilience building.

Table 3.2: Assessment of post-Cyclone support

Area of support	**Rating**			
	Very Good	**Good**	**Average**	**Poor**
1. Relief and psycho-social	9.6 %	43.7%	41.6%	5.1%
2. WASH	10.1%%	45%	42.1%	2.8%
3. Shelter	33.2%	41.7%	23.5%	1.5%
4. Health	12.5%	52.2%	33.4%	1.9%
5. Search and rescue	21.9%	41.2%	32.8%	4.1%
6. Infrastructure (roads etc.)	17.6%	47%	29.7%	5.7%
7. Power/energy	23.4%	46.3%	25.8%	4.5%
8. Agricultural inputs	18.3%	48.4%	30.6%	2.7%
9. Education	13.2%	45.6%	34.6%	6.6%

Source: Fieldwork, 2020

In terms of the guiding principles, logistics and of the state of humanitarian systems positive feedback was received on coordination, distribution and relevance. Relief agencies were swift to respond to the crisis in Chimanimani despite the difficulties that existed in accessing affected communities due to impassable roads. There were some cases of inappropriate and ineffective aid. On psycho-social support, it was observed that most organisations who offered this facility lacked training and knowledge hence they offered ineffective support to the bereaved and traumatized. At the heart of the low rating of psycho-social support were inappropriate techniques which did not speak to the gravity of the situation, the hurried and temporary nature of the sessions, lack of rapport, privacy and trust. In addition, the failure to bring closure to the issue of missing persons, the continued stay in temporary and poor-quality shelter provided a toxic and an unfriendly environment for any psycho-social support to be effective.

Overall, considering the period when field research was done it can be argued that the quality of humanitarian action meant for recovery and resilience phases was inadequate. It is apparent that local government authorities still had limited resources to start a path towards recovery and building resilience to future hazards. Available data indicated weak coordination of development partners for the recovery phase. Further, should another natural disaster affect the community or others the humanitarian situation associated with Cyclone Idai may become forgotten due to scarcity of

resources. In the end the humanitarian situation among victims of Cyclone Idai is compounded in the context other hazards befalling them. This creates a vicious humanitarian crisis which erodes any gains after the emergency and relief stage weakening prospects of recovery and resilience.

3.5 Conclusion

Cyclone Idai had a devastating impact on populations and communities of Chimanimani. It worsened a pre-existing humanitarian situation underlined by poverty, lack of adequate basic infrastructure and amenities, a struggling economy, weak institutions and a frailty caused by other natural hazards like droughts that have become frequent. The negative effects of the disaster were felt in the social service and economic spheres. The loss of livelihoods, displacements, a huge psycho-social burden, disruptions to the education sector, damage to water and sanitation, health and other basic infrastructures added to the communities' vulnerability. Responses have not been sufficient for most affected survivors. This exposes government inability to provide human security and safety.

Most humanitarian assistance came from non-government institutions while national government played a coordination role and attended to large-scale infrastructure restoration. This was befitting given the magnitude of the disaster. Nonetheless, this does not take away underlying issues of a weak economy and weak public sector capacity and lack of preparedness on the part of national and local government to respond to the disaster.

Generally, affected communities poorly rated humanitarian actions undertaken. The recovery efforts seem to be still in the distant horizon particularly for those still in temporary shelter. Generous assessments were given for the emergency and rescue phase while poor assessment was given to recovery and development responses. It can be concluded that recovery and resilience building remain a herculean task if it is going to be conceived as a role for government alone. Models which emphasize community driven recovery and resilience building may offer some promise. However, given the pre-Cyclone levels of poverty and polarisation thus 'leaving the survivors to their own devises' may not lead to resilient communities. Government needs to simultaneously focus on the bigger picture of correcting macroeconomic fundamentals while, as will become clearer in the political economy and governance section it releases the competences of local government to work more diligently with communities.

Chapter 4: Climate Change and Environment

4.1 Introduction

Climate Change is degrading the environment through spawning weather extremes which are destructive to people's wellbeing. Zimbabwe has not been spared by the devastating effects of heavy rainfall events, strong winds and tropical cyclones. For example, cyclone Eline of 2000 caused damages, some of which have not been repaired even up to now. Since then, the country has also suffered from other cyclones such as Japhet and Dineo of 2004 and 2017, respectively. In 2019, the eastern part of the country, specifically Chimanimani and Chipinge Districts were ravaged by Cyclone Idai, which left most of the residents homeless and resulted in loss of many lives.

The districts have not yet fully recovered from these damages as many roads, bridges and homes still need to be reconstructed among other socio-economic pressures the country faces. Activities before, during and after Cyclone Idai have shown the need to deeply examine all facets of the disaster management cycle as applied in Chimanimani. The Climate Change and Environment thematic area focused on understanding what transpired and sharing explanations with communities. It was also focused on generating data to inform future resilience strategies for the District should similar extreme events occur. The analysis provides a case study for other districts and regions in terms of examining their vulnerability to tropical cyclones and response strategies for related hazards. It focused on linking past, present and future climatic events from the perspective of their predominant drivers and the vulnerability of the environment to tropical cyclones. The objectives of the research were to:

- Determine past and present state of the environment as dictated by the climate in Chimanimani;
- Understand the impact of past tropical cyclones on Chimanimani district; and
- Assess linkages between climate change and future environmental characteristics

The specific questions for the thematic area were as follows:

- In what ways has climate change contributed to the tropical cyclone vulnerability of the environment, biodiversity and ecosystems in Chimanimani District?
- How do previous tropical cyclone impacts compare to that of tropical Cyclone Idai?
- How is climate change expected to influence the environment and its vulnerability to tropical cyclones in the future?

4.2 Rainfall Distribution

Rainfall estimates derived from spaceborne remotely sensed data indicate that rainfall in Chimanimani generally decreases westwards (Figure 4.1). The mean annual rainfall received in Chimanimani district varies, ranging from wet areas receiving high rainfall of above 1500mm in the eastern and south eastern parts of the district to marginal dry areas below 300mm in the western parts of the district. The year to year rainfall variation inversely related to the total amounts of rainfall received with dry areas being more variable compared to the wet areas of the district that are mostly stable. The impacts of climate change are not uniform across the district because of these different baseline characteristics especially in rainfall patterns.

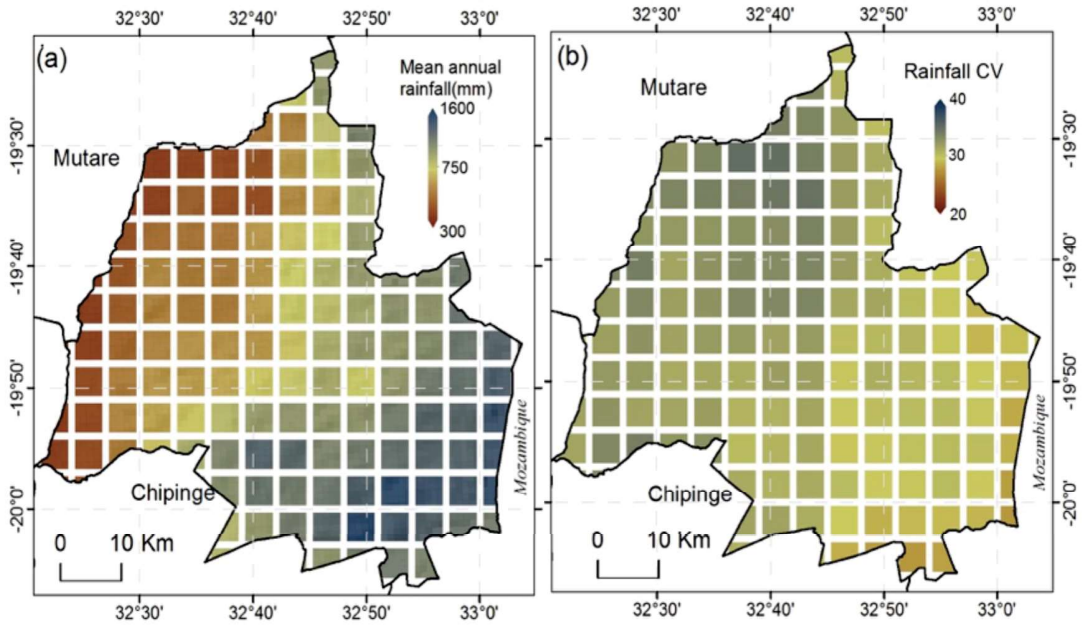


Figure 4.1: 1981-2020 Mean Annual Rainfall (left panel) and Coefficient of Variation (left panel), for Chimanimani District

Similar to Zimabwe`s national patterns, the rainfall distribution in Chimanimani is unimodal. However, a peak in December is followed by a slight drop in January and another peak in February (Figure 4.2). This peak brings rainfall almost equal in amount to the one in December. The district receives significant rainfall from November to April though it is generally wet throughout the year especially in agro-ecological region 1 areas due to orographic uplift at periods when other parts of the country are dry. The December to February sub-season is the wettest on average. The high amounts in the December to February sub-season can be explained by the combined effect of the main rain bearing system (the InterTropical Convergence Zone – ITCZ) and other localized effects such as orographic lifting. These factors are central to the temporal distribution of rainfall in Chimanimani district.

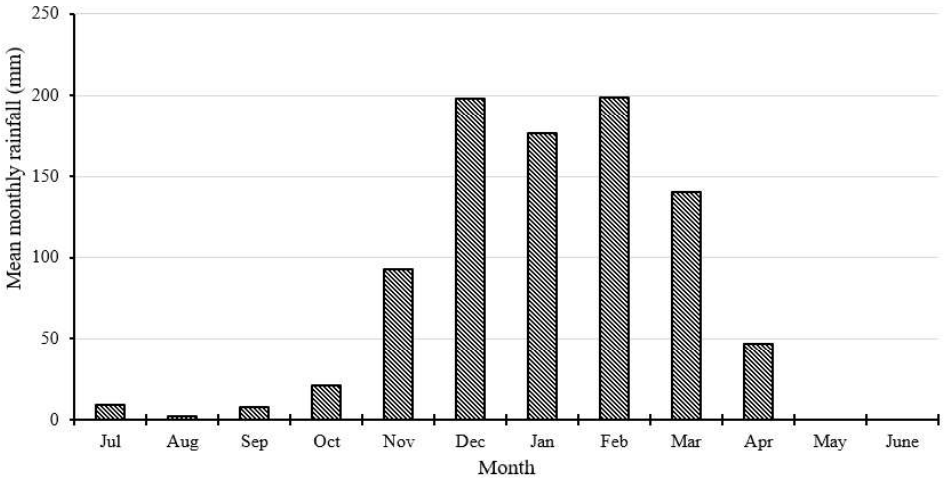


Figure 4.2: Distribution of Mean Monthly Rainfall in Chimanimani

Regarding long term variations and changes in rainfall patterns the 1918/19 season recorded the highest amount of annual rainfall in history with an amount exceeding 2250 mm (Figure 4.3). The bulk of the seasons recorded between 500 and 1500 mm although a few others received below 500 mm. Trend analysis shows that annual rainfall in the area has been decreasing with time.

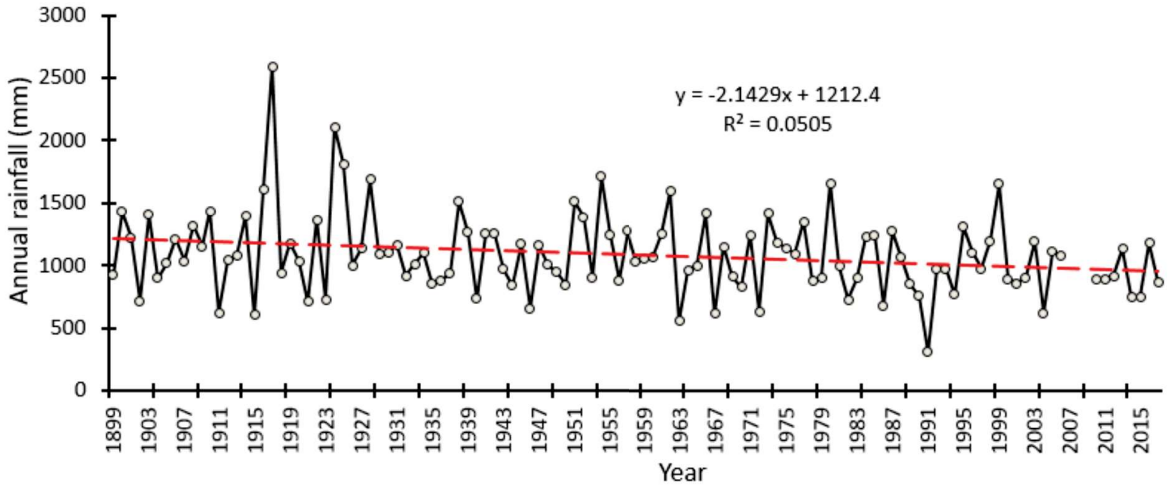


Figure 4.3: Long term changes in annual rainfall in Chimanimani District (p=0.003)

Similar to the annual average trends, rainfall for October to December (OND) is also decreasing though not faster than the annual rate. Rainfall for October to December mostly ranges from 200 to 500 mm although there are years outside this range. The highest rate of decrease in rainfall was recorded in the January to March (JFM) sub-season (Figure 4.4). The cumulative rainfall for this period of the year ranges mostly from 200 to 1000 mm. In extreme cases such as in 1918/19, 1925/26 and 1999/2000 seasons, amounts of 1800, 1400 and 1350 mm respectively were received in the January to March sub-season. The high rainfall spikes in the 1918/19 and 1999/2000 seasons coincident on both DJF and JFM graphs may be indicative of some extremes around January and February in both years.

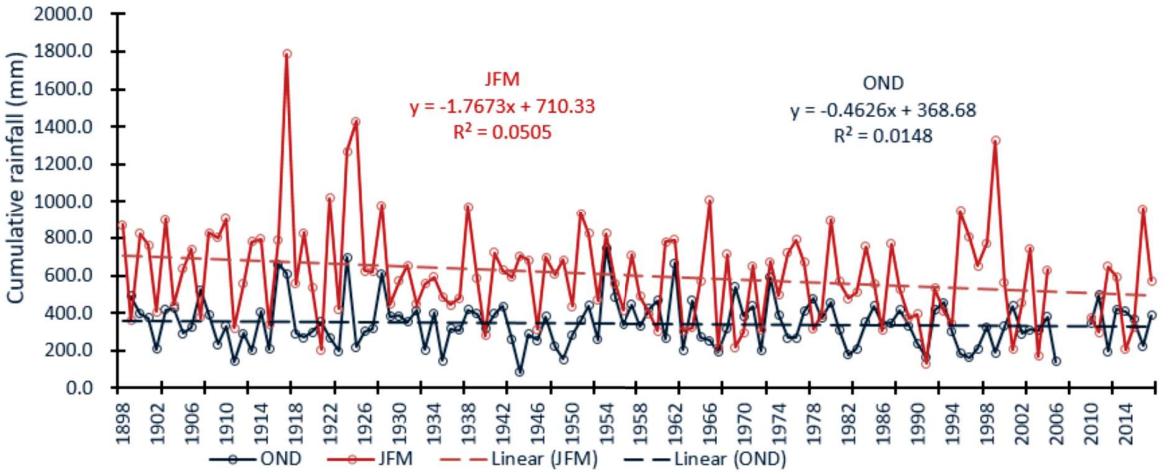


Figure 4.4: Long term changes in cumulative October to December and January to March rainfall

The frequency of years with negative rainfall anomalies per 10 year interval is increasing (Figure 4.5). For example, the frequency was about 3.5 years in period 1898 to 1908 rising to above 6.5 years in period 2008 to 2018. Similarly, the number of years in a 10 year interval experiencing meteorological drought (below 75% of long term mean) is also increasing. This further explains the drying patterns described in the previous analysis.

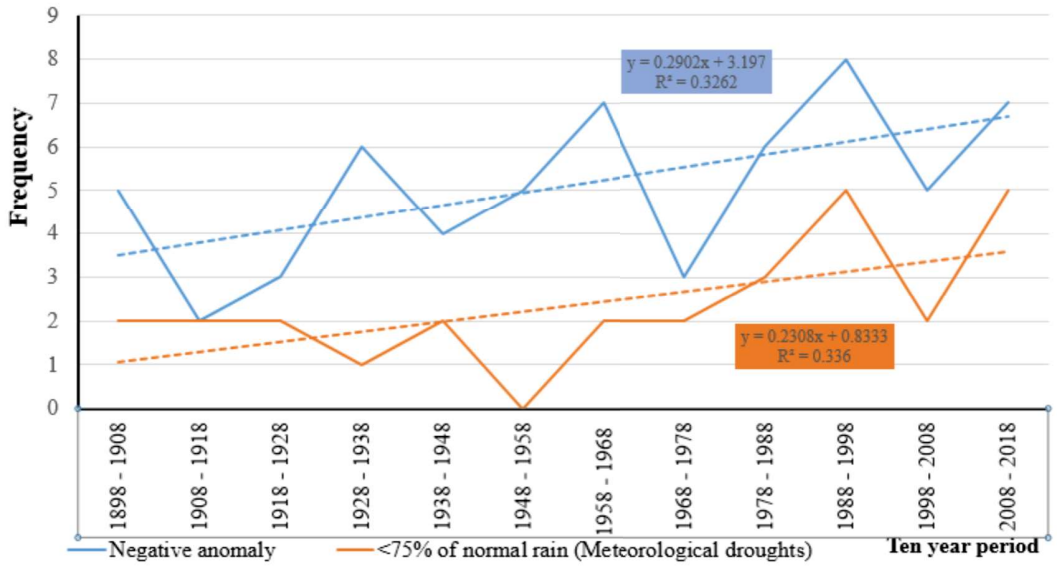


Figure 4.5: Observed increase in the frequency of meteorological drought and anomalous rainfall

4.3 Knowledge of Climate and Climate Change

A large proportion (73.6 %) of survey respondents indicated that they had some knowledge about climate change. The most frequently observed changes are increases in rainfall extremes such as drought and floods (Figure 4.6). About 57% of the respondents also noted that the seasons are shortening while 40% stressed that prolonged intra-season dry spells are becoming a common characteristic. As expected with an increase in extreme rainfall events, strong winds are also becoming common as cited by 44% of the respondents with knowledge about climate change.

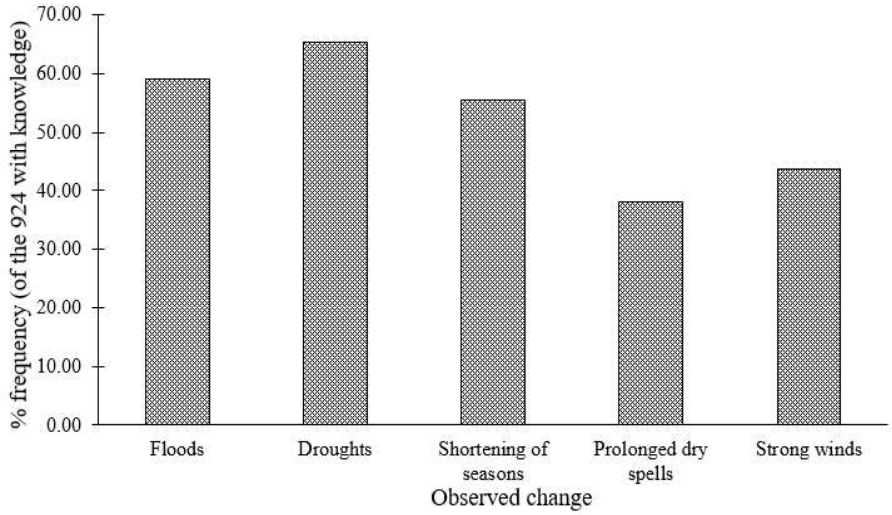


Figure 4.6: Definition of climate change by sampled households

All generations including the elderly acknowledged that the climate of the district had changed. Interactions with communities established that the start of the maize growing season used to be around September and by Christmas time (25 December) they would already be eating maize in the district. Due to climate change, the season now starts around early to mid-November with generally little rainfall compared to previous seasons. Trees used to start blooming in September but now bloom earlier and the white cold days now stretch into October. In the past they could play outside

while it was raining because lightning was not hazardous, but this is no longer the case. Rains used to be calm but now they are accompanied with a lot of thunder and lightning. The region was generally cool to cold but now the frequency of days with extremely high temperatures has increased. Local birds called "*mherepere*" would squeak to mark the beginning of the rainy season, but these species had since disappeared. It is believed that the local Bridal Vlei Falls shifted in position and its sacredness had since been lost. Climate change is also affecting nutrition especially due to heavy rainfall events which affect yield and food availability.

In terms of training and awareness on climate related issues some 41% of the respondents had received education and training on climate change from different agencies (Figure 4.7). Of those that received training, Agritex was the main provider (39%), followed by NGOs who trained 30%, others including social connections trained 17% while the Meteorological Services Department trained 14%. The Civil Protection Unit members from Harare once trained district members but covered Road Traffic Accidents (RTA) and nothing related to climatic hazards. AGRITEX offered another training on climate change in collaboration with Oxfam. Communities and their leaders received climate change training from TSURO Trust and shared lessons with other members. However, people do not seem to be working together in handling climate change issues. Response to impacts of climate change is not evident at all levels in the district. There is need for extensive climate change actions.

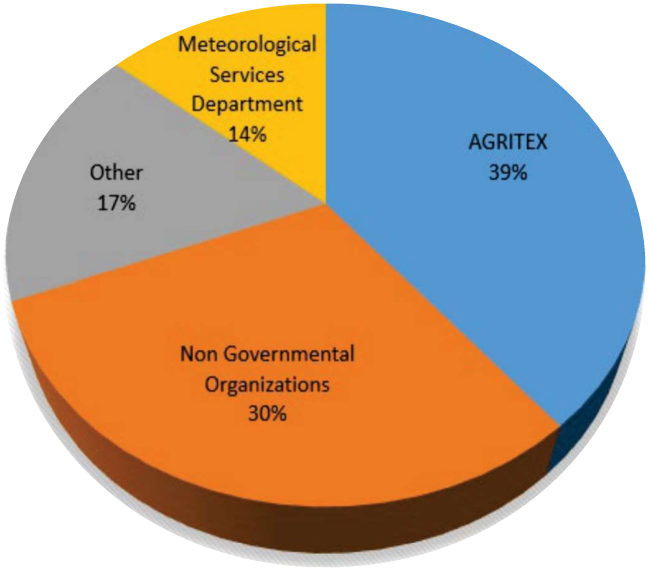


Figure 4.7: Stakeholders who provided climate change education and awareness

In terms of understanding and beliefs surrounding the causes of Cyclone Idai some (45.2%) of the respondents to the household questionnaire cited climate change as the cause of tropical cyclones, including Idai (Table 4.2). A notable number of respondents (21.22%) confessed ignorance while 10.85% cited traditional beliefs as responsible for occurrence of tropical cyclones.

Table 4.1: Perceived and understood causes of Cyclone Idai

Cause of tropical Cyclone Idai	Frequency	% frequency
Climate change	466	45.16
Don't know	219	21.22
Act of God	124	12.02
Traditional beliefs	112	10.85
Land degradation	37	3.59
Geographic location	29	2.81
Earth movements	24	2.33
Evil Spirits	15	1.45
Human activities in oceans	6	0.58

Some of traditional explanations included the observation that while local/indigenous chickens were buried under rubble, broiler/exotic ones survived yet they are believed to be the weaker species. This raised concerns among the locals which they interpreted as a signal that the ancestors were angry with them. Another traditional explanation was that people have over the years settled in some sacred places and behaved in culturally unacceptable ways which cause disasters to occur as punishment by ancestors. It was explained that at Kopa there was a lot of involvement in prostitution and murder. Traditionalists narrated that they had warned the locals about excessive rainfall long before the cyclone. They had recommended appeasement of ancestors, but no action was taken. It is believed by some, that impacts are worsening because people no longer perform rituals and have lost values due to foreign religions. It is also believed that people had angered mermaids who own the waters in the district. The mermaids then urged their counterparts in the oceans to stir the water in the ocean to cause cyclone as vengeance. It was claimed that where people kept values casualties were few.

For other community members, Cyclone Idai and other disasters happened naturally with impacts worsened by bad interactions between human activities and the environment, including land degradation and settlements in unsuitable areas. There has been massive cutting down of trees while some people did not realize the risk associated with settling near rivers. Impacts were also cited in some locations as caused by the unwillingness of politicians to remove illegal settlers from environmentally sensitive areas due to voter issues. Trees used to protect the land from mass movement. Heavy rains which cause waterlogging of maize plants have been common in the area. The rains could even stop movement of buses but were spread in time, unlike Cyclone Idai, which gave a lot in just a short time. There were also other views which attempted to link predicaments with inequalities from the colonial past. Based on this view, colonial settlers moved people to unsafe areas while places which they allocated themselves were least affected by Cyclone Idai.

4.4 Analysis of Extreme Weather / Climate Events in Chimanimani District

Most of the extreme 24-hour rainfall events experienced in the district range between 50 and 100 mm (Figure 4.8). The area has also recorded a couple of events exceeding 150 mm in 24 hours. Some of the extreme events could be linked to past tropical cyclones. For example, in the year 2000 Agritex Chimanimani recorded above 160 mm in 24 hours while Chisengu received above 250 mm. There were other extreme events of high magnitude which were not related to any tropical cyclone activity. In 2004 cyclone Japhet affected the country but did not cause intense falls in Chimanimani evidenced by highest rainfall below 150mm during that season.

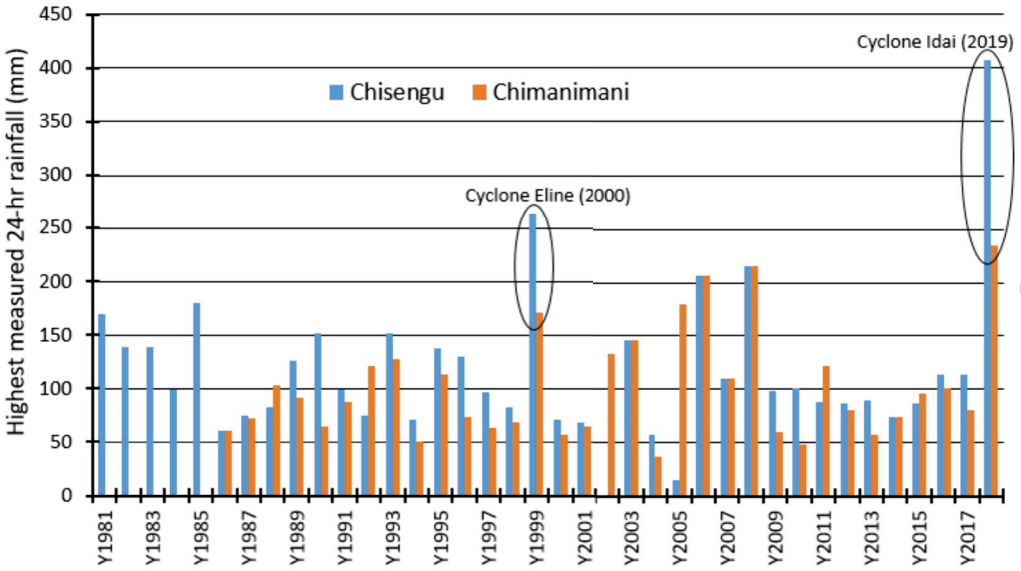


Figure 4.8: Highest 24-hour rainfall received per year in Chimanimani District

The probability of occurance for events of the order of magnitude above 400mm (recorded during Cyclone Idai) have very low probability of occurrence (less than 2%) and a return period of once in 38 years. Given the rarity, it was thus difficult to adequately prepare for and imagine the impacts of Cyclone Idai. In terms of history of tropical cyclones and other extreme events in the district, 62.2 % indicated that they had frequently/ occasionally experienced tropical cyclones, only 2.2 % had never experienced a tropical cyclone (Table 4.2). A large proportion of the respondents cited that tropical cyclones are infrequent indicating that, although they have been experienced before, they are a rare phenomenon in the district.

Extreme temperatures are a common feature, with only 2.2 % indicating that they had no experience. As for hail, only 4.2 % indicated that they had not had any experience in their area. It is therefore, a common feature in the district. Strong winds are occasionally experienced, 56 %, while 15.2 % indicated that they had frequently experienced these conditions. Only 2.6 % had not experienced these. Droughts are occasionally experienced, with 53 % indicating that they occur occasionally and 17.9 % indicating that they had become frequent recently. Landslides are not very common although once in a while they happen, with 24 % indicating that they occasionally occur and only 1.9 % indicating that they have become more frequent.

Table 4.2: Extreme environmental events experienced in Chimanimani

	Frequency of respondents per extreme event					
Response	**Cyclones**	**Extreme temperature**	**Hail**	**Drought**	**Landslides**	**Strong winds/storms**
Frequent	30(2.9%)	236(22.9%)	127(12.3%)	186(18.2%)	20(1.9%)	157(15.2%)
Occasional	609(59.1%)	603(58.5%)	476(46.2%)	543(53.1%)	242(23.5%)	575(55.8)
Seldom	368(35.7%)	174(16.9%	385(37.3%)	264(25.8%)	673(65.3%)	272(26.4)
Never	23(2.2%)	18(1.7%)	43(4.2%)	30(2.9%)	96(9.3%)	27(2.6%)

From the community accounts, three tropical cyclones had directly affected the district; namely Eline, Japhet and another one which occurred in 1947 before Cyclone Idai. The cyclone which occurred in 1947 with almost similar intensity to Idai was locally named “Gwanda” and it opened waterways in mountains as seen today. It was very strong but with few casualties, because during that time there were no people settled in waterways. Cyclone Japhet in 2004 had strong winds which caused two

small planes to crash in the district. During Cyclone Japhet, people died while trying to cross flooded rivers and starving as they could not cross water to fetch food. Cyclone Japhet was characterised by extremely cold weather which heavily affected gold panners in the "*Musanditeera*" Range because of the altitude of the mountain. The other cyclones had strong winds and high accumulation but gradual rainfall. Cyclone Idai had excessive rainfall in a short time. This resulted in excessive mass movements not only in form of surface runoff but also movement of upper soil layers. Cyclone Idai was stronger than Eline and Japhet as winds uprooted trees with a diameter of 90cm.

4.5 Early Warning and Sharing of Information about Cyclone Idai

The Meteorological Services Department of Zimbabwe, which is a member of Civil Protection Unit (CPU) is the major source of weather and climate information trusted in the district. According to 68% of the respondents, early warning information was received in the district. Of those who received the information, 53% indicated that they obtained it via radio and television broadcast, while 30% indicated their source as fellow villagers. Telephone, social media, government and government officials accounted for a total of 6.6 % combined. Of the people that received early warning, 85.9% shared the information with others. A concern raised was that, the means of moving early warning information in the district down to village level are slow and poor. Meteorological Services Department provided radio communication gadgets to stakeholders such as AGRITEX which are not in use due to inadequate training. The gadgets are few and key partners in information dissemination such as school heads and village heads were excluded.

The major deficiencies of the early warning issued ahead of Cyclone Idai were that it did not provide enough guidance on expected impact and the lead time was not enough to allow for the taking of appropriate actions (Table 4.3). It was also highlighted that the magnitude of the disaster could have been reduced if the MSD had communicated directly with the various departments in the district. Where the information was received, basing of judgment on experiences from past cyclones caused reluctance in responses by the communities. Analysis showed that extreme events of the magnitude of Cyclone Idai are rare in the district hence damaging effects were not anticipated. Furthermore, cyclones were associated with floods in low-lying areas and people on high ground perceived no threat and never expected to be affected by landslides.

Table 4.3: Assessment of early warning issued during Cyclone Idai

Perceptions about received early warning	**Frequency**
Came too late	350
Inadequate to warn of impeding danger	343
Misleading	233
Affected by previous experience	297
Other	20

Analysis showed that the information about Cyclone Idai reached communities with different lead times (Figure 4.9). Most of the members received the information 2 to 4 days ahead of the demise while a small number learnt of the cyclone when it was already affecting them. There are also other communities who claimed that they never received any warning altogether. Communities in Chiota Village of Ward 12 stated that they did not receive the Cyclone Idai early warning because there is no radio and TV signal and other communication networks are also poor. An interview with the youth representatives at Skyline obtained that some either took the warnings lightly due to past experiences or were caught unaware, worse still while asleep. People who received the information through radio and phones had no mechanisms to effectively further share the information with others.

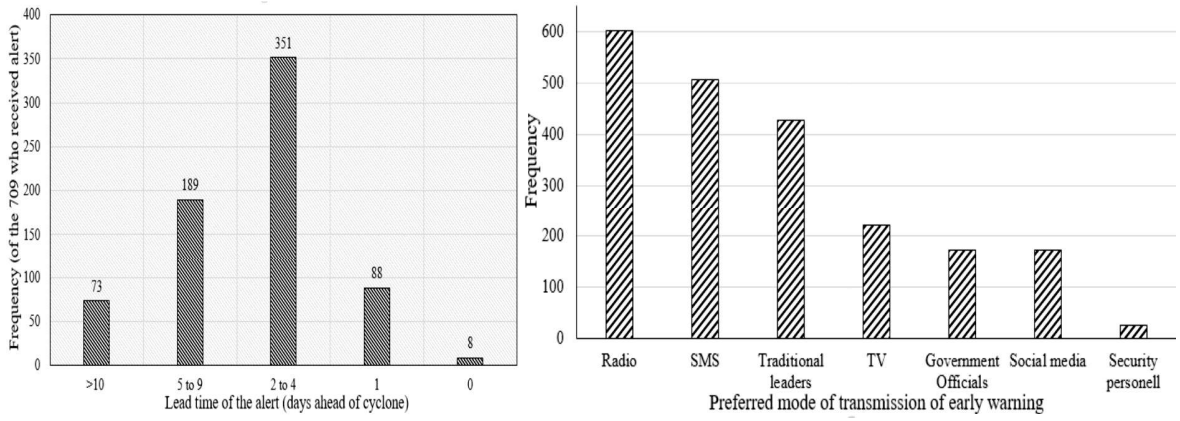


Figure 4.9: Cyclone Idai early warning lead times preferred transmission methods

However, of those that received information, only 36.7% took some safety measures. The safety to them entailed staying indoors. 52.6% chose this as a safety measure while 32.6% did absolutely nothing. Other community members indicated that usually information that comes on social media is misleading and is not taken seriously. Furthermore, communities were caught unprepared since the rains came at night-time. At district management level the response was overtaken by the disaster because the cyclone reached the district before a Civil Protection Unit meeting for strategizing was held. Inquiries into the preferred channels of communication showed that most people preferred communication via Radio, SMS and traditional leadership, respectively (Figure 4.9). Social media, TV and government officials were among the least preferred options.

4.6 Track Properties to Cycone Idai Impact in Chimanimani

The majority of the tropical cyclones that affect and make landfall in Zimbabwe originate in the South and South West Indian Ocean from large scale atmospheric and ocean surface conditions. These systems (including normal and important rainfall) pass through the Mozambican Channel and Mozambique before they reach parts of Zimbabwe. The five eastern most districts (Chipinge, Chimanimani, Mutare, Mutasa and Nyanga) are likely to have the first and most significant impacts of extreme rainfall events in the country (Figure 4.10).

To understand the risk for each district, the distances that a cyclone would travel before making landfall in each of the districts is shown in Figure 4.10. This shows that although there is a risk of cyclones from the northern and southern parts of Zimbabwe, the greatest risk is faced by the five districts which are likely to be hit earliest and hardest after places in Mozambique. We further analysed which of these districts has the highest risk by considering the distance from the coast and the altitude in its path. The results showed that Chimanimani district has the highest risk from any tropical cyclone because of two principal factors (i) it has the shortest distance from the coast (~180km) and (ii) it is the first district with a high peak in altitude above 1500m.

When a cyclone makes landfall, it loses its energy and intensity, which decreases its maximum sustained winds due to frictional differences between water and land with the free atmosphere. Since the distance to Chimanimani is shorter compared to other districts, a cyclone can make a landfall in thedistrict with sufficient residual energy to cause significant damage compared to what is possible in other districts. Secondly, and maybe most importantly, is the characteristics of the path to the district, which is relatively smooth and low with a very rapid rise in altitude on the Chimanimani Mountains. This increases the potential of the cyclone to dump moisture due to the synergistic cyclonic and orographic effects, with the latter being the normal rainfall generating effect in the districts. In the case of the Cyclone Idai, the huge amounts of rainfall received can therefore be partly explained by this mechanism. The mountain range could have created a strong vertical wind shear which enhanced the mixing of drier environmental air into the storm eyewall leading to downdrafts that are associated with

dumping of moisture and eventual decay. The general conclusion is therefore that repeat impacts or at least impacts higher than in other districts should be anticipated in Chimanimani because of these physical characteristics (Figure 4.9). The distances assume a linear path and show the topography along the path of the tropical cyclone from the coast to reach each of the districts. The distances were extracted from a 30m SRTM DEM and sampled every 100m to the centre of the district.

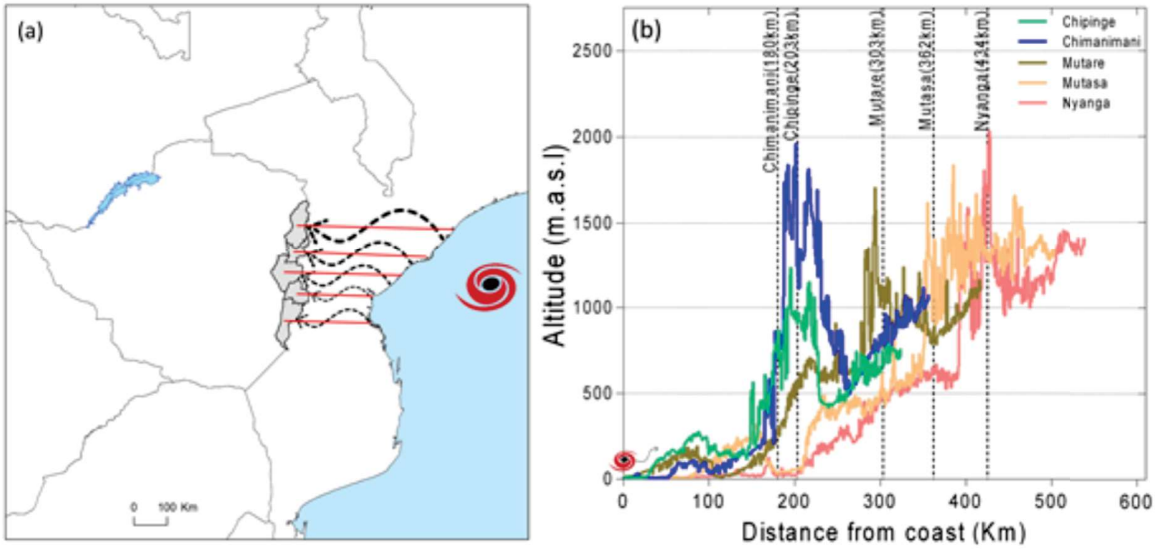


Figure 4.10: Distances travelled by a tropical cyclone to the five affected districts

4.7 Environmental Damages and Causes of Impact of Cyclone Idai

Weather conditions during and immediately after Cyclone Idai made landfall significantly compromised possible rescue and recovery efforts. There was mist for three days after the cyclone which hampered interventions until it cleared. Impact was worse because roads were damaged, slowing down response and recovery efforts. A lot of productive land was washed away or degraded (Figure 4.11). Observed environmental damage appears in a pattern of slide scars on the mountain escarpment slopes, debris deposit on the pediment slope, infrastructure destruction on the flood plain and high flooding on the valley bottom.

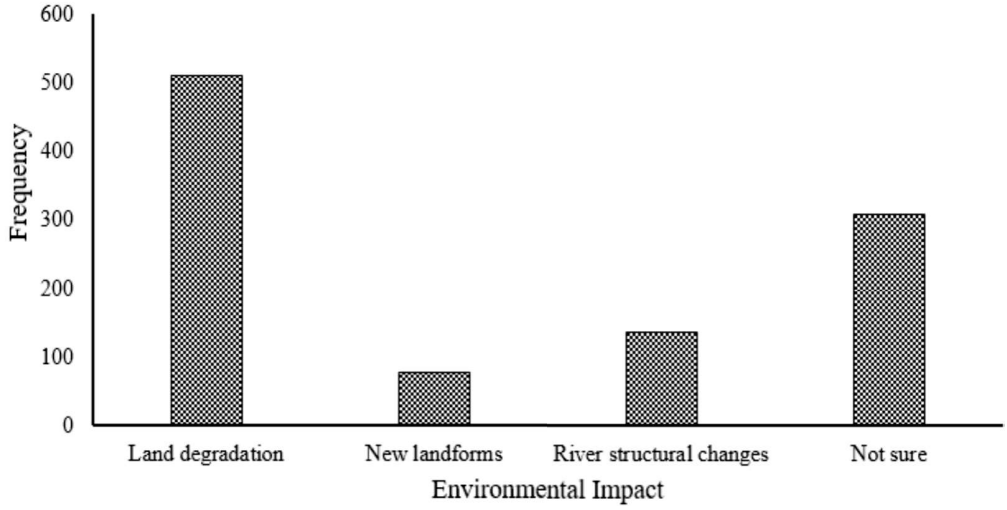


Figure 4.11: Observed and perceived environmental impacts of Cyclone Idai

The landslide scars on the slopes (Figure 4.12, left panel) show a tear off of the overlying soil, exposing the hard surface beneath which in most cases is at the end of the vegetation root system. The soils here are predominantly '*umkondo*' type of soils. The soils exhibit a tendency to absorb moisture to the extent of soil grains floating in the water absorbed by the soil mass. This inadvertently reduced cohesion of the soil particles leading to mass movement under the pull of gravity. The secondary vegetation with their shallow root depth would likewise be moved along with the soils they stand upon. The landslides occurred on both natural vegetated land and human modified lands. These slopes have been a victim of either deforestation and/or continuous forest fires hence the vegetation is typically bush with isolated trees. Where the landslides coincided with head ward erosion of streams, the dendritic drainage system was dominant and bursts of underground water were reported. Apparently, it appeared as if there was a rise in groundwater flow and subsequent rising of the water table giving rise to capillary action which led to outburst of water streams in the shallow soils on the escarpment slope. Where the burst coincided with water courses, the water simply brought about headward erosion and where there were crests, large mudflows or landslides occurred.

Figure 4.12: 'Marked' Mountains after Landslides (left panel) and Source of Rocks Deposited (right panel)

The community reports of a rambling noise during the night of the cyclone may have been because of the movement of rocks and mud. Figure 4.12 (right panel) shows the soil profile observed in most parts of the district especially along rivers and areas etched by the cyclone explaining possible source of deposited rocks after the cyclone. The underground flow which moved the rocks could account for such a noise as the core stones lubricated the flow of the rock boulders acting as rollers upon which the massive rock boulders were moved from beneath in the underground river channels revived.

At the valley bottom, the accumulating surface runoff gathered momentum by distance travelled and could move massive rock boulders cutting some from the riverbed and bank. The water went beyond the 30metres flood zone from the highest natural flood level. It was noted that in some cases, earth dams, and river blockages including chocked bridges increased the potential energy of the flow when bursts occurred. This new momentum gave the rivers/streams excessive power to rejuvenate erosive power causing excessive destruction downstream where it flooded. The water gained extreme erosive power within a short distance. Considering the damage inflicted on Ngangu residential area (Figure 4.13), the landslides erupted from a distance of less than 200 metres to sweep away a column of 15 houses and deposited their debris within a distance of 50 metres after the last house on the column.

Along the river courses, the water had travelled some 200 metres to erode houses with sheer power and river load. On a dry river course, the water gains momentum to move rock boulders of over a tonne in mass with the aid of a steep slope within 100 metres distance. The environmental damage had contribution factors of soil type, slope angle, land use, and hydrological influence. Discussions

with communities gathered that some of the settlements which were heavily impacted were on environmentally unsuitable locations such as near gorges. At Peacock, people had settled in a wetland at an intersection of four rivers whose flows had ceased for a long time which gave them a lot of comfort. It was also established from discussions that part of the settled Kopa area was a waterway even in the 1980s when there were no settlements. Later on, the council issued stands resulting in settlements which were destroyed by the cyclone.

Figure 4.13: Homesteads at Kopa completely destroyed and covered by rocks

The pictures in Figure 4.13 show buildings at Ngangu also demolished and replaced by large rocks a), b) and c), and vegetation on slopes removed due to mass movement (d). There was a great loss of topsoil, especially on steep slopes while very fine sand was carried by suspension and deposited lowlands. Strong winds damaged and broke trees, some of which were carried downslope and deposited blocking roads and bridges. New features were also formed due to erosion and deposition including wide areas of rock deposits in previously built and plain locations. Etching of the ground by strong winds and water created deep irregular trenches in places. However, in most of the cases the features formed are not attractive and not of environmental value.

Water quality was compromised temporally due to massive deposition of sediment and turbulent mixing as well as washing in of pollutant such as waste from destroyed toilets sewage systems. In addition, remains of victims of some of the floods were deposited in the water bodies with some never recovered. This compromised some of the water bodies as sources for drinking and fish while some wetlands were washed away. Although not quantified, there was also loss of fisheries due to pollution and loss to ocean waters. The urban centre had to run for three weeks without sewerage services, relying on pit latrines and other polluting disposal mechanisms. Rock boulders and pebbles of varying sizes were exposed and huddled along the riverbed and bank to be deposited on the riverbed, bank and flood plain when the river`s power could carry them no further. The cyclone caused massive siltation on flood plains and wherever the river had a bend. Some silt was deposited on riverbanks and beds where the river channel widened degrading the land.

The landscape upon which the disaster occurred suggests the influence of human activity. Factors such as settlements on slopes, cultivation of marginal lands, deforestation and veldt fires were expressed to be issues of concern. There was evidence of streambank cultivation which was also an exacerbating factor to the damage on the river morphology. In other parts of the affected areas, settlements on extremely steep slopes were evident. The mudslides however, were evident on both human disturbed and undisturbed lands. The most affected areas being coincidental with old or existing water courses. It may be concluded that the human factor accelerated the calamity but evidently the high trigger was hydrological factors on a fragile ecological setting.

Post cyclone Idai response to environmental damage has mainly been in the form of research assessments, clean ups, tree planting and integrated projects. Five environmental assessment/researches have been conducted on various issues pertaining to the cyclone. The Environmental Management Agency (EMA) did an ecosystems assessment to objectively investigate

the causes of the damage inflicted by the cyclone and to assess the suitability of continuity of the land uses before the cyclone. Africa University, in conjunction with EMA, conducted research to investigate the spatial impacts of Cyclone Idai using a case study of ward 21, Ngorima A. The Ministry of Public Works conducted a geological survey in Chimanimani urban ward with focus on Nhuka farm to assess the stability of the landmass. Econet Higher Life Foundation commissioned an Environmental Impact Assessment on Chayamiti where a housing project was intended. Despite assessments having been done, the local authority is not in possession of the findings of the research or assessment work. The unavailability of the findings impacted on key decision-making processes, including siting of the new location for the settlement for displaced persons and luring in interventions for the massive environmental distraction on the ecosystems.

Efforts in response to the cyclone calamity on the environmental front were basically divided into two sections namely environment, led by EMA and the Water and Sanitation, led by the DDF. The environment sector focused on ecosystems and environmental quality while the water and sanitation focused on drinking water supply and provisions of sanitation services. Both sector committees had linkages on waste management. Achievements by the environment sector included clean-up of cyclone generated waste, i.e. animal carcasses and infrastructure rubbles, construction of a consolidated garden, planting of 3 000 trees, and establishment of a 610-beehive apiculture project. The water and sanitation achievement included restoration of Ngangu township sewerage works, 142 drinking water analyses, installation of 14 water tanks, sinking of 16 water boreholes, repairing 38 boreholes, flushing 13 boreholes, rehabilitating 2 piped water schemes, and protecting 1 spring.

Environmental restoration started by the initial clean ups that comprised of waste cleaning from public places, rill filling, rubble cleaning and progressed to works tied to livelihoods programming that included de-siltation of water sources especially weir sites for irrigation plots and rehabilitating dip tanks. The immediate response focused on the water and sanitation sector which gave direct threat to human wellbeing. The Ngangu sewerage works and water supply across the affected areas was key. Interventions made show that the significance of an environmental damage was given relevance by its impact on human wellbeing. The medium and long-term environmental restoration has little attention having no development partners showing interest in them. Issues pertaining to future environmental security have not had much attention yet.

The local authority expressed a gap in environmental interventions. The cyclone left a lot of gullies on the pediment and flood plains, large scars on sliding slopes and exposed rocks along the riverbanks. The scars have become an environmental scare to the community. The rocks are currently being harvested by communities for various uses. Chimanimani hotel used the stones for pavement construction at their car park, the road construction works are also using the rocks for construction, locals constructing their houses are likewise using the stones for core stones and other stone works in construction, while Chimanimani Tourist Association is selecting water pebble for display decorations. Some of the pebbles are being transported out of Chimanimani. The large boulders however remain unused. Tree planting at various places is ongoing. Currently, no major planting has been done within the bounds of the riverine course. The gullies have not yet been attempted at. The DDC also mentioned the lack of development partners attending to environmental issues.

4.8 Flood and Landslide Hazard Map for Chimanimani

The results of flood modelling show that high to very high hazard classes are dominant on the western side of Chimanimani district as well as along river channels draining the highlands in the eastern part of the district (Figure 4.14). A large proportion of the district is characterised by low to moderate flood hazard as a result of high elevation. Eastern Chimanimani district is characterised by higher elevation and highlands compared to Chipinge. The eastern and south-eastern regions of the district have high to very high hazard for landslide occurrence as these are highlands. The western regions are characterised by low landslide hazard due to low elevation.

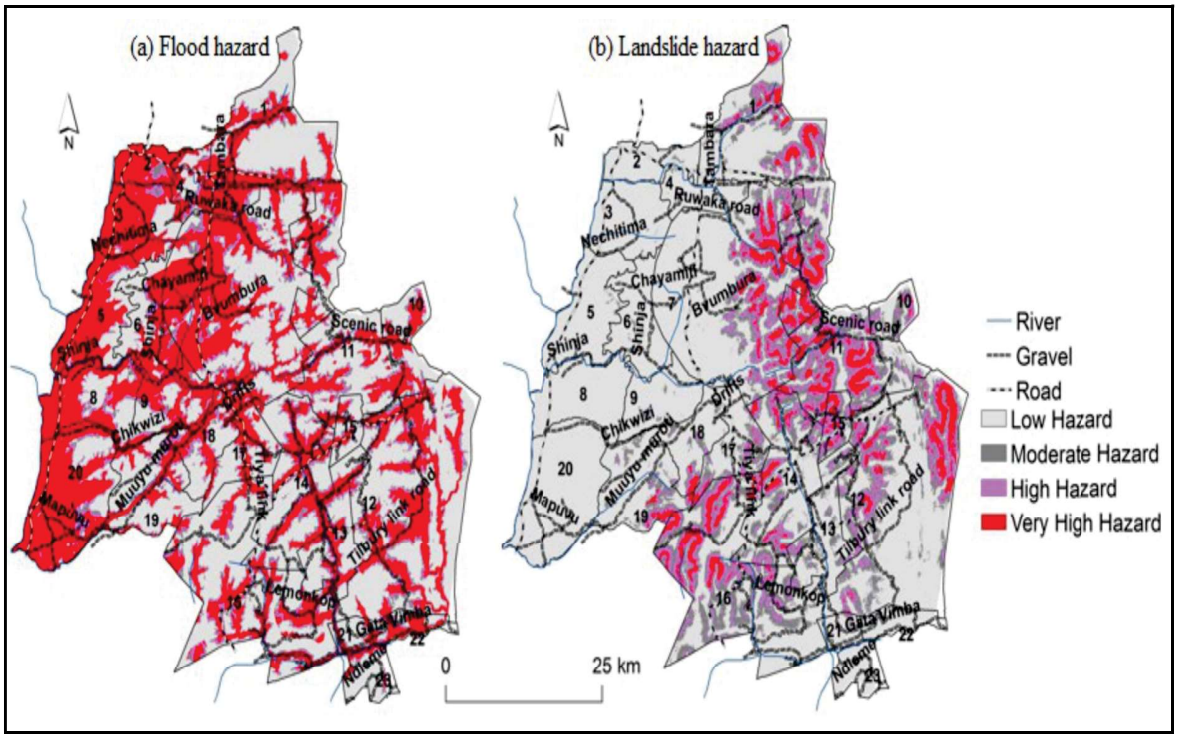


Figure 4.14: Flood (a) and landslide (b) risk maps of Chimanimani District

Combined risk to both landslides and floods in the District is largely in the moderate to high categories (Figure 4.15). The risk to both increases eastwards due to undulating terrain and steep slopes as well as soil characteristics. Westward movement is associated with decline in elevation and movement away from steep slopes to stable soils reducing risk of/to landslides while increasing exposure to floods.

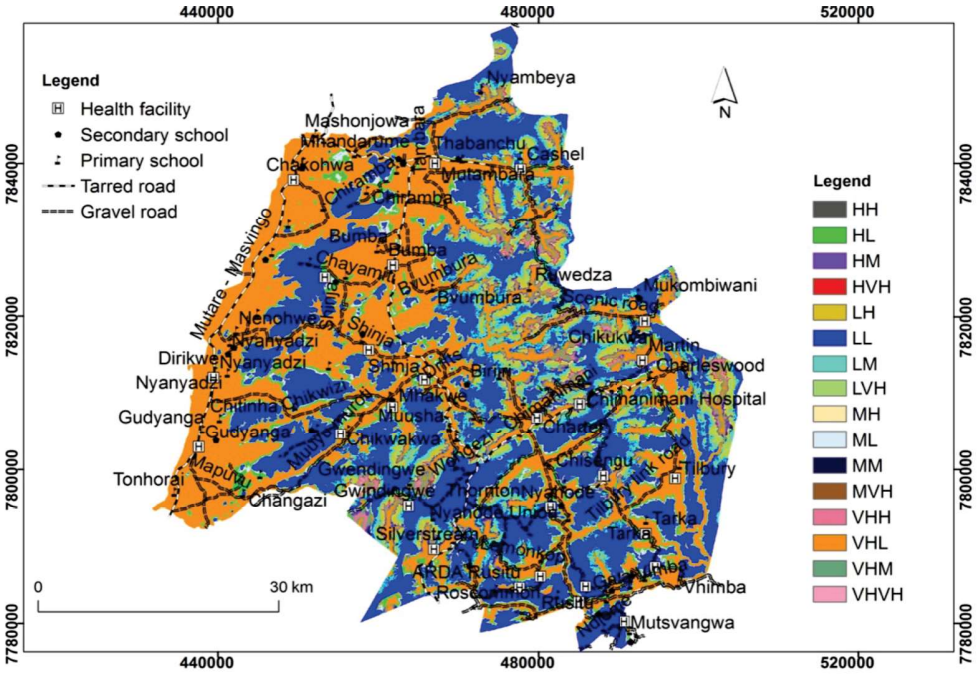


Figure 4.15: Spatial variation of combined floods and landslides risk in Chimanimani

The hazard levels mapped in Figure 4.15 are described in the Table 4.4

Table 4.4: Explanation for the combined flood and landslide hazard map in Figure 4.15.

Abbreviation	Meaning
HH	High hazard for floods and high hazard for landslides
HL	High hazard for floods and low hazard for landslides
HM	High hazard for flood and moderate hazard for landslides
MVH	Moderate hazard for floods and Very high hazard for landslides
LH	Low hazard for floods and high hazard for landslides
LL	Low hazard for floods and low hazard form landslides
LM	Low hazard for floods and moderate hazard for landslides
LVH	Low hazard for floods and Vey high hazard for landslides
MH	Moderate hazard for floods and high hazard for landslides
ML	Moderate hazard for floods and low hazard for landslides
MM	Moderate hazard for floods and moderate hazard for landslides
MVH	Moderate hazard for floods and Very high hazard for landslides
VHH	Very high hazard for floods and high hazard for landslides
VHL	Very high hazard for floods and low hazard for landslides
VHM	Very high hazard for floods and moderate hazard for landslides
VHVH	Very high hazard for floods and Very high hazard for landslides

4.9 Projected Risk of Extreme Rainfall Events under Climate Change

The decadal analysis of number of heavy rainfall events (daily rainfall events above 10mm) and very heavy rainfall (daily rainfall events above 10mm) is shown in Figure 4.16. The results show that the number of rainfall events per decade is decreasing by the proportion of those events above 10 while those above 20mm have been steadily increasing since 1981. Thus, the percentage of rainfall events that are considered heavy and risky to livelihoods, environment and ecosystems has increased in Chimanimani from 40.1% (17.2% for very heavy) of events between 1981 and 1990 to 51.2% (27.5%) between 2011 and 2020. This shows that a higher percentage of rainfall events in the district are becoming heavy and risky. The same pattern is also observable when the rainfall events above the 95 and 99th percentile are analysed (Figure 4.16). Climate projections show that these heavy and very heavy precipitation events will continue to increase in the coming decade (2021-2030) and for 2041-2050 with a slight decrease projected for 2031-2040 (Figure 4.16).

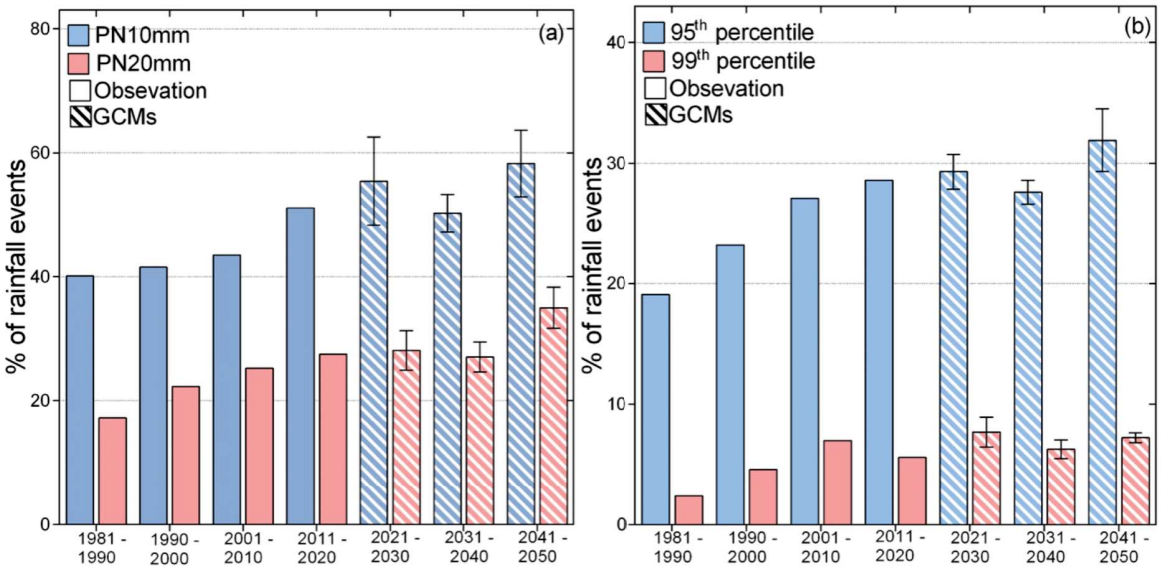


Figure 4.16: Characterisation of historical and projected impacts of climate change on extreme rainfall

4.10 Conclusion

Lack of preparedness was also due to the fact that event of the magnitude of Cyclone Idai was never anticipated in the district. Although the relayed early warning had inadequacies, reluctance based on past experiences of impacts affected response by communities. Movement of massive rocks due to increased runoff and saturation of ground caused vibrations previously interpreted as earth tremors. Besides floods in low lying areas, heavy rainfall events also pose threats of landslides in the mountainous parts of Chimanimani.

Moving towards 2050, the district must invest towards reducing impacts of projected frequent heavy rainfall events. Even an extreme event with low probability of occurrence must be prepared for, given that there was an almost similar but less destructive event in 1947. Recommendations around responses conveyed to communities regarding impeding hazards need to consider their physical environment rather than to be 'straight jacket' suggesting the need for nuanced evidence and close-to-population agencies. In the case of Cyclone Idai it was not safe to move to higher ground due to landslides. The issued response ought to always be hazard, population and location specific to avoid reluctance based on past experiences. The silver lining in this case is that the Cyclone Idai experience increased the desire by communities to access and share climate information, ensure safety and manage their environment. This enthusiasm needs to be properly captured and built upon.

Chapter 5: Potential of Agroecological Systems for Reducing Vulnerabilities to Disaster Risks

5.1 Introduction, Research Focus and Approach

Diverse, severe, and location-specific impacts on agricultural production are anticipated with climate change especially in Africa. Climate-induced changes in temperature, water availability, insect, pest, pathogen and weed population dynamics and invasiveness could compound such effects in dominant industrial model conventional farming systems. Agroecological farming systems have potential to strengthen the resilience of farmers and rural communities through diversification of agro-ecosystems in the form of polycultures, agroforestry, and crop-livestock mixed systems accompanied by organic soil management, water conservation and harvesting. This enhancement of on-farm agro biodiversity should have the effect of reducing pressure on, and stabilising the surrounding landscapes.

The present study was co-generative, multi-site and compared 'agroecological' and 'conventional' farming systems within and between selected sites differentially affected by Cyclone Idai. In establishing the resilience of different farming landscapes and investigating factors that have exacerbated social vulnerabilities amongst farming communities. Apart from generating data to answer the study's pre-defined questions (below), the action research also aimed to build the confidence and resilience of those farmers participating. The guiding questions for this component of the study were as follows:

- What is the resilience differential between how agroecologically and conventionally managed farming landscapes performed during and after Cyclone Idai?
- How are 'resilient landscapes' defined and differentially experienced by farmers within and across selected sites in Chimanimani district?
- What has been the difference in impact between Cyclone Idai and previous cyclones in areas that have since adopted agroecological approaches to land and resource management?
- Under what changing land-use patterns are the effects of Cyclone Idai most observable in selected sites?
- How effective, in either mitigating or reducing event impacts have the employed techniques been?
- To what extent have social farming systems (i.e. co-operation on landscape planning, labour, and participatory seed breeding and sharing) been able to buffer impacts and speed recovery?

The specific areas of inquiry included the following:

- *Landscape management*: cropping practices that stabilise soils, practice watershed management, including swales and/or contours intended to manage and slow surface run-off; upland management systems for early infiltration; rangeland management, and livestock integration (crop pasture rotations); and forestry management, including the agroforestry to deflect high winds, stabilise soils, and aid water infiltration (groundwater recharging for pre- and post-event drought management).
- *Food and seed systems*: comparative systems for productive diversity to reduce loss impacts; the application of cover crops, conservation tillage and soil organic management that may protect soils and crops; and the use and resilience of grain stores for food and seed security;
- *Social systems*: collective management of soil and water systems, and systems of reciprocity for the sharing of food, labour and seed for early post-impact recovery which considered signs of a solidarity consciousness, and a more equitable resilience emerging.

5.1.1 Research Approach and Coverage

Eight wards that experienced variable cyclone impacts, and where agroecological NGOs have been active, were selected for the study. The selected wards are in the different natural regions from the wet/upland to the dry lowland areas of the district. The research was framed against the backdrop of recent reports that starkly warn of the interconnected negative impacts of conventional food and farming systems on climate change and biodiversity loss (UNCTAD, 2013; IPCC, 2018; IPBES, 2019; UNDRR 2019). At-risk small-scale producers, who produce approximately 70% of the food consumed globally (Altieri et al., 2012), positioning them as cornerstones of local-global food systems and social-ecological stability. Where plural knowledge linked to their diverse ecologies to optimise production and stabilise agroecosystem functions, these have been found to reduce biodiversity loss as a buffer against climate disruption (IPBES, 2019) . Across landscapes increasingly buffeted by extreme weather, those that are managed agroecologically have been found to out-perform those exposed to conventional land-use practices. Studies after hurricanes in Nicaragua (Holt-Gimenez, 2002) and Cuba (Alvarez et al., 2011) and Puerto Rico (Febles and Felix, 2020) found that agroecological farming communities suffered fewer soil and crop losses and recovered considerably faster due to their improved adaptive capacity and social networks. Diversified landscapes are more resilient, able to absorb the impacts of flooding, high winds and exhibit greater yield stability during periods of drought (Pretty et al., 2006; Altieri & Koohafkan, 2013).

To assess landscape resilience in extreme weather events, the research set out to establish optimal soil conditions for moisture and nutrient retention on farmland, rangelands and forestland. The research applied methods including soil analyses and veld assessments, focus groups discussion sessions and farmer-led solution-building, as well as interviews and observations of different agricultural practices. The research found that forested landscapes, followed closely by those managed using agroecological practices had the most soil organic matter, able to absorb more excess run-off, and retained more nutrients in the upper layers, making it more available to plants. These findings were reinforced by observations of agroecological and neighbouring conventionally managed farmlands, with the former containing more agrobiodiversity and showing signs of better plant health with implications for food diversity, quality and availability. The research also set out to understand the social mechanisms that might improve post-cyclone recovery.

Against a background of land and natural resource degradation, politisation and increasing climate disruption a co-generative, multi-site and participatory research approach was selected. It compared ‘agroecological’ and ‘conventional’ farming systems within and between selected sites differentially affected by the impacts of Cyclone Idai in Chimanimani. With empirical data derived from mixed methods, it considered the most effective combinations of practices and techniques for mitigating stresses at different scales and layers of vulnerability i.e. from household to landscape levels.

Thirty-five farmer co-researchers were invited from eight selected wards. Of the 35, 11 were men, 13 women and 11 young people. A survey was co-developed during focus groups discussions and undertaken with 821 respondents using purposive sampling of agroecology and conventional farmers across the eight wards. The rationale for disaggregation according to farming typology was as follows: Identifying ‘AE’ farmers as those practicing without the use of external inputs (traditional or organic farming, permaculture, agroforestry and holistic land and livestock management); and ‘CF’ as those who apply external inputs, including those applying ‘conservation agriculture’ techniques. It was also necessary to identify farmers using ‘both’, but on different plots of land (often organic for HH production/consumption and CF on drylands for storage and/or sale to GMB).

Field research undertaken in the high potential Natural Region 1 (NR1) covered Chikukwa (Ward 10), Martin (Ward 11), Nyahode (Ward 13), Ngorima A (Ward 21) and B (Ward 22). For the Middleveld (NR2) Biriiri (Ward 17), and Chayamiti (Ward 6) were selected with Chakohwa (Ward 3) representing the Lowveld (NR4). As trends were surfaced through the data, further engagement took place through Key Informant Interviews (KIIs) with 20 agroecological and conventional farmers (6 women, 10 men and 4 traditional leaders), and soil and veld assessments and informal survey were

undertaken with 16 co-researchers (8 women and 8 men) in four 4 wards, considered both high and low performing namely (Chikukwa, Nyahode, Biriiri and Chakohwa) were purposively selected from the original sampled villages for a deeper dive. Here, field and veld assessment were carried out ……. Soil samples: 3 (low veld), 17 (middle of the escarpment), 10 and 13 (upland and epicentre of the cyclone); Pit codes - 50 pits (10 p/ward - 5 AE and 5 CF) + 10 in Ward 17 forested areas; Veld assessments - 5 sites p/ward (X 100 points per assessment) = 20 samples.

5.2 Synopsis of the pre-Cyclone Idai Context

The study covered areas with traditions of social farming, particularly strong in agroecological farming communities. These are areas that are more inclined towards reciprocal seed and labour sharing, and to organise recovery strategies and mutual support networks. In recent years high levels of mistrust have been reported in both leaders and neighbours. These have resulted in people being concerned about theft from their granaries and being less inclined to engage in community grain production for the most vulnerable, suspecting leaders of corruption. This collective sense of mistrust undermines the value of community safety nets and weakens resilience strategies and recovery – all serving to increase dependency on government and NGO distribution. This was notable in areas with high-value resources and poorly managed settlements. While particularly notable in wards where decision-making is highly politicised, confusion was widespread regarding responsibilities for environmental protection mechanisms by different layers of governance, resulting in poor land-use planning capabilities amongst decision-makers and confusion by land users. The situation reflects a shifting political economy of the agricultural sector that resonates with experiences from other parts of the country.

Chimanimani has been a hub for agroecology since the 1991/2 drought that affected all districts in Zimbabwe. In response to subsequent storms in 1992, community-based organisations in Chimanimani district such as the Chikukwa Ecological Land Use Community Trust (CELUCT),the Towards Sustainable Use of Resources Organisation (TSURO) Trust and the Nyahode Union Learning Centre (NULC) have been promoting agroecological (AE) farming practices that reduce the impact of climate change in communities. This work is based on the knowledge that agroecology offers a unique approach for smallholder farmers to address the root causes of low productivity by providing holistic and long-term solutions based on co-creation of knowledge, sharing and innovation.

While disruptions to farming activities in Chimanimani that have been affected by cycles of natural disasters (Dow and Downing, 2011) are not new, Cyclone Idai is on record as being the most destructive natural disaster in Southern Africa in living memory (World Bank et al, 2019). Other rapid- and slow-onset disasters of note are Cyclones Japhet and Eline, and agricultural droughts of 1991/92 and 2015/16 respectively. Other relatively good years like the 2019/2020 season) have been punctuated by mid-season droughts which negatively affected crop yields and livestock production (World Bank et al, 2019 and Campbell et al, 2002). Pests, notably the Fall Army Worm (beginning during the 2016/2017 cropping season) have impacted crop production in both the low lying and upland areas of the district. The IPCC (2018) projects that Africa is going to be hard hit by the recurrent of these climate change-induced disasters. These extreme weather events add another layer of socio-economic challenges compounding pervasive poverty (Sayer and Campbell, 2004).

Anecdotal evidence shows differential landscape impacts arising from disasters (Van der Sommen, Pearson, and Boggs, 2018; Brown, 1983 and Scherr and McNeely, 2008). In agricultural landscapes, the history of land-use also has a bearing on how the land fares in the face of disasters like droughts or cyclones. Disasters also provide important points for enquiry and reflection in terms of the application and performance of different land-use practices. Still such debates are also neither new nor unique to Chimanimani. Settler colonial systems and post-colonial land use, redistribution and resource extraction systems have generally been disruptive or destructive to the diverse and highly complex agroecosystems, that were farmed sensitively and successfully for (Maseko et al., 1988; Scoones, 1997; Ranger, 1999; Detto et al, 2019, Phiri et al., 2019). Some of these tensions or contestations have reproduced vulnerability to climate change-induced risks.

5.3 Understanding Landscape Resilience

This section presents the main findings of the study from across the 8 selected sites/wards that experienced variable impacts of Cyclone Idai. It lays out the factors (landscape and social) that contributed to the intensity of the impacts, and factors that might have led to improved recovery. From the 821 respondents were interviewed farming from 0.04 to 10 ha of land. Most of the farmers practiced both AE and CF (n=296), 238 practiced AE alone while 285 practiced CF. More women than men practiced AE including young women (Table 5.1).

Table 5.1: Distribution of respondents by Gender and Farming type

Gender		**Farming type**			
		Agroecology	**Conventional**	**Both**	Total
Female		132	124	135	391
Male		71	99	90	260
Youth	Female	22	37	26	85
	Male	13	25	18	56
Total		238	285	296	792

Agroecology farmers who participated in the questionnaire development during FGD sessions identified certain landscape designs as indicators of a resilient landscape. These included contours and terracing on slopes that aid the capture and sinking of surface water for groundwater recharging, and to reduce soil erosion and loss. Others included zoning, pit coding and catchment management. Table 5.2 below shows the distribution of land design practices amongst the studied farmers. They included those practicing AE, CF and mixed systems (both AE and CF). The different choices were confirmed during the feedback sessions in both the Eastern Cluster (Chikukwa, Martin, Ngorima A & B and Nyahode) and the Western Cluster and by key informants.

Table 5.2: Land use design practices used

	Farming management system					
Land use design	**Agroecology**		**Conventional**		**Both**	
	Yes	No	Yes	No	Yes	No
Zoning	94	154	104	187	120	158
Pit coding	38	211	23	268	47	231
Contours	151	98	165	125	173	105
Terracing	127	121	131	160	145	133
Catchment management	55	194	70	220	73	205
Enterprise choice	19	229	25	265	34	244
External energy	14	235	22	269	33	245

There were more farmers practicing mulching under AE than CF or both (Table 5.3). More farmers under AE and those practicing both farming systems used manure than those in the two categories who did not. Farmers who composted were more under AE while fewer farmers under CF and both used the soil management practice. There was generally low adoption of terracing, swales contouring and use of biological barriers as soil management practices across all the farming systems.

Table 5.3: Soil management - Practices applied

Soil management	Farming system					
	Agroecology		Conventional		Both	
	Yes	No	Yes	No	Yes	No
Mulching	176	74	91	202	112	166
Minimum tillage	89	161	71	222	108	170
Manuring	178	72	146	147	184	94
Composting	126	124	71	221	120	158
Terracing	92	157	91	200	109	169
Swales	28	222	20	272	40	237
Contouring	98	152	107	185	121	157
Biological Barrier	24	226	51	242	51	227

In terms of water management there was adoption of some relevant practices indicating a resilient landscape to weather shocks under all farming systems although terracing and contour dead level had significant adoption (Table 5.4). Diversion drains were the least adopted across all farming systems.

Table 5.4: Water management – Practices *applied on-farm*

Water management	Farming system					
	Agroecology		Conventional		Both	
	Yes	No	Yes	No	Yes	No
Terracing	107	143	118	173	115	163
Diversions drains	39	211	41	251	55	223
Contour dead level	105	145	103	189	108	170
Contour drain away	64	185	87	203	90	187
Roof top harvesting	52	198	49	242	82	196
Grey Water	64	185	76	216	102	176

There was overwhelming evidence from the survey, feedback sessions and KIIs that AE farmers adopted practices that encourage diversity, such as crop rotations and intercropping. They also used methods beneficial to the environment such as use of plants and their extracts as push-pull-repellents and organic fertilisers. While a resilient household requires diversification with other enterprises such as livestock, animal diversity was low indicating a need for capacity building. Farmers using ethno-veterinary medicine (AE farmers and those using 'both') tended to have more varied knowledge on other practices such as chemical tick control, controlled breeding, dehorning, tagging, insemination, controlled breeding and branding. Few farmers were practicing silvo-pasture management. Most lacked knowledge on mixing grasses and legumes and there was no intentional fertility management of grazing lands reported, although from observations and discussions, this was being practiced under Holistic Land and Livestock Management by participating farmers in Chikukwa. During KIIs farmers acknowledged that areas demarcated for controlled grazing in Chikukwa, Martin, Nyahode, Biriiri, Chayamiti and Chakohwa had less landslides or erosion but indicated need for resources and further capacity building in other areas of livestock management such as stocking rate management and management of grass species composition.

The articulation of a need for capacity building was an important insight, indicated by farmers across the board, to enable the adoption of a wider range of land use designs. This related to soil management practices such as mulching, minimum tillage, composting, manuring, swales and use of biological barriers among farmers, and to water conservation structures.

5.4 Effects/Impacts of Cyclone Idai on AE and CF Landscapes

Data collected from farmers' fields during pit coding included soil profiles [restricted to the organic (O) Horizon and the A horizon], nitrate and pH measurement at 0-15 cm, 15-30 cm and 30-45 cm (zone with more than 90 % of crop roots). This showed biological diversity in the soil, root density, soil wetness and crop diversity. Data focused on three wards namely Chikukwa, Nyahode and Biriiri representing (Wards 10, 13 and 17 respectively) and exclude the indigenous, naturalised and exotic forested areas of Biriiri plus Chakohwa (Ward 3). Nitrate and pH data are exclusive to Chikukwa and Nyahode which were yet to be analysed due to COVID19 restrictions. This ongoing analysis will include data on total carbon, nitrogen, phosphorus and potassium for all sites. Results of KIIs pertaining to soil loss and loss of grazing are also presented in this section.

Generally, farmers that practiced agroforestry, mulching, manuring, composting and intercropping achieved a faster infiltration rate (mm/hour). These farmers largely fell under AE although most farmers under CF adopted one or more aspects of AE, such as minimal tillage, mulching and composting. Although AE achieved a mean, median and minimum, indicating reduced infiltration compared to CF, there were outliers in the study. For instance, one CF farmer in Chikukwa practiced techniques characteristic of AE such as mulching, swales, intercropping, rotations (maize in summer and wheat in winter), agroforestry, and had biological barriers, yet had the lowest infiltration rate of 0.128 mm/hour. This is thought to be due to his use of an ox drawn plough which resulted in the only site with a compacted soil structure of the 30 sites.

However, most sites with slow infiltration had visible signs of low soil organic matter indicating that most plant residues on the soil surface were washed away. In contrast, AE achieved the highest infiltration, with the maximum infiltration of 3.5 mm/hour and a wider infiltration range of 3.4 mm/hour. The farms with the highest infiltration rate under AE also had soils that were described as ‘wet’ by the co-researchers. Wet soils were defined as soils with visible water molecules and could not be rolled (moist) or crumble (dry) thereby reducing infiltration. Of note, is that the CF sites with fast infiltration rates had most facets characteristic AE practice. These farmers have adopted most AE practices (mulching, minimum tillage, composting, manuring, swales and use of biological barriers) but still practice monoculture, use hybrid seed and apply fertilisers and chemicals to the crop. Adoption of AE practices and reduction of CF practices therefore, indicated better infiltration rates. Table 5.5 shows results from Chikukwa, Nyahode and Biriiri excluding Chakohwa and forested area at Biriiri (N=30 sites i.e. n=15/production system)

Table 5.5: Initial infiltration rate under

Descriptor	AE mm/hour	CF mm/hour
Mean	0.8	0.9
Median	0.4	0.5
Minimum	0.1	0.2
Maximum	3.5	3.4
Range	3.4	3.1

In areas where soil texture was sandier, infiltration was generally faster than under soils that were predominantly clay. Soils became sandier at Biriiri than at Chikukwa (9 sites were clay with one site being loamy) and Nyahode (9 sites were clay with one site being loamy). However, due to increased build-up of soil organic matter, under AE soil texture played a less significant role as it would in more susceptible landscapes i.e. with low organic matter. Nyahode achieved the fastest initial infiltration rate, followed by Chikukwa and lastly Biriiri (Table 5.6). Chikukwa and Nyahode had deeper A Horizons (plough zones) than Biriiri with shallower soil profiles and bedrocks.

Table 5.6: Initial infiltration rates under AE by ward

Descriptor	Chikukwa mm/hour	Nyahode mm/hour	Biriiri mm/hour
Mean	0.785	1.105	0.767
Median	0.454	0.609	0.414
Minimum	0.128	0.228	0.162
Maximum	3.367	3.548	3.113
Range	3.239	3.321	2.951

Farmers identified forested area, AE, contouring/terracing and flat areas as having been more resilient landscapes to the effects of Cyclone Idai (Figure 5.1). During the project inception workshop in November and during the KIIs, loss of nutrients and a reduction in fruit sizes and yield of most crops was raised as one of the negative impacts of Cyclone Idai. During the KIIs, all selected wards observed that CF fared badly than AE in terms of yield during the 2019/2020 rainy season.

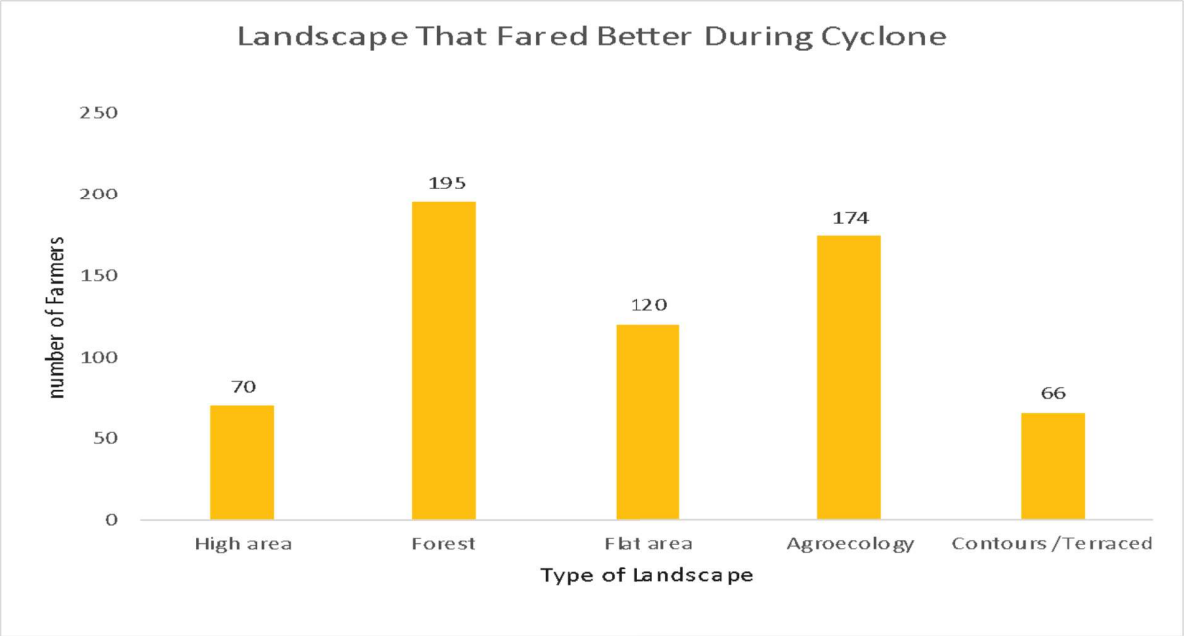


Figure 5.1: Effects of Cyclone on landscapes - Farmer perceptions

They attributed the better performance of AE farms to production practices that promote increased soil organic matter which is less susceptible to leaching (Figure 5.2). This was seen in contrast (by farmers across typologies) with CF, which relies on fertilisers that are either too expensive or from government program handouts which are not reliable. Nutrient leaching and changes in pH were thought to be the causes to subsequent productivity challenges post-cyclone. (More detailed lab analysis is required).

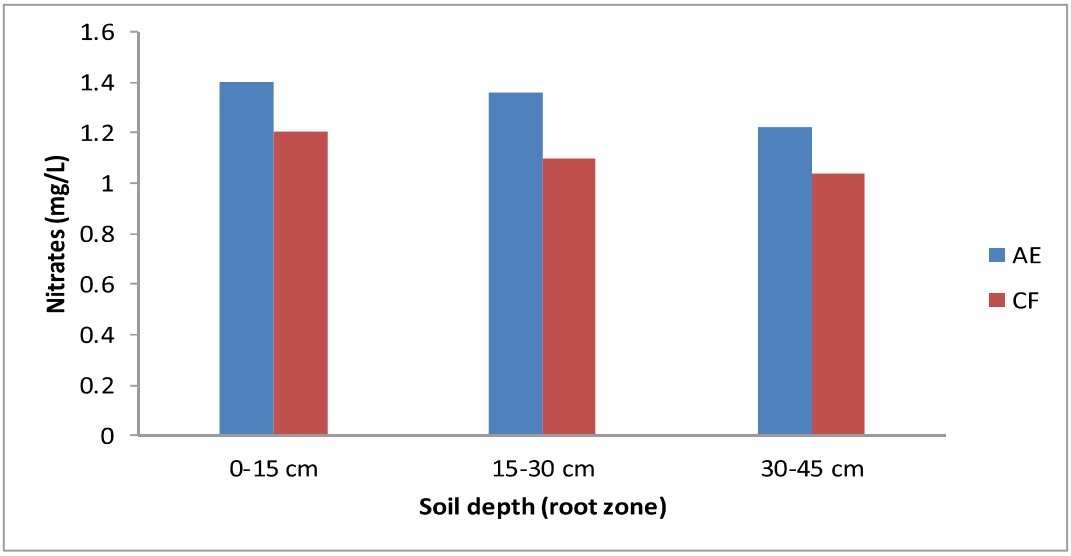


Figure 5.2: Nitrate levels in the root zone of most agronomic crops (Chikukwa and Nyahode)

AE achieved higher nitrates at 0 - 15 cm, 15 - 30 cm and 30 - 45 cm soil depths across the 20 plots at both Chikukwa and Nyahode compared to readings for CF (Figure 5.3). Leaching of nutrients is higher in soils that have low soil organic matter normally found in systems that do not encourage mulching, reduced tillage, rotations, intercropping and multiple cropping. Use of legumes, manure and composts result in gradual mineralization of nitrogen compared to inorganic fertilisers which come in forms readily available to the crop, and is therefore prone higher losses, as depicted by results under CF.

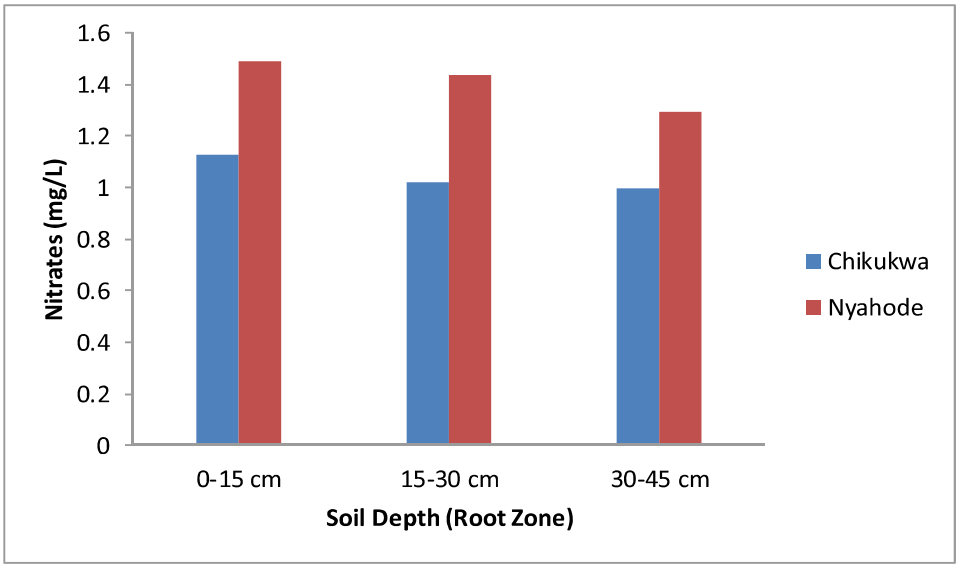


Figure 5.3: Nitrates (mg/L) different soil depths in root zones

Cyclone Idai affected Chikukwa and Nyahode areas differently. Chikukwa is on a more windward direction than Nyahode, which could have had a bearing on the presence of nitrates at different depths. In Nyahode more nitrates were up to 45 cm compared to Chikukwa indicating higher leaching after Cyclone Idai at Chikukwa. There was a lower pH in AE plots at 0-15 cm depth than under CF (Table 5.7). As organic matter decomposes, various organic acids are released by various microbes in the soil. There was an increase in pH from 15-30 cm and 30-45 cm under AE, while pH decreased with depth under CF. This could be because most inorganic fertilisers cause acidity as hydrogen (H) ions to increase in soil water solution as nitrates are leached down the soil profile. CF however had the lowest pH of 5.2 at 0-15 cm. It is noted, however, that most nutrients are available at pH 5 to 6.5,

a range of means found under both AE and CF. Generally, Chikukwa had a lower pH than Nyahode which could be an indication that Nyahode had less leaching of some locations during Cyclone Idai.

Table 5.7: pH levels at different soil *depths due to AE or CF and site*

Soil Depth/Descriptor	**Farming System**		**Ward**	
	AE	**CF**	**Chikukwa**	**Nyahode**
Soil Depth A	**0-15 cm**	**0-15 cm**	**0-15 cm**	**0-15 cm**
Mean	6.5	6.7	6.4	6.8
Median	6.7	6.6 esxc b	6.4	7.1
Minimum	5.5	5.2	5.9	5.2
Maximum	7.2	7.6	6.8	7.6
Range	1.7	2.4	0.9	2.4
Soil Depth B	**15-30 cm**	**15-30 cm**	**15-30 cm**	**15-30 cm**
Mean	6.5	6.5	6.2	6.8
Median	6.8	6.3	6	7
Minimum	5.3	5.4	5.8	5.3
Maximum	7.1	7.7	6.9	7.7
Range	1.8	2.3	1.1	2.4
Soil Depth C	**30-45 cm**	**30-45 cm**	**30-45 cm**	**30-45 cm**
Mean	6.7	6.4	6.2	6.9
Median	6.75	6.45	6.1	7.1
Minimum	5.7	5.7	5.7	5.7
Maximum	7.2	7.7	7.1	7.7
Range	1.5	2	1.4	2

The most common observations by farmers from Chikukwa, Nyahode, Biriiri and Chakohwa during KIIs were that soils were washed away from uplands to lowlands reducing food security as farmers used to grow winter and early summer crops along streams (all 8 wards), wetlands and irrigation schemes in upland areas. Furthermore, swales, diversion drains and contours reduced the impact of water affecting neighbours' fields and homesteads practicing AE especially in Chikukwa which, having been in place since the early 1990s, have nonetheless been somewhat neglected but are nonetheless holding out – demonstrating the resilience and persistence of these structures. Soil and water conservation structures were deemed necessary among all four wards and farmers expressed desire to form groups to increase the construction of these structures under the leadership of their traditional leaders and Village Development Committees (VIDCOs). It was also observed by stakeholders like TSURO and Agritex that, if swales, diversion drains, contours and terraces were to be built, then capacity building was also considered as very important and needed.

Fields and gardens along riverbanks, and springs were washed away reducing the capacity of farmers in all wards to grow food and vegetables outside the rain season. Key informants at Chikukwa lost soil and fields without the soil being deposited in the area due to its watershed landform. This further demonstrates the need for landscape solutions that slow water and capture soils at key points along downward slopes and across watersheds.

However, key informants in Nyahode, Biriiri and Chakohwa indicated that some soil was deposited in valley and other areas set aside for pastures even though they also lost soil from their fields and gardens. In Chikukwa, Nyahode, Biriiri and Chakohwa wards, planting of trees and grasses along rivers was seen as a way of improving soil deposition. Capacity on development of nurseries, selection of species with varying growth rates and habits to plant on homesteads and rivers was cited as being very important.

Cyclone Idai caused loss of soil, plant residue and nutrients resulting in patched grazing, and poorer quality and quantity of forage across all the four wards. Areas with good ground cover especially forested areas was found to have been more resilient. AE promotes controlled grazing, paddocking and improvement of pastures. Invasive species grew more rapidly reducing pastures in all wards. As with gardens and fields along riverbanks, grazing lands and watering pools in rivers were replaced by

boulders after Cyclone Idai in all wards. Animals had access to poorer quality grazing during the dry season as river reeds previously provided grazing during the dry months. Wells where animals also drank water were filled up by soil in Chakohwa.

Heavy rains and flash flooding left deep gullies that are now dangerous to both humans and livestock in Chikukwa. The gullies are sometimes not visible due to plant growth leading to accidents by animals and humans. Overall, CF was perceived as having suffered the most destruction under Cyclone Idai followed by AE while grazing lands, forested area and undisturbed areas were less susceptible (see Table 5.8). In the highveld (Chikukwa, Martin, Nyahode, Biriiri, Ngorima A and Ngorima B) AE performed better including at Chayamiti in the Middleveld. However, Chakohwa in the Lowveld CF was described as having fared better than AE. Most AE in this area was practiced in riverbanks that were washed away.

Table 5.8: Farming type which suffered more destruction under the cyclone

Ward name and (number)	Land use system which was more susceptible to the effects of cyclone					Number of respondents
	Agroecology farmlands	Conventional farmlands	Grazing lands	Forest plantations	Undisturbed areas	
Chakohwa (3)	57%	29%	9%	4%	1%	100
Chayamiti (6)	41%	49%	2%	6%	2%	99
Chikukwa (10)	15%	82%	1%	0	2%	99
Martin (11)	6%	45%	47%	1%	1%	100
Nyahode (13)	17	64%	4%	4%	11%	99
Biriiri (17)	20%	71%	1%	2%	6%	120
Ngorima A (21)	28%	64%	4%	2%	2%	100
Ngorima B (22)	47%	52%	0	1%	0	100
Total	**29%**	**57%**	**8%**	**3%**	**3%**	**817**

5.5 Social Impacts of Cyclone Idai on Farmers

The study observed a renewed sense of the importance of social-ecological connections (+ve) as well as improvement to social cohesion (+ve) as families worked together in problem solving and dispute settlement. The boxes shaded show the wards where survey respondents confirmed a spike in particular Cyclone Idai-induced issues (Table 5.9).

Furthermore, the study revealed a renewed sense of the importance of lost social-ecological connections and relationships. This arose during discussions around causal reasoning and solution-building for improved responsiveness. An improved sense of social cohesion was reported in specific wards stimulated by the sense of urgency and collective efficacy in the face of institutional failures by NGOs and government. These failures have serious ramifications for at-risk communities. Yet, the collective mobilization, that was particularly effective where traditional knowledge-based farming systems remain strong, saw local people joining together into first responder units to aid recovery of people, homes and infrastructure. These mutual aid and solidarity networks provide an indication of where future investment in adaptive capacity development might focus.

The majority of households in Chimanimani depend on agriculture for a living. However, they also pursue other non-farming economic activities such as trading, building, piece jobs an, harvesting natural products. These non-farming activities support and are supported by agriculture. A more nuanced understanding of the nexus farming and non-farming economic activities is needed. Future research needs to capture the implications of this nexus on land and broader resource use in relation to disaster preparedness and its impacts.

Table 5.9: Social impacts of Cyclone Idai by:

Ward number	Disputes		Food security issues		Environmental reclamation		Stock theft		Gender based violence	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Chakohwa (3)	10	90	76	24	17	83	42	58	27	73
Chayamiti (6)	36	64	95	5	44	56	62	38	88	12
Chikukwa (10)	70	29	67	32	72	27	51	48	61	38
Martin (11)	50	50	76	24	28	72	53	47	45	55
Nyahode (13)	31	69	3	97	19	81	33	67	11	89
Biriiri (17)	82	38	62	58	84	36	81	39	83	37
Ngorima A (21)	84	16	79	21	43	57	51	49	55	45
Ngorima B (22)	49	50	64	35	33	66	29	70	81	18

5.6 Veld Condition Assessment

The Table 5. 10 shows results of farmers' rating of the quality of grazing in their areas.

Table 5.10: Veld condition Summary Rating

Criteria	A- Chakohwa	B- Nyahode	C- Chikukwa	D- Biriiri	RATING	SCORE	VELD FINAL RATING
Grass spp composition	0	2	1	3	**Excellent**	**10-9**	**40+**
Ground cover	0	3	1	3	**Good**	**8-7**	**30-40**
Forage Production	6	3	3	5	**Fair**	**6-5**	**20-30**
Litter and plant residues	3	3	1	4	**Poor**	**4-3**	**10-20**
Soil compaction and erosion	1	4	10	8	**Very Poor**	**2-1**	**0-20**
Veld Final Rating	**10 Poor**	**15 Poor**	**16 Poor**	**23 Fair**			

5.7 Factors that influenced Cyclone Idai Impact

Key land use factors that influenced the gravity of Cyclone Idai impacts included sparse AE practice, patchy ground cover, compacted soils, high stocking rates and loss of trees. The majority of farmers subscribe to use of destructive farming methods influenced by land use pressures, access to and ready cash incentives. Patchy ground cover led to increased surface flow. Ground cover of 50-60% resulted in increased surface flow leading to washing away of grazing lands. On compacted soils as a result of tillage and animal movement infiltration was rate reduced contributing to excessive surface flow (rapid run-off). On the other high stocking rates as evidenced by high proportion of plants which increase as a result of overgrazing, degrading landscapes and the creation of bare surfaces leading to reduced forage. In general, there has been considerable loss of trees partly as it is opened up for farming and also for energy needs. This leads to open spaces and exposure to the elements such as winds and frequent droughts, leaving bare soils that are susceptible to erosion.

Other factors related to social settings. One of these was a lack of resource users understanding of the soil–water connections, therefore undermining mitigation strategies that would increase resilience to slow-onset disasters. Also undermining resilience, is a sense of pervasive mistrust, undermining collective strategies and local safety nets for seed and grain storage and distribution for recovery. Other concerns related to the reaction time to common problems and perceptions related to preparations to threats, which were found to be slower and less responsive where leadership is more politicised.

Besides social factors the impact of Cyclone Idai was also determined by structural or institutional issues. A lack of solution finding and planning capacity in communities was found where decision-making is highly politicised (Nyahode and Chakohwa). Traditional leaders and officials were not fully aware of the difference between by-laws and environmental regulations. As such, responsibilities for their establishment and enforcement were unclear adding to confusion and associated with weak land use planning and management. Another area where this manifested was in non-existent settlement design, and with inappropriate land/resource use and non-existent 'settlement design' leading to ownership and recourse use disputes. It was unanimously agreed that weak planning and stewardship was generally inadequate and was found to be resulting in the blame of migrants rather than with corruption and/or poor planning.

In responding to the study's research questions it was found that AE farmers had clear and detailed definitions of what a resilient landscape would or should look like which (below), we believe, is helpful to policy makers in understanding the capacity that exists to be built upon. Due to dependence on now destroyed riverine production, replanting and afforestation to capture and build soils would be critical as is expanding of small grains into production systems to create resilience against environmental and economic shocks. Regarding soil and water conservation creation of more contours and swales, using mechanisation for scaled activities would be critical.

At the same time reduced tillage and increasing of soil organic matter through mulching and composting, planting more biological barriers (trees) around homesteads, bee keeping to benefit from increased post-cyclone invasive species while also establishing more nurseries to produce appropriate tree and grass species for afforestation and landscape stabilisation will be strategic. Traditional home infrastructure designs like round huts and other strictures seem to have been more resilient suggesting their adoption as a mitigation measure has potential to reduce future disaster impacts.

Regarding land and related governance more action on by-laws to prevent veld fires and deforestation is needed. Social mobilisation around reinvigorated *nhimbe* (work parties or labour sharing), 'democratised' Zunde raMambo (the Chief or King's field, where communities collectively produce surplus grain, intended for the most in need), environmental management clubs, and disaster management committees at ward level is critical. Chapter 6 engages with the need for some of these institutional arrangements or innovations to be better coordinated and aligned to local government systems and structures for effectiveness.

5.8 Conclusion

Local farmer co-researchers and supporting Agricultural Extension Workers (AEWs) helped clarify and contextualise issues while also expediting the research. This enabled authentic co-production of knowledge as well as making connections that can be built upon in future action phase/s to strengthen collective responsiveness for resilience. AE farmers in the study sites demonstrated sound knowledge of their environment and farming practices. They draw on different facets of knowledge linked to social ecology to produce a rich appreciation of what constitutes a resilient landscape. This contributes to diverse thinking on what 'building back better' might actually mean in praxis after Cyclone Idai. From a pragmatic standpoint, this will be an important feature of interventions that seek to create more responsive social and ecological landscapes rooted in existing knowledges around which change can most feasibly be mobilised.

Identified problems can be addressed using technical and non-technical solutions. For example, in some instances, soil and water conservation works are required at different scales and would be particularly effective on-farm and at landscape-scale, working to scale-out and join these up across the watershed to reduce on-farm, landscape, and downstream impacts. In all cases, social processes are called for e.g. encouraging people to work collectively to participate in landscape level challenges, resource governance strategies and/or to realise required policy changes that otherwise incentivise destructive practices. Solutions need different scales, geographical, temporal and institutional. In temporal terms, timelines for addressing the myriad problems differ. Some problems can be solved in a season (e.g. restoring some of the lost seed) while others are considered to require 5-10 years (e.g. restoring degraded riverine production systems). Institutionally, different actors need to come together and address the problems brought about by the cyclone.

To deal with the landscape challenges brought about by the cyclone, residents need local alliances and with outsiders like state and NGO extension staff as well as researchers. Traditional leaders can help steer local initiatives to address these challenges. In most cases land distribution and enforcement of regulations can be undertaken more effectively and equitably by empowered local authorities including traditional leaders. However, these would first need to rebuild the trust of their land and resource users by initiating transparent and inclusive processes for planning and engagement if these are to be managed successfully. Otherwise, it is anticipated that land and resource conflicts will only increase, and resources will be further degraded, thus increasing social vulnerabilities to already high levels of disaster risk.

In terms of soil and water conservation measures farmers (both AE and CF) in all the wards are adopting layers of recommended options, such as contour ridges and swales. However, some are practicing both AE and CF often on different plots. A deeper understanding of this latter group is important in understanding and encouraging more effective agroecological transitions. Study findings demonstrate that AE fared better during the Cyclone Idai disaster, the extension message can be repacked to make a strong case for a widespread transition to AE.

This study clearly points to the benefits of agroecological farming systems in fragile and at-risk environments to stabilize land and create more resilient landscape and livelihoods. Indeed, within this study, both farmers and extension workers called for approaches that are more applicable to changing local conditions. Taking agroecology to scale would require commitment from Agritex to skill up its extension workers, officers and supervisors across the board. It is possible to see from farmers' recommendations here, that systems of co-learning that incorporate farmer's knowledge and encourage observations, would go some way towards creating more resilient food and farming landscapes.

A starting point would be to better value, and to connect up home-grown agroecological initiatives that have been working on local seed systems in Chimanimani, and others such as the Regional Seed and Knowledge Initiative and joint FAO/ Gene Bank Local Seed Restoration Project, and Fambidzanai Soil Testing Initiative. Such layering and sequencing would ensure continuity and complementarity and generate data for further capacity development and scaling. The Gene Bank, for example, can engage local resource users in

restoring lost local seed which was collected and stored in the national gene bank before the cyclone. Related is the need to continuously monitor and document unfolding processes affecting farmers in the district, particularly supporting adaptation to an emerging ‘new normal’ associated with climate change and the likelihood of ongoing novel viral pandemics. A longitudinal study in the district will yield rich data sets that provide important nuances about how households adapt and adopt innovative strategies to climate change-induced disasters and other pandemics.

Chapter 6: Cyclone Idai, Livelihoods, Political Economy and Governance in Chimanimani District

6.1 Introduction and Research Approach

The focus of this section is on the circumstance that lead people's vulnerability, the drivers for economic activities and the natural resource conflicts in the district prior to Cyclone Idai. It focuses on the livelihoods, political economy and governance causes of the impacts of Cyclone Idai. The major study objective was to analyse the impact of Cyclone Idai by identifying its multiple causes and recommend policy and action options for mitigation, adaptation and emergency responses in case of recurring tropical cyclones. This component of the study interrogated how 'pre-existing livelihood, political economy and governance situation' shaped the impact of the cyclone-induced disaster in Chimanimani. The specific research questions related to whether i) the pre-existent factors and processes were changing and how, and ii) the lessons extracted already or those that could be harvested for application in Chimanimani District and other African Mountain ecosystems. Studies show that these ecosystems require urgent action and protection from climate change induced disasters and mitigate the human risk from these extreme events (EAC et al 2016). Essentially, integrating climate change adaptation practices into relevant policies, plans and strategies in contexts of weak governance systems has become urgent, though it is often given little more than lip service.

In framing the study, livelihoods were conceptualized as comprising 'people, and their capabilities and means of living, which include food, income, assets, and resources (Chambers and Conway 1991; Scoones 1998; Krantz 2001; Mushongah and Scoones 2012; Mugabe et al 2012, Chitongo and Casadevall 2019). The variable contexts that affect relevant capacities and means are dynamic. This explains the need for appropriate regulatory regimes overseeing the processes by which people make a living (Krantz 2001). The framing of the research questions was influenced by concerns raised by Chimanimani district (at the time they developed the overall research project). Key amongst these concerns were i) circumstances leading to people (that became vulnerable to the disaster) settling where they are, ii) drivers of economic activities attracting migrants from other parts of the district and from outside, iii) factors behind non-movement of people from sensitive areas particularly around the Skyline Area, iv) unresolved land and natural resource access conflicts, and v) complexities of district and community-based governance institutions as well as their vertical and horizontal interactions. Importantly, these concerns pre-existed Cyclone Idai. They had been the subject of facilitated engagements leading to a Climate Change Response and Watershed Management Policy (Chimanimani RDC 2017), which:

> '… covers six priority areas…[of] governance and climate change mainstreaming, sustainable land use planning, eco-system integrity and water source management, education and research, settlement and physical infrastructure. The protection of watershed areas is also crucial to the policy' (Chimanimani RDC 2017:4).

The Policy identifies two threats to Chimanimani's sustainable development. These are climate change and poor watershed management (ibid). Clearly, the focus on sustainable development underpinned by good governance exercised the Policy's framers. Additionally, evidence for decision-making was given importance. It is within this construction that the study operationalized to explore the intersection of livelihoods, political economy and governance concepts mindful of the understanding amongst Chimanimani's governance institutions (coalescing around the Council/local government) and actors that livelihood sustainability was threatened by climate change and poor watershed governance.

Policies, laws and administrative practices positively or negatively impact on livelihoods and income streams or residents. A community's assets and its overall capacity are context-dependent and framed by political relations (Fraser and Kirbyshire 2017) and micro-macro linkages through which policies are defined and

executed by different actors (Goldman et al 2000). Whereas 'policy coordination in multilevel and multi-sector settings is not new' (Rohdewohld 2017:2), the study acknowledged the enhanced complexity arising from the Cyclone Idai response.

Governance (World Vision 2018) determines livelihood choices and their sustainability by regulating access to key livelihood resources like natural, physical, financial, human and social capital (Scoones 1998; Goldman et al 2000). Political relations are critical to framing and administering social and economic policies (Fritz et al 2009) including existing and new spaces for engagement between stakeholders (Fraser and Kirbyshire 2017). Governance and political economy analytical models, that include the problem driven (Fritz et al, 2009) and Applied Political Economy Analysis (Cammack, 2016), among others that focus beyond the façade of formal institutions to structural and historical factors that affect community governance were adopted for this study (DFID 2009, Hout 2015). This livelihoods-governance lens was used to explore livelihoods trends before and after the cyclone and how the governance structures and dynamics aided or hindered the community and its leadership`s ability to bounce back from the disaster.

6.2 Policy and Technical Institutions in Chimanimani

Chimanimani rural is one of the 10 local governments in Manicaland Province (seven rural and three urban). Chimanimani Rural District Council has 23 wards with 19 elected councilors affiliated to both ZANU PF and MDC in the 2018-2023 Council. These wards fall into the six Chieftainships of the district. Council and traditional leaders co-govern the district guided by the Rural District Councils and the Traditional Leaders' Acts, the Regional, Town and Country Planning Act and the Communal Lands Act. Constitutional provisions define the role of Council as representing and managing the affairs of people while traditional leaders are assigned cultural, customary and traditional functions as well as facilitating development (Government of Zimbabwe 2013).

At district level, the delivery of local governance functions is aided by i) the rural district council, ii) national government through ministries and state-owned enterprises, iii) headmen and village heads), iv) civil society organizations (CSO), and v) the district corporates. The capacity measured in terms of actual numbers of these technical support institutions or their staff and other resources at district level varies. For instance, Chimanimani District had 28 CSOs in 2017, 22 in 2018 and 45 in 2019 suggesting an average of 32 per financial year. Similarly, the national government institutions operate at different levels and some have technical staff at ward level. These include Agricultural Extension Workers, educators, health personnel and Ward Coordinators. Equally, CSOs establish project-based or community-level liaison structures operating alongside farmer, business associations and clubs.

These various organizations interact with Council and traditional leaders through assemblies and committees at village, ward and district levels for purposes of development planning and management. The district and government institutions are supposed to speak to national policy, run national programs and administer various initiatives aligned to broad development objectives. However, at the time of fieldwork in February 2020, Chimanimani had no District Development Plan and was making efforts towards preparing one. The 2017 Climate Change and Watershed Management Policy and the post-Cyclone Idai Recovery Plan constituted the only district-wide development management frameworks. This lack Development Plans mirrors experiences of other districts, provinces and national level, suggesting sub-optimal local governance processes and structures including funding instruments for preparing and implementing plans. Further, the coordination of the Cyclone Idai response in Chimanimani was through the Civil Protection Unit under direct national government supervision, which suspended local government procedures and complicated power matrices in terms of the vertical and horizontal relations for/of coordination.

6.3 Population and Economic Structure

In 2012 Chimanimani had 134 940 residents comprising of 43.8% under 15 years, 51.9% between 15 and 64 and the remainder 65 years and older (ZIMSTAT 2012). Based on the population figures and the total land area of 3 345 km2, the district population density was 40.35/km^2. The district has all the agro-ecological regions in Zimbabwe (Box 6.1) and the dominant commercial sector is forestry. Apart from agriculture the district has commercial and artisanal small-scale mining operations that include diamonds in Ward 12, gold in Wards 12, 16, 21 and 22 and lime in Ward 7. Influenced by the performance of the national and provincial economy, the district's economy has not diversified from the agro-ecological conditions. For instance, Box 6.1 shows that the potential of each agro-ecological region dictates the main livelihoods. Fruit, crop and livestock production dominate the district and emerging urban nodes such as Ward 15 that has employment and trade/vending dependent livelihoods. In the drier parts of the district residents, access productive land in micro to medium-scale irrigation schemes, engage in livestock production and off-farm economic activities such as handicraft making, small-scale manufacturing, building and community-based income, savings and lending schemes.

Box 6.1: Ward-based Household Economic Structure

Ward	Source of Income (%)				
	Fruit Agriculture	Agricultural Crops	Livestock	Other Income	Total
1	5	60	25	10	100
2	2	12	56	30	100
3	2	12	56	30	100
4	12	60	15	13	100
5	1	13	55	31	100
6	12	13	60	15	100
7	3	80	13	4	100
8	4	20	40	36	100
9	3	30	50	17	100
10	4	86	2	8	100
11	2	88	3	7	100
12	1	88	6	5	100
13	10	80	1	9	100
14	1.5	30	0.5	68	100
15	0.5	2	4	93.5	100
16	20	23	8	49	100
17	13	4	30	53	100
18	4	6	21	69	100
19	8	4	40	48	100
20	0.5	1	59	39.5	100
21	94	2	0	4	100
22	94	2	0	4	100
23	94	2	0	4	100

Source: AGRITEX Chimanimani, February 2020

6.4 Status of pre-Cyclone Idai Livelihoods

This sub-section discusses the livelihoods and governance systems of the Chimanimani District in the pre and post Cyclone Idai phases. A baseline study by Practical Action (2015) in wards 6, 7, 11, 16 and 20 found over 70% decrease in crop yield per unit area. Similarly, AGRITEX statistics for the periods 2016/17 to 2018/19 show a consistent drop in the outputs for the main crops grown in Chimanimani (Table 6.1). During the same period, households recorded food (crop and livestock) insecurity of about 49% in 2017, 50% in 2018 and 32% in 2019.

Table 6.1: Main crop outputs

Main Crop Outputs in Tonnes in 3 years before Cyclone					
Crop	**2016-17**	**2017-18**	**% Change**	**2018-19**	**% Change**
Maize	19999	17587	(12.1)	8565	(51.3)
Sorghum	1904	1262	(33.7)	885	(29.9)
Pearl Millet	1019	138	(86.5)	17	(87.7)
Finger Millet	192	10	(94.8)	28	180
Groundnuts	970	511	(47.3)	59	(88.5)
Sugar Beans	266	446	67.7	211	(52.7)

Source: AGRITEX Chimanimani, February 2020

Focus Group Discussion sessions and key informant interviews suggested that erratic rainfall seasons, economic hardships are leading to input access challenges and land access issues that constrain production. Additionally, the farming seasons were reportedly changing and difficult to predict resulting in farmers planting either too early or too late and often without the right seed varieties (see section 3.2 of this paper). As such, the existing livelihood activities saw loss of natural resources such as tree cover even before Cyclone Idai. For instance, Mugabe et al (2012) observe settlers at Nyabamba A1 Resettlement Area who cleared 600 to 700 hectares for agriculture reducing forest cover by about 70% between 2000 and 2009. These settlements negatively impacted on commercial forestry (pine and wattle) as well as plantation crop sector at times resulting in conflicts (Hughes 1996; Mambondiyani 2017; Verheecke et al 2019). The economy of Chimanimani has thus undergone some structural fracturing over time. The fractures include contemporary as well as centuries-old grievances whose resolution, or at least their attempts have triggered strategic fallouts at local, regional and national levels. Key informants confirmed existence of land conflicts around the Skyline area affecting key operations of commercial foresters and other largescale farming enterprises. Further, as a source of major rivers conflicts and associated poor land stewardship in the Skyline area has far reaching environmental and economic sustainability ramifications.

6.4.1 Effects of Cyclone Idai on Livelihoods

Figure 6.1 shows the income sources of the survey respondents that were used as a proxy on the livelihoods impacts of Cyclone Idai. The dominant source of income in the district is agriculture, especially cash crops followed by trading at 15% and a joint third for fruit farming and formal employment at 13%. Minor income sources include remittances, sawmilling and alluvial mining.

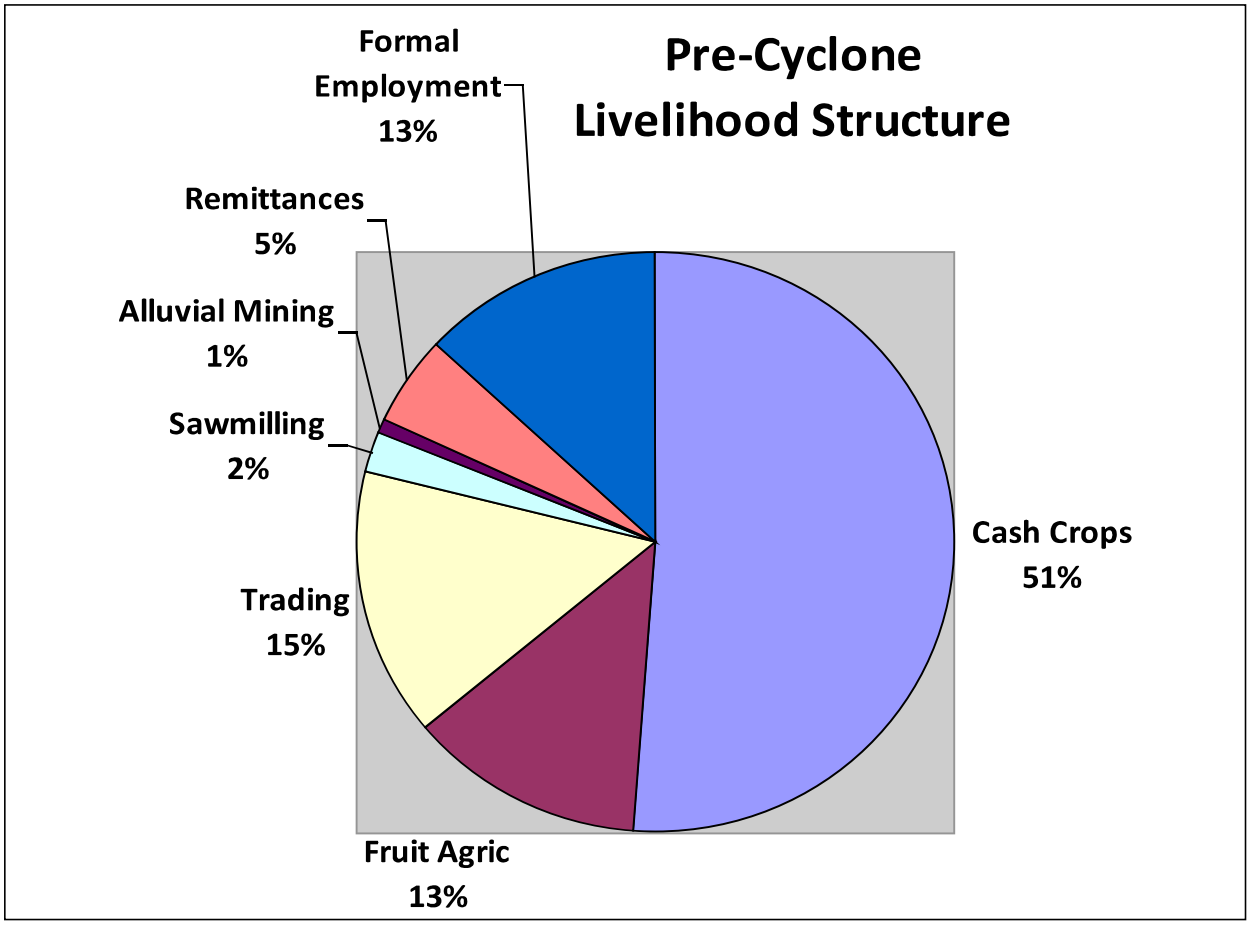


Figure 6.1: Income sources/livelihood structure (Source: Fieldwork, February 2020)

However, the residents' livelihoods were degraded by the cyclone. Survey respondents reported losses of fields with crops and fruits constituted (50%) followed by grain (20%), livestock (13%), farming equipment (7%), and business goods and assets (10%). Based on these statistics, agricultural-related livelihoods experienced the greatest losses. In monetary terms, about 33% of the respondents estimated that their losses ranged from USD301 to USD500. This loss of assets triggered changes in livelihood portfolios for households. However, estimates of losses by communities were undervalued. For instance, World Bank et al (2019) estimated production loss at USD135 284 780 out of which the major losses were maize, bananas and pineapples. Chatiza (2019:19) elaborates 'that 45% of arable and 105 hectares of grazing land were damaged and 348 cattle, 17 000 chickens and 222 goats and sheep were reportedly lost in Chimanimani'.

Specific cases show the magnitude of vulnerabilities of farming communities. A headman-cum-farmer only harvested 5 tonnes from his farm that normally produced 16 to 19 tonnes of maize in the 2018/19 and expected 7-9 tonnes in 2019/2020 season (Key Informant Interview, February 2020). Equally, the Rusitu Valley Fruit Growers Trust, with a membership of 1000 farmers experienced a dip in their produce because of the Cyclone. The post-cyclone weekly throughput from wards 16 and 21-23 for deliveries to Harare, Chitungwiza and Bulawayo dropped by 75% from 120 to 30 tonnes due to a combination of access constraints, disarrayed producers and lost harvests. Additionally, new fungal infection for bananas and heavy leaching were reportedly affecting crops reducing productivity and short to medium term output (ibid). From this experience, most farmers who lost field crops, fruit trees, livestock, land and other farming assets may take many seasons to recover.

6.4.2 Cyclone Idai's Impact on Businesses

The corporate sector incurred considerable losses with a bearing on the economy and livelihoods for workers as well as up and down-stream industries connected to their operations. For instance, the forestry sector recorded losses worth USD500 000 for the Wattle Company, and Allied Timbers lost USD4.5 million. Estate agriculture firms like Makande lost 350ha of maize worth USD0.8 million, USD0.2 millions of macadamia nuts and USD0.04 millions of avocados. Equally, Ariston Holdings' operations in Chimanimani lost about USD1.5 million. The disruption to big and small businesses in Chimanimani had a knock-on effect on the local economy. People lost permanent and seasonal employment opportunities and the local economy shrank. The small businesses felt serious shocks in the immediate aftermath of Cyclone Idai. Tuck-shops, retail shops, small-scale sawmills contracted by Border Timbers Limited and Allied Timber in Chimanimani East, the transport sector and wholesalers were affected by Cyclone Idai (FGD at Biriiri, December 2019). Cyclone Idai also induced rains that destroyed beekeeping businesses in the district.

Given the magnitude of the loss, the recovery after the cyclone was slow. The challenges for business bounce back included i) road access constraints that took long to unblock, ii) lack of funding to help businesses recover (for instance, the local CBZ branch was closed for up to 3 months), and iii) fuel shortage, high prices and a generally constrained delivery of goods due to bad roads. The disaster induced constraints and macro-economic environment will delay the ability of the business in the district to bounce back. National government had no rescue plan for the businesses. Further, Chimanimani RDC had little control over the key economic sectors of mining, small to medium sized enterprises (SME's) and forestry to such an extent that they virtually yield to power to resolve conflicts between farmers and miners. There was a perception that resources disbursed had been inequitably distributed as they were not enough to cover all submitted claims. It is also a source of evidence enhancing the believability of corruption claims surrounding the management of Cyclone Idai goods and funding. This governance reality is a key strain to livelihoods as discussed in the next section.

6.4.3 Pre to Post-Cyclone Institutional Capacity Issues

The disaster induced infrastructure damage demanded pragmatic responses. However, some recovery projects, for instance, construction of toilets for schools were delayed because of lack of fly screen, supervision and commissioning by the responsible Ministries. Though these were genuine requirements, the bureaucratic practice led to comments by stakeholders that `following the book` rather than practical approaches was blocking recovery efforts. However, stakeholder discussions at a CPU meeting attended by the research team resolved that the toilets must be used, observing that Cyclone Idai was a disaster warranting adjustment of institutional behaviours or approaches. This experience also showed limited decentralisation of the necessary functions including the building of capacity of those who put up and handed over the facilities locally.

The study noted and painted the contours of capacity strain and development management fissures seen in inadequate coordination. A district state official observed that, '…for the few days that I have been here it is difficult when you have numbers of non-state agencies greater than government departments and workers. When you have more partners competing for you, for instance we have more than 15 to 20 programs daily… [it is difficult] to know and support them as one office and one official. As government we will then be compromised' (Key Informant Interview, February 2020).

The capacity constraints gravely affected agencies involved in Cyclone Idai response and the recovery phase. For instance, only one out of seven agencies that completed a capacity assessment reported that they had highly motivated staff. Further, across the seven agencies, the planning and coordination functions were wobbling. For instance, the office of the DDC, though charged with coordination had limited mobility (vehicles) to carry out its functions. For public sector agencies operational resources critical for outreach or extension were not available. There was also a feeling that partner priorities were not matched to real needs.

For instance, some NGOs that came to the district in 2019 with cyclone-related interventions had not reported on their work. Again, while government institutions preferred prioritizing the relocation of IDPs from tents they lacked the capacity to do so. This was contrasted by one key informant with NGO support for psycho-social support for the same IDPs at workshops in hotels.

In terms of land use planning and management the unresolved nature of streambank cultivation was also another area indicative of capacity gaps of the key environmental institutions at district levels and lower. The interpretation of existing by-laws and guidelines on streambank cultivation was heavily contested partly arising from the lack of context behind the 30m guideline. Some farmers argued that river courses are widening and thus shifting towards people's fields and homes displacing them and their livelihood activities. Other farmers cited the sustainable utilisation of wetlands over generations noting importance of the choice of agricultural activities including *madhumbe* and *magogoya* which are traditionally cultivated along stream banks. These experiences warrant a critical evaluation of existing by-laws that are often implemented without proper reference to local contexts.

6.4.4 Institutional Disharmony, Policy Inconsistencies and Incidences of Corruption

Besides operational limitations, state actors work within a context of policy inconsistencies as well as varying institutional incentives and value bases. Some of these inconsistencies arise from contradicting statutory instruments. For instance, spatial/physical planning was cited during interviews in terms of the roles of the Ministries responsible for local government and that for lands. The Ministry responsible for lands plans and allocates land at business centres in resettlement areas a function Councils contest as their role. The Departments of i) Public Works and ii) Spatial Planning and Development both in the Ministry responsible for local government also overlap in the planning processes for Nhedziwa Business Centre where some people displaced by Cyclone Idai will be settled. Further, conflict also occurs between Council and traditional leaders especially at Growth Centres where the latter allocate land just outside designated boundaries complicating future expansion of these centres. Harmonisation of the functions of hereditary and elected political leaderships not just in Chimanimani is another area of conflict.

Traditional leaders through local rules and regulations have had a longstanding presence in local governance (Chidhakwa, 2003; Kujinga et al., 2012; Mapira et al., 2013). Their role was observed as strong in natural resource management and land allocation. They are also guardians of culture and societal values. However, the emerging need to appease the Spirit Mediums, as perceived after the Cyclone Idai disaster is often not mainstreamed in district programs but quickly organised to tick boxes. Thus, traditional leader`s roles in development remains contested and peripheral.

Growing awareness of 'human rights' has resulted in residents asserting their power eroding the authority of the traditional leadership. There are instances where some residents have taken traditional leaders to formal courts where local byelaws are not fully recognised. As a result, traditional leaders feel that formal courts tended to favour those reporting than defending the common good, which they represent. One traditional leader argued, 'We are getting tired of being asked to attend court cases as this weakens our role' (Key Informant Interview, February 2020). These experiences weaken the traditional leaders. However, the study shows that their legitimacy was somewhat boosted by the disaster with stakeholders rethinking their role in local governance.

Chimanimani RDC has very little to no control over the economic levers within the district. Mining, land and agriculture, small to medium sized enterprises and forestry (timber) are controlled by national government agencies. As such, the local authority is unable to fully regulate these sectors let alone resolve land use conflicts for instance between farmers and miners. In the mining sector artisanal and small-scale miners are licensed, evicted and permitted to resume operations often in very unclear circumstances with Council a mere spectator. Security forces tasked with policing mining areas 'bring in their people corruptly'. The role of coordinating development actors is also undertaken by national government. Resources to remunerate those

involved in the response were not distributed equitably and transparently prompting victims of the unclear processes to allege corruption on the part of the Human Resources Committee (in the Office of the District Development Coordinator). The non-production of records despite repeated requests during Civil Protection Unit meetings enhanced the perception of corruption surrounding the management of the Cyclone Idai response.

6.5 Conclusion

Cyclone Idai hit a fragile social and political economy. That the key sectors were not performing well at all levels for nearly a generation resulted in key pillars of the local economy like forestry and largescale commercial agriculture as well as smallholder farmers experience serious losses. The stresses in Chimanimani's social and political economy dislocated key livelihood activities undermining whole-of-economy sustainability and institutional relations. District level local governance institutions were unable to track, influence and take account of micro-to-meso economic trends in their decision-making. For years livelihoods were inadequately supported by government and community institutions even during the Cyclone Idai response. Allocation of land for agricultural activities and homestead establishment did not follow established rules resulting in some homes and farmlands being inappropriately located.

The study also showed that independent Zimbabwe's cumulative layers of policies, laws and local to national organizations have been created or emplaced without sufficient analysis of how they work in practice. This inattention has caused institutional contradictions that compromise performance in the face of ever-evolving development challenges. Before and since Cyclone Idai, external development agencies have not built the capacity of local governance institutions, yet they have worked in numbers that are unwieldy placing demands on a frail coordination system that also lacks development plans. Disarrayed and under-resourced state agencies that await devolution implementation and general capacity building necessary for them to perform effectively thus continue to be strained.

The findings of this study evidence the need for a follow-on analysis for purposes of informing an appropriate set of policy and practical responses based on a shared understanding of the district economy regarding what its strains are including unresolved conflicts over land, performance and relations amongst key institutions, strategies tried previously, and policies needed given that climate change-induced risks remain.

Chapter 7: Cyclone Idai's Impact on Topography, Infrastructure and Settlements

7.1 Introduction and Research Approach

This component of the study assessed the impact of Cyclone Idai on the topography, infrastructure and settlements in Chimanimani. Cyclone Idai ripped through the landscape of Chimanimani District leaving many people homeless, the road network damaged and other infrastructure destroyed. The event was described as a 'once-in-a-lifetime' occurrence whose scale of impact left many residents traumatized and searching for answers. Reports of extensive damage to critical infrastructure, including roads, WASH infrastructure and education and health facilities were recorded (UNICEF 2019; OCHA 2019; Africa Daily Voice 2019). Much of the local electricity transmission infrastructure as well as communication lines were destroyed in Manicaland and Masvingo provinces, affecting service provision. The power supply across the flood affected areas was cut off or disrupted (BBC 2019; OCHA 2019; Reuters 2019). Blocked roads and damaged bridges left people stranded in Chipinge and Chimanimani districts. Limited movement hindered trade to neighbouring Mozambique (ZBC 2019; ERCC 2019; Al Jazeera 2019; The Standard 2019).

During initial scoping visits to the district residents often asked where the massive boulders (up to 5 meters in diameter) that had washed up during the cyclone came from. They wanted to understand how and why the cyclone hit Chimanimani with such force. An important aspect of this research was attempting to provide some answers to communities in the District. The component's overarching question related to how Cyclone Idai impacted topography, infrastructure and settlements in Chimanimani. The specific questions were as follows:

- What was the spatial distribution of Cyclone Idai's impacts on infrastructure and settlements?
- How does the geology, slope and forest cover contribute to the landslide risks?
- Which areas are particularly at risk to cyclone induced floods?
- Which settlements and infrastructure are more at risk to tropical cyclone induced hazards?

The research approach taken involved a physical inspection of the landscape and geology of the district focusing on the most affected areas in combination with GIS Mapping/Remote Sensing work. In addition, damage to infrastructure and human settlements was surveyed on the ground. An assessment of the ongoing construction work to rebuild the district was conducted as well.

7.2 Cyclone Idai's Impact on Infrastructure

The infrastructure in Chimanimani was devastated by Cyclone Idai. Communities were displaced and the road network severely damaged. Effort put by the Ministry of Transport to resuscitate the road network continued from the immediate aftermath of the disaster in March 2020 through early 2020 for the major Skyline-Chimanimani Village Road to be opened to traffic for instance. The Ministry of Transport contracted three contractors namely i) Masimba Construction, ii) Bitumen World, and iii) JRG Contractors to repair sections of the road network and bridges while the Government of South Africa through its army assisted with two bridges at Kopa. The following narrated pictures (Figures 7.1 and 7.2) detail the team's observations about the progress and challenges of infrastructure rehabilitation in the district.

Figure 7.1: Concerns over perceived poor workmanship and materials

The sheer volume of work and its complexity given the terrain resulted in stakeholders complaining in terms of delays and quality of work. During fieldwork some stakeholders observed that the materials being used were substandard and on other works one could use a finger to scratch loose dry mortar on bridges (Figure 7.1). For bridges and related structures, embankments were not well reinforced and some works which were declared complete still looked incomplete as structures like rails were missing on key bridges. Some rocks were still falling from the cliffs along the roads which have been opened for use (Figure 7.2).

Figure 7.2: Rocks still falling off road cliffs and bridges

7.3 Impact of Cyclone Idai on Human Settlements

The cyclone devastated many settlements and up to the time of fieldwork (early March 2020) many displaced people were still living in tents. Living in temporary tents had a demoralizing effect on many people. Furthermore, those displaced persons were at a higher risk of communicable diseases as their stay prolonged. In terms of the cyclone's impact on settlements, three major hotspots were identified. These were Ngangu, Kopa and Peacock settlements. In these areas, many lives were lost.

Proposals of potential areas for resettling displaced communities included Bumba, Nhedziwa, Chikukwa and the Ngangu plateau. Due to challenges with many of these proposed settlements which range from resistance by the existing land occupiers, lack of water resources and difficulty to clear land due to existing vegetation/plantations only Nhedziwa was found to be suitable for resettlement. However, the research team observed that the proposed settlement at Nhedziwa Growth Point is going to be predominantly within a wetland and very vulnerable to flooding (Figure 7.3). The research team found Bumba ideal for resettlement if the land ownership issues are resolved.

Figure 7.3: Wetland area in Nhedziwa earmarked for resettlement

7.4 Spatial Mapping Cyclone Idai's Impact

It was imperative to get a bird's eye view of the district before and after the cyclone in order to map the damage caused (Figure 7.4 and 7.5). Sentinel-2 (10m resolution) true colour satellite imagery was used from February 2019 and April 2019 for the before and after data. Flooding and landslides were digitized manually by comparing before and after images (Figure 7.6). While it was fairly obvious to observe the cyclone damage by eye, this method was considered to be too dependent on the observer's skill and potentially flawed because of observer biases. A more automated approach perhaps combined with some manual quality checks was used. A lesson learnt was that manual digitization is fairly quick and very simple. As such, it is an approach that can easily be replicated in future using free GIS software. Currently Sentinel-2 data is available without cost from the US Geological Survey at (https://earthexplorer.usgs.gov/) and was relied upon for this study.

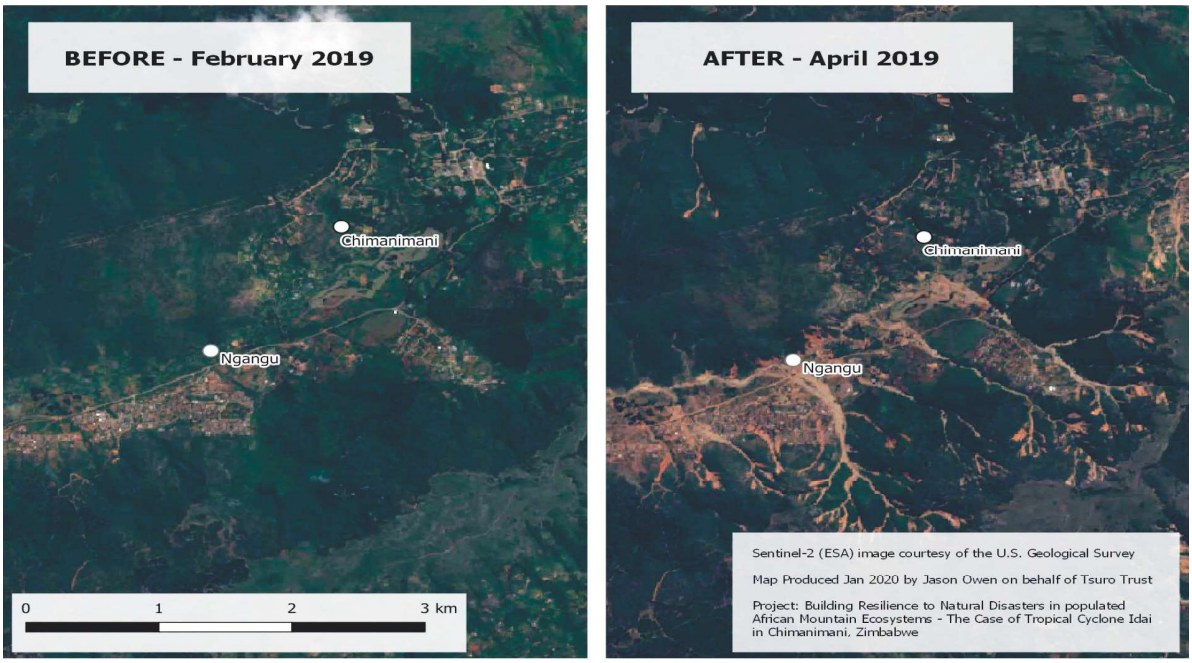


Figure 7.4: Landscape images before and the Cyclone, Nyahode River at Kopa

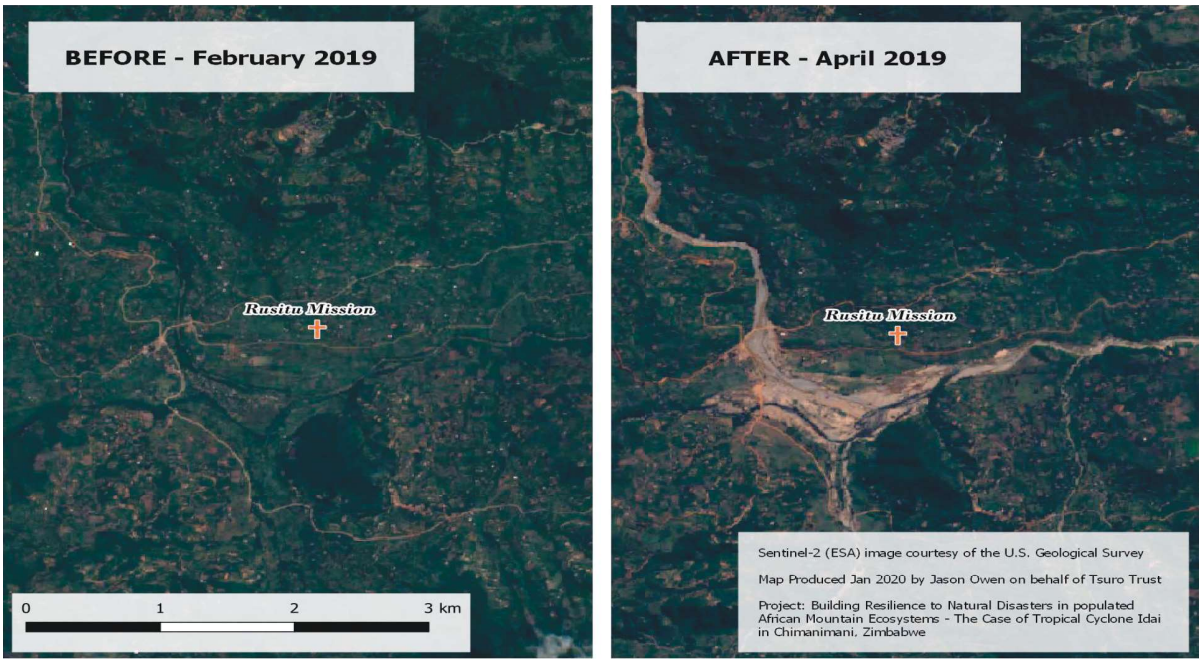


Figure 7.5: Landscape images before and the Cyclone, Ngangu Township and Chimanimani Village

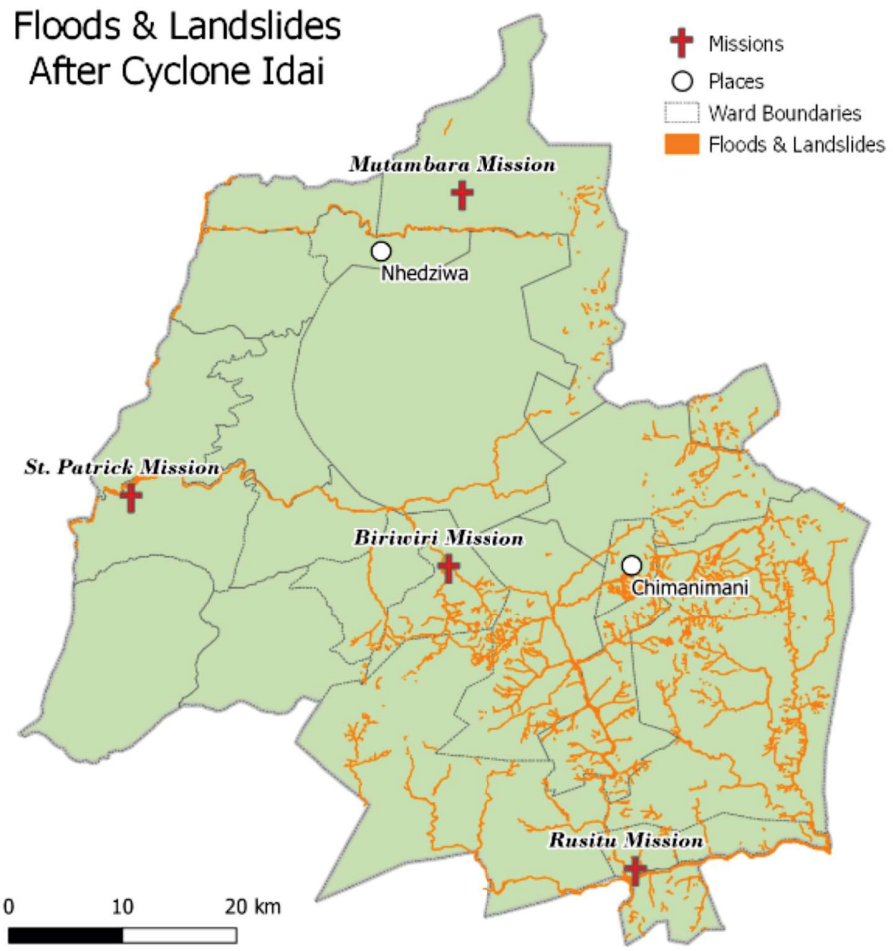


Figure 7.6: Digitized spatial distribution of floods and landslides

Most damage occurred in the South-East of the district. This map combines sites affected the most in terms of floods and landslides. During fieldwork the team was able to observe that many landslides could more accurately be described as debris flows that occurred when large volumes of water flowed rapidly down mountain slopes transporting massive amounts of material and large boulders along a ‘path of destruction’.

Table 7.1: Total area damaged by Cyclone Idai

Ward Number	Ward Area Estimate (km^2)	Damaged Area Estimate (km^2)	As a % of Total Ward Area
15	31.167	2.5	**8.0**
13	101.438	6.5	**6.4**
23	42.965	2.2	**5.2**
21	24.741	1.2	**4.8**
17	76.523	3.2	**4.2**
12	466.325	18.8	**4.0**
14	186.752	7.3	**3.9**
22	36.055	1.0	**2.7**
10	37.878	0.8	**2.2**
8	114.367	2.2	**1.9**
16	362.603	6.7	**1.8**
11	189.218	2.6	**1.4**
2	58.971	0.7	**1.3**
18	71.705	0.9	**1.3**
9	81.255	0.9	**1.2**
1	317.611	2.3	**0.7**
4	52.504	0.3	**0.5**
5	117.512	0.5	**0.4**
7	458.608	1.7	**0.4**
6	89.93	0.3	**0.3**
3	102.939	0.3	**0.3**
19	129.471	0.1	**0.0**
20	194.059	0.0	**0.0**

7.6 Examining the Geological Causes of the Landslides

Two landslide mechanisms that occurred during the cyclone were identified. These were Classical Slope Failure and Large Debris Flow. Classical slope failure involves a mass of soil sliding along slope during failure. This appears to be the case in the Rusitu area deeply weathered soils became saturated with water and slid/failed (see also section 3.2 in this paper). These failures could have been associated with the risk factors of i) steepness of slopes (perhaps greater than 75%), ii) large area of steepness, and iii) landcover loss due to deforestation. In all instances this was dependent on the amount of rainfall leading up to a landslide.

Large debris flow refers to intense runoff from quartzite mountain tops along drainage channels. The effect of eroding shallow soils and picking up dolerite and quartz boulders following massive rainfall results in immense flow power. Some of the large rocks that are picked may deposited along the landslide channel and eventually in a wide flat “fanglomerate” area but while in motion the large rocks have with exacerbating erosion and at times damaging to vegetation and infrastructure. These types of slides flow in topographic depressions, somewhat similar to a river. Since these slides tend to be confined to depressions, this provides a key to landslide hazard mapping.

Debris flows could have been associated with associated with risk factors of i) steep slopes (perhaps greater than 75%), ii) quartz mountain tops with shallow soils, and iii) drainage channels coming down from steep quartz mountains with potential for separate debris flows to join into single flow linking drainage channels. Though mapping work is set to continue the Topographic Wetness Index (TWI) has been identified as an important tool for mapping drainage channels associated with landslides (Figures 7.7 and 7.8). TWI is a measure of “wetness” that shows where in a landscape water flows and accumulates. It matches up very well with the path of the landslides as shown in the figures that follow.

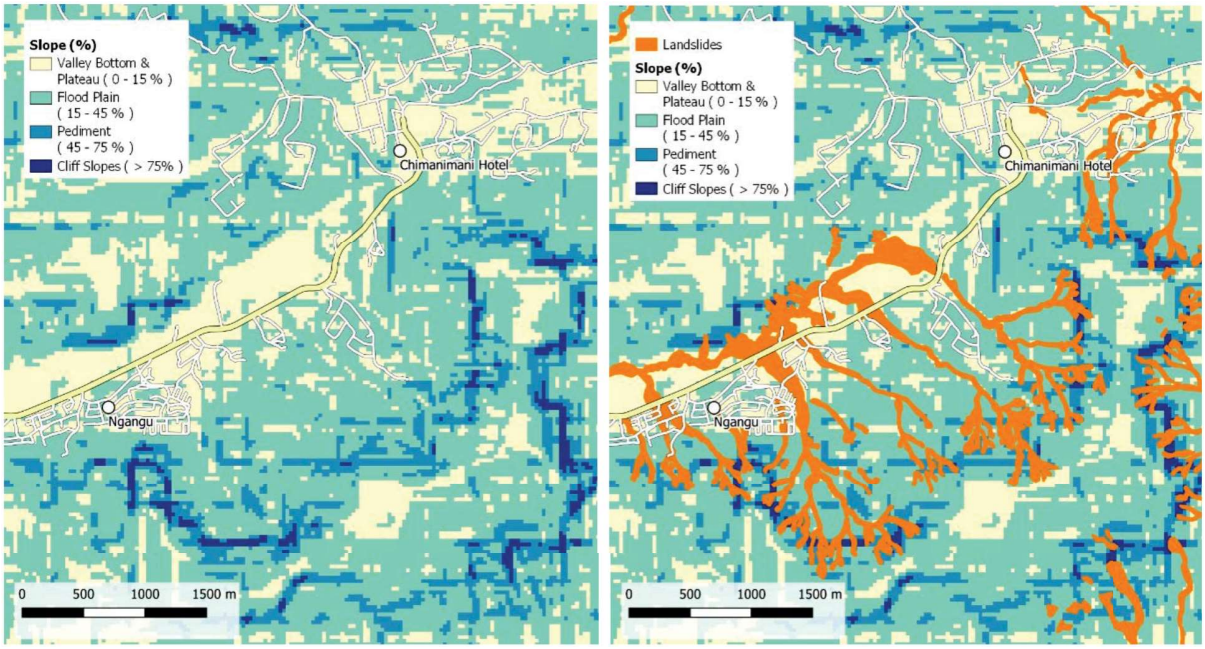


Figure 7.7: Maps of Chimanimani Village showing slopes

In the maps in Figure 7.7, darker colours correspond to steeper slopes and these corresponded with the areas where landslides occurred under the influence of Cyclone Idai (in orange). The maps show that landslides began in the steep slopes of the mountains and flowed down to the valley bottom in a fluviatile fashion

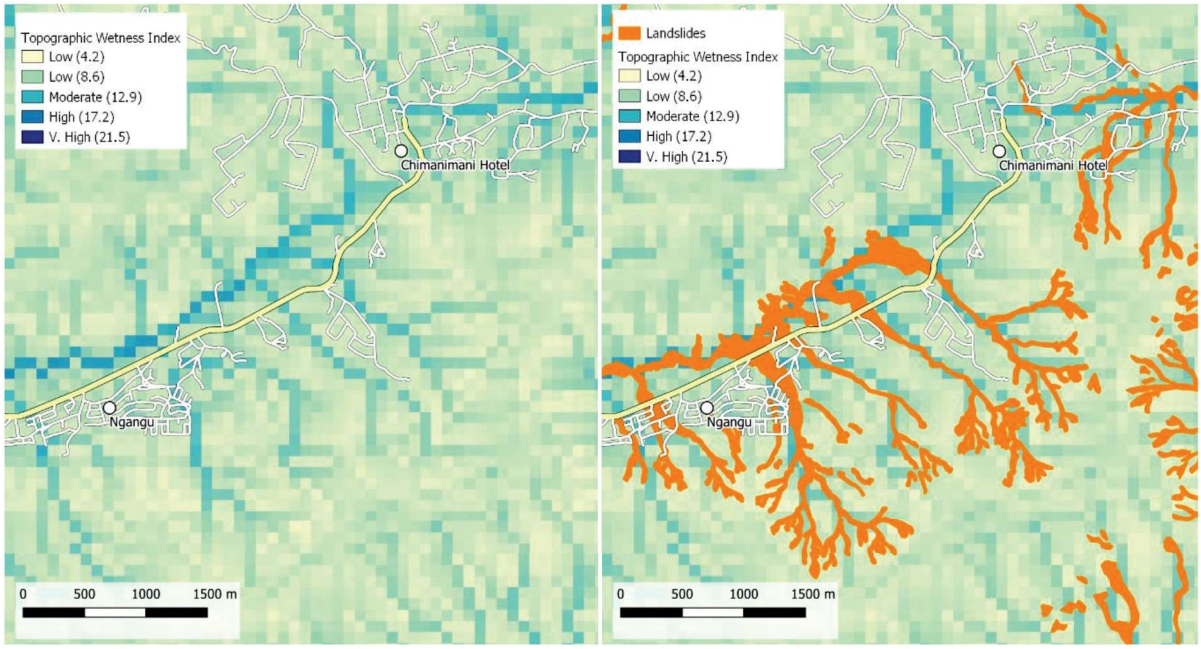


Figure 7.8: Topographic Wetness Index (TWI) Map, Chimanimani Village.

TWI picks out the depressions and drainage channels that the landslides followed (Figure 7.8). It is clear that slope and TWI data are powerful tools for mapping landslide risk.

7.6 Questions from the Community and Stakeholder Responses

“Akaputika” – water was bursting through the ground

Many communities observed that water “burst through the ground” during the cyclone. We believe that this is indeed possible, and we propose a mechanism where brittle fractured highly permeable quartzite is overlain by dense soft impermeable shale. During the cyclone, huge volumes of water infiltrated into the joints and bedding planes in the quartzite but could not readily discharge due to the impermeable shale capping. Pressure would have built up rapidly until the sheer strength of the shale was exceeded, resulting in catastrophic failure with water and debris exploding or “bursting through” the land-surface as described by eyewitnesses. The explanations for communities were that mermaids pressured the water through crevices as a sign of their anger

Where did the large boulders come from?

Many residents reacted with shock at the size of the boulders that appeared in their communities after the cyclone and wanted to know where such massive rocks came from. As outlined in the geological assessment of the flooding and landslides, the massive volume of water flowing down mountain slopes generated enough stream power to erode large channels in the mountainside, picking up soil, trees and very large boulders along the way. As this torrent of water, mud, and debris flowed into flatter flood plains, the stream lost some of its power and deposited the largest materials including the boulders.

Are we still at risk?

This is a case by case and indeed a site-specific issue. However, study findings seem to suggest that structures built in high TWI areas are at still at risk. The flood plain around Kopa is clearly a high-risk area for future flooding.

7.7 Quality of ‘Building Back Better’ and Post-Cyclone Settlements

A Chief interviewed as part of the study alluded to the fact that the level of supervision of all interventions in Chimanimani was very weak. In addition, he mentioned that those who have been designated areas to resettle have still not been allowed to move into their proposed new settlements. In as much as the chief should have answered questions he was asked, he had even more questions indicating that much may be happening without full awareness of key stakeholders. One of the questions the chief asked was: “Where is the national disaster fund chaired? What are they saying about the status quo?”

The chief alluded to some challenges being experienced in the communities: There is lack of movement by responsible authorities. The holder of the office of DDC changed three 3 times since the cyclone hit the area and there seems not to be a convincing reason for those changes to stakeholders. On the other hand, the chief complained about the donated provisions having not reached the beneficiaries; “The Department of National Housing has stocks of material not yet used and in particular coffins which are stashed among other materials.”

On a positive note, the chief indicated that ZESA and ZINWA were the fastest entities/utilities to restore service to the community. Within 4 weeks they had restored their supply systems. However, Ministry of Transport officials were reluctant to be interviewed, despite them having consented to being interviewed. Consequently, the two officers interviewed were predominantly defensive in their responses. However, the research team was clear in their objective of getting to know the status quo despite the many justifications the officers wanted to bring on board. The Ministry of Transport concurred that there was a talk about cement being misappropriated and some being sold in the community for as little as USD2 per 50kg bag and this had featured in the Manica Post newspaper.

Asked what they were doing to ensure good workmanship and adherence to set quality assurances, the officers indicated that for the greater part of their interventions, they had only one person to do quality

assurance, and this person was manning 15 construction sites. As a result, the possibility of contractors doing substandard work was inevitable. They however indicated that with effect from January 2020, another seven-member team of the Ministry of Transport were deployed to Chimanimani and significant improvements in quality workmanship were observed. Asked about the progress in resuscitating the road infrastructure, the ministry pointed to shortages of fuel by the contractors as well as the onset of the rainy season that has seen many projects being stalled.

The Ministry of Lands, Agriculture, Water and Rural Resettlement pointed out that their major challenge was transport to the sites which are to be selected for prospective settlements. In addition, the Chimanimani area has more illegal settlements than those with permits. The example given was of the Thornton and Lemon Core areas where many have built homes illegally. However, the Ministry has identified two farms in Bumba where 500 one-hectare farms have been surveyed and are ready for settlement. Other possibilities for settlements include Nhuka farm. Unfortunately, settlers at Nhuka Farm are resisting the coming on of other new settlers.

The magnitude of cyclone devastation could be traced back to settlements that were setup after year 2000 since some of these are on waterways. Council would only request prospective homeowners to identify any vacant area and would go on to peg that place despite the area being in an unsuitable location in terms of topography and or being within a wetland. A Physical Planning Technician stated that 157 properties were completely destroyed, 34 partially destroyed, 12 stands were no longer developable, and 25 properties were assessed as being at risk.

A Civil Protection Unit (CPU) subcommittee allocated temporary camps at Nyamatanda, Ngangu, Kopa, and Chimanimani. The technician alluded to the four proposed sites for settling people displaced i.e. Lindley Farm (Nhuka Farm), Parksview (rugged terrain), Greenmount (Upper Ngangu) was found not to have water supply sources and had too many gum trees which makes it difficult to survey and Nhedziwa Growth Point, which was ready to receive people since offer letters had already been provided. However, further topographic surveys need to be done in order to increase the number of stands available. The planning technician did not attribute any destruction by the cyclone to settlement pattern noting that Kopa was not low lying but still it was heavily affected.

The District Development Coordinator (DDC) pointed out that Ngangu and Kopa were the epicentre of the disaster. He noted that the district was trying to settle people as soon as possible since they are not happy with their communities living in tents. He pointed out that many of the proposed sites for settlement neither have water nor sewer services and as such it was difficult to immediately move people there. Some private organisations had promised shelter but had not been forthcoming since their pledges a year earlier. Consequently, the government was left with no option but to attend to the issues of IDPs. One other challenge with settlement provision was that the private organisations were interested in helping rural communities with shelter, despite the fact that it was the urban who were affected the most. The DDC pointed out that not all the people in the tents were affected by the cyclone, hence the challenge was to verify the beneficiaries. Asked about the sentiments of those in the tents he indicated that some are ready to move though they would have loved to be relocated back to their usual areas. On the other hand, some people no longer want to continue living in the same area due to the trauma experienced during the cyclone.

7.8 Conclusion

Cyclone Idai's impacts on topography, infrastructure and settlements were mostly distributed in the southern and eastern parts of Chimanimani District. Settlements like Ngangu, Kopa and Peacock were the most affected. In rural Chimanimani, the impacts on settlements were more pronounced in the Rusitu Valley and in Chikukwa. On the other hand, road infrastructure was badly affected throughout the district. Big and small bridges were wiped away, culverts and shelverts were destroyed in many places. Water, telecommunication and power lines were also affected, though most of them have since been restored.

The topographic wetness index TWI shows that the wettest areas drained by channels from upstream were closely correlated with the path of the landslides/floods. This may provide a useful tool for future spatial

planning (siting settlements and infrastructure) to avoid areas that overlap with drainage channels (as identified by TWI maps). Developments earmarked for such areas should not go ahead without further detailed analyses and surveying of the proposed sites.

It was observed that some road networks within the residential areas of Chimanimani urban were going upstream suggesting poor urban planning. The planning of settlements should be across slopes to avoid the enhancement of any flows which normally result in development of gullies which in turn affect the strength of infrastructure. Despite adherence to urban planning by-laws and construction standards, houses and all residential infrastructure was susceptible, and it was those who were within the high TWI which were most affected. Thus, the destroyed houses were not those which were poorly constructed. Planning of infrastructure should be such that certain places are avoided. This includes areas below cliffs and far uphill areas. These areas are vulnerable to landslides and human activities can result in weakened slopes. The capacity of strategic institutions also affected infrastructure development/rehabilitation post-Cyclone Idai. Delays in infrastructure rehabilitation were attributed to shortages of fuel by the contractors as well as the onset of the rainy season that saw many projects being stalled.

Of the four proposed sites for settling people displaced by the cyclone only one, Nhedziwa Growth Point was found to be suitable. However, a further topographic survey needs to be done in order to increase the number of stands available. Nhedziwa site has been received with mixed reactions. One common reaction is that Nhedziwa is too far (65km) from current usual sources of livelihoods in Chimanimani Village. Also, some people prefer to have property in Nhedziwa but are not interested in staying there. There is need for proper siting of settlements and Council needs a Physical Planning policy, Committee and relevant staff to process settlement plans before construction. The issue of land occupation without permission or legal authority (e.g. at Nhuka Farm) is a concern that Council needs to resolve. That they are resisting new residents on the land they currently inhabit even when the new settlers are being brought formally by Council raises questions about the future expansion of Chimanimani Village as a settlement. Settlement issues require immediate resolution while also establishing long-term systems given predictions that events like Cyclone Idai may occur in future.

Chapter 8: Disaster Risk Reduction Systems in the Context of Cyclone Idai in Chimanimani

8.1 Introduction and Study Approach

Zimbabwe continues to experience natural hazards such as tropical cyclones, droughts, and floods. Such disasters are expected to increase both in frequency and intensity due to climate change. Cyclone induced floods are one of the most common and devastating events causing nearly half of all victims of natural hazards (Rana & Routray, 2018, Mhlanga et al 2019; Munyai et al 2019). For example, during Cyclone Eline in 2000, floods claimed more than 700 lives, left more than 500,000 people homeless, and caused USD1 billion in infrastructural damage in Zimbabwe and Mozambique (Wamukonya & Rukato, 2001). Furthermore, the most recent tropical cyclones such as Cyclone Dineo (2017) and Cyclone Idai (2019) that hit Zimbabwe caused flooding and left a trail of destruction in communities creating socio-economic challenges among the people. As reported by the Chimanimani District Development Coordinator (DDC) Cyclone Idai claimed about 300 lives whilst more than 325 were reported missing and those displaced were approximately 4,000.

The occurrence of Cyclone Idai exposed capacity and policy gaps in Zimbabwe's disaster risk management or governance system. The magnitude of this disaster exposed the deficiencies in national and local systems and community factors that increase household vulnerability to hazards. This research assessed the adequacy of Disaster Risk Management (DRM) policy, legislative and administrative systems and how this affected household vulnerability to Cyclone Idai. It also explored the impacts of Cyclone Idai at household level as well as the impact on different vulnerable groups such as women and children. By interrogating the factors that increased household vulnerability to Cyclone Idai the study formed a basis for the formulation of appropriate recovery pathways and how they can be steered i.e. setting appropriate disaster risk management strategies.

While focusing on the DRM systems in Chimanimani the purpose was to inform decisions and processes in other jurisdictions in Zimbabwe and elsewhere. Practically, the inquiry looked at four interconnected questions related to the i) effectiveness of policy and administrative systems in preparing for and responding to Cyclone Idai, ii) social impacts of Cyclone Idai, iii) factors that increased household vulnerability, and iv) appropriate recovery pathways and their steering. The specific research objectives were to:

- Assess the effectiveness of disaster risk management policies and administrative systems in managing Cyclone Idai.
- Determine the social impacts of Cyclone Idai in Chimanimani district.
- Assess the factors that increased household vulnerability to Cyclone Idai.
- Suggest possible pathways of strengthening community resilience in Chimanimani District.

8.2. Caught Napping: DRM Institutional Framework and Cyclone Idai

Interviews with key informants revealed that national government and Chimanimani district stakeholders relied on a number of policies as they responded to Cyclone Idai from the moment it was declared a national. These were both national and local policy and legislative instruments. National ones included the Constitution of Zimbabwe (Amendment No. 20 of 2013); Traditional Leaders Act [Chapter 29:17]; Rural District Councils Act [Chapter 29:13]; Provincial Councils and Administration Act [Chapter 29:11]; Housing Standards Control Act [Chapter 29:08] and Civil Protection Act [Chapter 10:06]. Local policies instruments included Chimanimani RDC Environment Policy (Resolution Number C3090) and Chimanimani District Climate Change Response and Watershed Management Policy (Resolution Number C3331).

Some of these policies may apply directly and indirectly to DRR. They however fit into the category of DRR focused policy frameworks particularly as the seek reduction of people's vulnerability to hazards. For instance, the Kopa the area which was swept away was planned and allocated formally. Council had been told that sections of the land in question were 'sacred' (Key Informant Interview, 2020). However, it went on to establish the location. As such, in spite policies being in place, the study found that national government and local institutions were unprepared for Cyclone Idai in terms of awareness, early warning, human and financial resources, infrastructure, equipment and coordination.

Further, although the country has made significant strides in developing comprehensive national and sub-national disaster risk strategies aligned to the Sendai Framework, the DRM legal and policy framework has not been updated. The amendment of the Civil Protection Act to keep abreast with the prevailing international frameworks has been slow. Key informants revealed that the proposed Emergency Preparedness and Disaster Management Bill has been in Draft form since 2011. Thus, the finalisation of the DRM policy, legislation and organizational structures based on the Constitution, the Sendai Framework for DRR and relevant lessons from recent local experiences like Cyclone Idai and Dineo and those from other jurisdictions is becoming more urgent than ever. Whilst districts such as Chimanimani had their Disaster Risk Management Strategies in place, key informant interviews revealed that implementation remained weak and under-resourced.

8.3 Socio-economic Impacts of Cyclone Idai in Chimanimani District

Research participants recounted how Cyclone Idai damaged and destroyed houses, schools, roads, crops, and trees leading to heavy physical, social and economic losses, while also killing people and livestock. Figure 8.1 presents some of the impacts of Cyclone Idai on livelihoods.

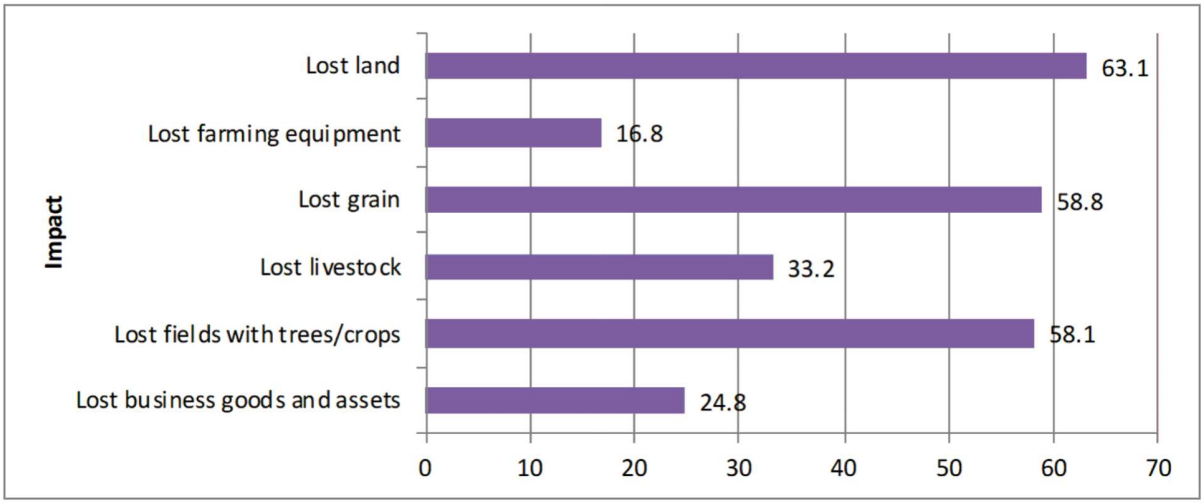


Figure 8.1: Impact of Cyclone Idai on Livelihoods

Chimanimani district has a mixed economy, and agriculture is the main economic activity. Agriculture is primarily subsistence with small scale horticulture production (dryland and irrigated) alongside a substantial commercial sector (tea, coffee, maize, macadamia nuts and forestry among others). Small scale horticulture producers in Chimanimani lost pumps, pipes and generators for individual small irrigated plots and crops that include sugar beans, potatoes and bananas due Cyclone Idai. The inaccessibility of some areas by road made it difficult for the surviving communities to transport their produce to the market for a long period after the disaster (Chatiza 2019). In some areas, roads were still in bad condition causing transport operators to hike fares. As a result, some of the produced could not reach the market on time forcing farmers to sell at

very low prices in an economic environment where basic commodities are sky rocketing. A large percentage of farmers also lost livestock.

Cyclone Idai had some social impacts captured in Table 8.1. More than 60% reported loss of land and conflicts as the main challenges followed by associated psychological impacts. Conflicts were mainly reported between internally displaced persons (living in tents) and surrounding communities over resources. At Ngangu, surrounding communities were reportedly vandalising campsite resources and threatening the survivors. Conflicts also arose where the communities felt that survivors were getting preferential treatment by development agencies. Some villagers argued that donors had actually created a gap between survivors and the rest of society. They felt that they used their resources to help the survivors before the external agencies intervened but were neither compensated nor did they benefit from donor aid.

Table 8.1: Social impacts of cyclone Idai

Impact	% affected
Psycho-social	43.5
Social groups	25
Missing members	12.1
Loss of property	44.3
Loss of arable land	62.2
Increasing conflict within the community	61.0
Loss of life	9.4

Focus Group Discussion (FGD) sessions and Key Informant Interviews showed how some survivors remain haunted by the sights and screams of people they were unable to save from the floods. The events of the cyclone and its aftermath flash back through their minds. During an FGD session it was reported that some women were spending nights wide awake, had poor eating habits, felt apprehensive and worthless. Some people suffered “survivor guilt”. They reported feelings of self-defeat and self-loathing, manifestations of post-traumatic stress disorder.

Lack of privacy and safe spaces at emergency shelters in Ngangu and Kopa exposed women to sexual abuse. Participants highlighted that there was no lighting at the campsites exposing women to the risk of sexual abuse. Families leaving in tents noted the lack of privacy as they were sharing a room with the children exposing young children to sexual abuse. Lack of privacy for parents also triggered GBV in emergency shelters. The survey also revealed that Cyclone Idai affected women and children more than men. The feeling of powerlessness in decision–making process and feelings of insecurity invoked both social and psychological vulnerabilities for affected women in the ravaged communities. Thus, women are at risk of falling into deeper poverty post Cyclone Idai, and this realization raises their social and psychological vulnerabilities. Slow recovery and limited livelihood options are making women’s position difficult. Most households in Chimanimani have the opinion that women are now severely vulnerable to all forms of current and future shocks after Cyclone Idai.

About 64% claimed that they were aware of human rights abuses during the disaster response. This is disturbing in that abuse occurred in a context of rights awareness despite the general expectation that it is less likely where people know their rights. About 57.8% reported no preference given to pregnant and lactating women and girls in provision of humanitarian aid. More than half (57.2%) indicated that no efforts were taken to ensure access to clean water. 40% reported cases of sexual exploitation and abuse of women and girls. Those who reported indicated that no action was taken as majority (92%) claimed that they were afraid of victimisation. It is disturbing that 20.3% reported cases of gender discrimination on access to relief aid. However, it is commendable that 89.9% of respondents say women and girls received aid related to menstrual hygiene.

8.4 Factors Contributing to Household Vulnerability to Cyclone Idai

Chimanimani represents the concentration of flood related hazards resulting from the multifaceted impacts of physical location compounded by climate change. Survey results showed that some houses were located in waterways and in flood plains. The geographical location of homes especially at Ngangu and Kopa exposed inhabitants to Cyclone Idai. The increased exposure to flooding increased the likelihood of losses in the form of destruction of homes, infrastructure and disruption of livelihoods. The main elements that were at risk included neighborhoods, schools, health centres, business centres and croplands. Study results indicated that the majority of the surveyed households' croplands are very close and along rivers in Chimanimani.

Education and knowledge of climate hazards by household heads increase the capacity to respond to flooding as this affects their level of understanding of disaster management issues as well as interpreting weather forecasts and early warnings. Most people in Chimanimani had some knowledge on climate-related hazards. Yet despite this knowledge they were seriously affected. Some of the reasons why this was the case were discussed in section 3.2. Suffice to note that the transfer of knowledge into actual actions remains low. This correlates with the finding that despite the district having an appropriate policy and strategy the district still was not yet implementing the provisions of the climate change and watershed management instrument.

Further analysis revealed that less than 50% of the respondents received training on climate related hazards. This further supports the need to build capacity of vulnerable communities, to assist them cope with the hazards. Apart from education and training, 68% of the households got information about the coming of Cyclone Idai but more than 31% were caught unaware. This means a lot still needs to be done to make disaster information reach people to enable the required mitigating action.

Important to note is that although the majority (84%) indicated that they got first assistance from community members, generally households had limited resources to enable effective responses. More than 70% of the respondents rely on agriculture which is susceptible to the damaging effects of hazards. As such the communities were finding it difficult to recover from the impacts of the cyclone mostly due to loss of their livelihoods. This could mean that all the stable and growing livelihoods came to a halt. Therefore, there is need for livelihood diversification mainly off farm activities that are less susceptible to climate hazards.

Attitude of community members influence disaster preparedness and response. More than two thirds (68%) of the respondents indicated that they received early warning information about cyclone. Of those who received the information more than 85% of the household who got information about cyclone Idai shared the information with fellow community members. This is very encouraging to note that people share information about impending danger. Surprisingly, only 36.7% took precautionary measures. This might mean that the majority who did not take action were not aware of what they were supposed to do. As such, there is need to carryout training at community level on how people can decisively ahead prior to and mitigate the effects of disasters. This was exacerbated by lack of local disaster management committees suggesting that disaster preparedness is still lagging. For those that took action based on disseminated Cyclone Idai information 12.6% moved to safer areas, 52.6% stayed indoors and 2.1% monitored reports from radio and televisions on what was safe to do. They thought the floods were not serious basing on previous cyclone events.

The capacity of local institutions also plays an important role in reducing community vulnerability to disasters. Agritex trained most people (39.5%) on climate change hazards. Agritex officers are in contact with the people hence they are better positioned to train people on climate hazards. However, less than 25% indicated that they had knowledge on climate hazards. This raises questions on the capacity of Agritex Officers in DRR. This may call for training of trainers in DRR.

A slight majority of the respondents got information on early warning about Cyclone Idai from radio and television (53.7%), followed by fellow community members. The Meteorological Services Department (MSD) early warning on Cyclone Idai reached about 53.7% of the people. The low number of the people who got the information might be because in some wards there is low or no radio transmission. Other areas also have no cell phone network coverage, explaining the low number of people who received the cell phone message. For message to reach all people there is need to use all possible methods of communication. Further, participants highlighted other shortcomings noted in respect to communicating cyclone Idai related information. Most of the households (41.2%) said the information about the impending cyclone came too late. About 24% of the people said the information was inadequate to warn people of the pending danger, making them unable to act upon it. More than 15% said the information was misleading and hence it's use increased their exposure to the cyclone impact. The information was also affected by previous experience with cyclones like Japhet and Eline, which were less destructive. All these factors could have led to community's lack of preparedness in the face of Cyclone Idai.

It was noted that only 3% got early assistance from government agencies. This might mean the government had no structures to respond fast and adequate enough to disasters. Since government through its early warning systems was aware of the pending danger, they were supposed to deploy trained people to assist people who might be affected. But this was not the case in Chimanimani. Interviews with key government institutions indicated lack of human and financial resources to prepare for emergencies. Further investigations on assistance provided to survivors post Cyclone Idai only 5.1% were supported by the government. Interviews with key informants indicated that the government had no capacity to continue supporting the survivors after the disaster although the communities had not recovered from the impacts of Cyclone Idai. The government relied on humanitarian aid.

8.5 Discussion

The Zimbabwe disaster management system is more of a responsive system than a proactive, given any kind of disaster be it slow/rapid onset or natural/human-induced. World Bank et al (2019), Mudavanhu (2015), and Mavhura and Collins (2017) support that DRM activities in Zimbabwe are predominantly focused on response. World Bank et al (2019) notes that the Government of Zimbabwe (GoZ) declared an emergency on the 16th of March 2019 activating a government-led response directed by Department of Civil Protection (DCP) in coordination with humanitarian partners, the military and sub-national flood command centres. Thus, response from the national level started to reach the communities after about 4 days to a week as argued by different sources. There was a huge setback to the ability of DCP to respond to the disaster in a timely and adequate manner because of the absence of reserved funds at all levels (World Bank et al, 2019). The absence of human resources such as the sub-aqua and military within communities at district/ward level was a major contribution to the failure of the system to respond to the cyclone disaster. More so, World Bamk et al (2019) noted that the national budget of Zimbabwe did not allocate direct support to DRM, thus DCP like other departments gets its funding from Treasury. This bureaucratic arrangement with decentralized power delays the response to disasters and even preparation of disaster (Mavhura, 2016). DCP requests funds from the Ministry of Finance and Economic Development (MoFED) contingency fund so that they can channel resources to the affected population. In addition, it can be noted that lack of DRR investment disturbs the disaster preparedness of a system.

According to Chatiza (2019) the survivors of Cyclone Idai were inadequately informed and supported. DCP at both district and national level failed to issue coherent early warning messages in time for adequate response by the affected communities. It was reported that the message about Cyclone Idai and how it was projected to affect Chimanimani did not effectively filter to the communities. The World Bank (2019) confirmed that there was lack of community engagement as key actors in DRM through awareness-raising and evacuation drill exercises. Also, the DCP had a gap in their risk perception as evidenced by the reports they made towards the disaster.

Furthermore, the current warning communication is a one-way process, with those issuing warnings not fully aware of the needs and the priorities of vulnerable communities, and therefore not responsive to their needs (Gwimbi, 2015). When emergency service committee meetings were held before the Cyclone Idai disaster, early warnings given were not accurate as they were not specific as to which areas were most vulnerable. This supports what Chatiza (2019) noted that the MSD's Cyclone Idai warnings generally lacked detail necessary to allow the Civil Protection Community to decide on immediate action in terms of evacuating people. World Bank (2019) also notes that the reason behind the failure of early warning was incapacitation on flood risk management and the institutional capacity of ZINWA and MSD is not enough in terms of financial/human resources, technical expertise, facilities, and services. More so, the lack of localized disaster preparedness is very evident from the MSD, the army, police, education and health sector which led to the disaster (Chatiza, 2019). One would support this view looking at the DRM system of Zimbabwe that schools should have been closed earlier before the occurrence of the disaster in the affected areas. Also, the army lacked helicopters that could fly during extreme weather events. This is clear evidence that there was a lack of preparation as the army could not immediately fly into affected areas, instead of having to wait for visibility to improve (Chatiza, 2019). Likewise, the police also were not prepared for search and rescue as they lacked sniffer dogs capable of detecting buried human bodies.

The lack of access to information related to early warnings, response strategies, coping and adaptation mechanisms increase household vulnerability to disasters (IPCC, 2012). Behaviour change is vital when people get access to information because it is not information per se that determines action, but how people interpret it in the context of their experience, beliefs and expectations (IPCC, 2012). The early warning information was not comprehensive enough for any action. There were no action recommendations to take, so everyone was doing what s/he thought was appropriate. However, the government was also unaware on what action to take.

Poor people have limited access to vital information critical for reduction of vulnerability and increasing resilience (Toleni et al., 2019). The poor are often hard-hit by disasters because of lack of accessible information. Disaster preparedness is very poor among poor people hence it is generally agreed that poor people are least equipped and prepared to cope with the impacts of disasters. Poor people also have no resources to construct resilient houses that can withstand the impacts of disasters.

Most people got assistance first from fellow community members. This calls for need to strengthen communities' capacity for copying with disasters (Musarura and Lunga, 2012). The role of government was not felt by the community members who are saying the major players were NGOs. Individuals should have a role to play, as they are the first responders. According to Bongo et al. (2013) if NGOs are the dominant players in times of hardships, then most communities are treading on the undesirable road of dependence. The authors went on to question what could happen to these communities if the NGOs suddenly withdrew from their area, or if their funding ran out? Consequently, the most sustainable approach is to train the community to assist themselves and government (national and local) must also prioritise DRR in the budget. Bongo et al. (2013) noted the need to build on the traditionally existing extended family system and local community support systems as part of reducing vulnerability as well as building and strengthening resilience.

There is evidence that most injuries, damages, and deaths from disasters can be prevented and disaster preparedness measures such as housing adjustment against risks can reduce the damage caused by disasters and accordingly improve recovery (Torani et al., 2019). Adherence to recommended standard building codes is a must. Low awareness and inadequate understanding of risk play a negative effect on people's readiness, response to hazard warnings, personal protection measures, and recovery. Disasters are reduced when people are well aware and have the motivation to create a culture of prevention and resilience to disaster.

8.6. Conclusion

The occurrence of Cyclone Idai exposed capacity and policy gaps in Zimbabwe's Disaster risk management governance system. For example, people got information of pending disaster but did not know how to use the information, because it was not properly packaged. The local institutions proved that they do not have the capacity to prepare and respond to climate related hazards. Cyclone Idai caused socio-economic and environmental impacts in the district. Lack of effective DRM systems and politicisation of law enforcement; lack of DRR training and awareness, population growth in mountainous areas, climate change, beliefs and attitudes; and settlements in dangerous locations like waterways, lack of disaster preparedness at all levels and household vulnerability attributes caused Chimanimani district to be susceptible to the damaging effects of Cyclone Idai. Besides highlighting the deficiencies in the disaster management system, this study also emphasized on other community factors that increased household vulnerability to hazards such as community attitudes, household sensitivity and exposure. Generally, the system has collapsed and there is need for rehabilitation and reconstruction in order to restore the communities. There is also a need to build the capacity of government institutions and traditional leaders and set up effective and efficient early warning systems in order to build community resilience.

Chapter 9: Study Conclusion and Recommendations

9.1 Summary of the Study Insights and Lessons

This considerably comprehensive first phase of a study did not only avail critical resilient building insights for Chimanimani district stakeholders, but illuminated the multi-pronged nature of the Cyclone Idai disaster and its impacts. It qualified and quantified these impacts as well as identified preliminary causes of the severity of the disaster in the district.

The disaster dislocated all facets of livelihoods, settlements, infrastructure and the environment. This dislocation compounded an already fragile humanitarian situation that was underlined by pre-existing factors like poverty, lack of adequate basic infrastructure and amenities, a struggling economy, weak institutions and other hazards principally driven and exacerbated by climate change intensification. Displacements increased the psycho-social burden on survivors. Disruptions to education services as well as water, sanitation, health and irrigation infrastructure left some survivors homeless and vulnerable to health risks and food insecurity. Cases of sexual abuse and gender-based violence rose during the search and rescue as well as humanitarian response phases.

A number of lessons were consolidated. Critical ones include the necessity of i) clear disaster risk reduction institutional frameworks that are properly resourced for timely and effective activation, ii) decentralised planning and response structures that are accountable, properly coordinated and capacitated, iii) clear local policies and laws participatorily set up and executed by de-politicised and empowered local institutions, iv) sound appreciation of risks posed by (and the responses needed to mitigate) geology, slope, topographic wetness, population and socio-economic density, v) meaningful/inclusive engagement with and application of blended knowledge (local and external) to develop and implement land/resource use plans and sustainable livelihood initiatives, and vi) territory-sensitive and evidence-based understanding of hazards, developing and executing hazard-specific warning systems and responses.

The humanitarian response that followed aided many survivors to slowly recover. National government led the response. Coordinating the response exposed both policy and practical frailties. Technical, political and traditional officials in the district expressed a sense of feeling initially abandoned and later overwhelmed. At the same time, they remained anxious regarding the causes of the disaster and at the prospects such events recurring. Their anxieties informed the demand for and actual design of the research presented in this paper.

As noted in the paper, the causes of the heavy destruction in the district was due to a combination of fragile institutions, a progressively bared, mountain and highly uneven relief. This was also an environment witnessing systematic ecosystem degradation as land administration particularly spatial planning and land allocation institutions acted based on incentives unsuited to good resource stewardship. Traditional and formal institutions presided over settlements in sensitive areas and cited rising populations and land pressure for the encroachment. At the same time, land use as well as related conflicts, pre-existing socio-economic inequality and poverty risks in a context of worsening climate change reduced the communities' resilience. The cumulative effects of these factors on the local economy and livelihoods predisposed both people and the environment to the force of Cyclone Idai, itself aided by the relief of the area, which acted to slow the cylone resulting in heavy rains being dumped in the area in a short 24 hour period. The latter factor led to heavy flooding and landslides that saw critical infrastructure and settlements being destroyed with severe losses in terms of life and livelihoods.

9.2 Recommendations

The study proposes a follow-on phase of deeper and broader analyses for purposes of identifying and effectively following pathways towards resilience. This is critical given predicted frequency and intensity of extreme rainfall events through to 2050. While there are variations in model predictions on the future of tropical cyclones observations suggest that for Chimanimani intensification is likely suggesting an increased risk of Cyclone Idai-like events. Resource poor and vulnerable populations need strategic support particularly through being involved in policy making and implementation of sustainable initiatives guaranteeing equitable access to important resources like land for food production (croplands and grazing areas), collective protection of fragile landscapes, securing seed and grain alongside deepening appropriate farm and off-farm livelihood practices.

The study's preliminary synthesis suggests an urgent need for appropriately arraying district and sub-district development or governance institutions. The way in which the local political economy functions (or does not) requires further interrogation. However, appropriate arraying of institutions is a precondition for effective relations of performance, framing and implementing appropriate spatial development or land use plans, delivery of services, gathering/receiving and processing actionable knowledge in locally-accessible and acceptable institutional structures. The individual thematic papers provide more nuanced recommendations, which at a strategic level speak the following:

1. **A Council-led development planning and land administration system that is clear, accountable and resourced (i.e. political or policy, social, financial and technical capacity).**

The Constitution of Zimbabwe in Section 5 defines a three-tier government of national, provincial/metropolitan and local. Chimanimani Rural District Council is the government for the area. However, its operations (policy and practice) are constrained by layers of socio-economic development and political organizations that it does not coordinate, which are not accountable to Council and overlap in terms of functions.

Early warnings relating to disasters, implementation of responses and undertaking of everyday governance occurs in this disarrayed institutional environment. Spatial and economic planning is regulated more by national than local government. Existing conflicts, for instance over land have gone unresolved arising from limits and contradictions regarding the power that traditional leaders and Council have and the modes of its exercise.

The unresolved issues and inadequate coordination between traditional leaders and Council has seen irregular land allocations, unplanned developments and poor resource governance. National government is a major contradictor of the three-tier system. Unfortunately, its field institutions are poorly resourced and coordinated, yet they hold considerable formal power.

There is need for appropriate realignment or harmonisation of functions and capacity development of Council and sub-Council structures or institutions alongside systematic adaptation of national policies and laws to local realities. The office of Councilor needs considerable development for effective coordination of local governance institutions or processes at Council and sub-Council levels.

2. **Designated DRM Office that leads on collecting or receiving and analyzing relevant information for use in development plans that embed DRR (including research and administering early warning system) and social protection.**

Delays in updating national policy and legislation on disaster risk management has resulted in weak sector structures as well as inadequate performance. The CPU capacity needs to be strengthened. Establishing a more permanent and well-resourced sub-Office of the CPU is recommended for quick reaction time. At district level DRM is a national government function coordinated through the Office of the District

Development Coordinator, chair of the District Civil Protection Unit, Rural District Development Committee and delegated administrator of the Traditional Leaders Act.

Disaster risk management in Zimbabwe is reactive. The CPU does not have resources to collate and analyse relevant information and is also not the planning authority. Council is the planning authority, yet the disaster risk management remit is not expressly its purview. Its planning committee is inactive in terms of siting settlements on agricultural land in areas administered by traditional leaders and the Ministries responsible for land and environment (e.g. farms, plantations, state forests and parks). Early warnings are invariably affected by the 'multi-pillar system' delaying reach and reaction while reducing localization and community ownership. A permanent presence of the CPU/DRM Unit within Council having the capacity to anticipate and react quickly is critical.

At the same time, resilience building requires effective application of gender and social inclusion principles. The CPU/DRM Unit has to lead processes of developing an appropriate social and child protection system suited to pre, disaster and post-disaster situations including providing for soft and hard infrastructure (e.g. Evacuation Centres) at community level.

3. Meaningful engagement of resource users in preparing, adopting and implementing land use plans at village, ward and district levels.

The 2017 Climate Change and Watershed Management Policy awaited operationalization at the time Cyclone Idai struck. Apart from being a strategic framework to guide addressing of the environmental challenges faced on farmers' individual plots and shared resources (land, water, forests) the policy would essentially help frame the choice of production systems including the necessary soil and water conservation regimes and the by-laws necessary for enforcing resultant land use plans. It is critical to observe that the social organization of production (e.g. *nhimbe/*work parties, social and environment management clubs, Zunde reMambo), homestead architecture, fire and deforestation prevention, managing invasive vegetation species all require clear and participatorily developed land use plans supported by depoliticised local institutions. It will also support proper siting of homesteads, allocation of arable land, management of grazing areas, growing and management of forest resources.

As observed in the first recommendation, traditional leaders and elected representatives have a collective role to play in this where the former's local rules are informed and strengthened by Council Resolutions/Policies and local/by-laws. Statutory and non-statutory land use plans backed by Council Resolutions/Policies and local/by-laws that have the buy-in of traditional leaders have a better chance of contributing to resilient landscapes. Further extension staff are able to support their implementation as they will be more predictable and less susceptible to political whims. Such an environment allows expanding proper resource stewardship and utilisation using approaches like agro-ecology that are well-placed to enhance biophysical resilience and social responsiveness to extreme weather events.

4. Ongoing development of community resilience and active citizenship.

All considered, informed community attitudes are critical for resilience. It is communities that are directly affected by disasters. It is also some of their socio-economic activities that exacerbate disaster risks. Informed and better organised citizens also hold district and sub-district institutions and their agents accountable for action or inaction in relation to established policies and programs. Active citizenship that goes beyond partisan politics is critical for resilience as it allows for collective actions, social solidarity and state building from below. The development of relevant capacities also needs coordination and adequate resourcing. External development agencies should therefore positively impact on the capacity of local governance institutions, and include local elected actors, formal and informal, small and big private sector actors in decision-making, besides bringing significant support during emergency situations.

There should be an appropriate alignment, renegotiation of functions and capacity development of sub-district development institutions for systematic adaptation of national policy and law to local realities led by a 'refurbished' institution of Councilor while effectively coordinating with actors and actions steered from a District Node. It is imperative to set up social protection systems that are sensitive to disaster situations, including evacuation centres where communities can seek refuge in case of disaster. It should be realized that scaling up and deepening agro-ecology as a key strategy for improved biophysical resilience and social responsiveness to extreme weather events. And finally, in order to mitigate further impacts on inhabitants, there is need for proper sitting of settlements and council should have a working physical planning committee and the planning committee should approve any settlement.

5. **Capacity building of local and international external development agencies for them to positively impact the local governance institutional environment.**

External development agencies have tended to focus on narrow project-based foci. As they implement their interventions, they have not always positively impacted the local governance environment. Their role and capacities should be better deployed for sustainability in context of development effectiveness, which requires going beyond bringing emergency and development aid. Relevant capacity development will enhance the possibility that their interventions also build the cooperative governance capacities of local elected, traditional and community leaders, small and big private sector organisations as well as formal and informal actors.

On the overall, these recommendations form a critical precursor to the creation and sustenance of well capacitated and more resilient communities that will be able to withstand and reduce damage and loss from impact from future cyclones.

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Annexes

Annex 1: Household questionnaire for KTA's 1, 2, 4-6

META DATA		
1.1	Date	___/___/2020
1.2	Enumerator's name	Surname:
1.3	Location:	

District	(Tick √)	Ward	Village
Chimanimani			
Location coordinates			

INTRODUCTION AND INFORMED CONSENT

[Greet people in their local way] My name is _____ and I am from TSURO Trust and we are conducting a household survey in your community on……. Your household has been selected to participate in the survey and I will be asking you few questions about Cyclone Idai which affected this community. Our intention is to get from you, information that will assist to improve community resilience.

Participation in this survey is voluntary and you can choose not to answer any individual question or all the questions. Feel free to stop me whenever you want.

The information we are collecting will be treated as confidential. We will not take down your personal details

Feel free to say exactly what you know

Is there anything you want to know before we start?

Will you participate in this survey? Yes ☐ ☐

If "No" would you mind giving a reason?.....

I_____ the enumerator responsible for the interview-taking place on ___/___/_____ certify that I have read the above statement to the participants and they have consented to the interview. I pledge to conduct this interview as indicated on instruction and inform my supervisors of any problems encountered during the interview process.

DEMOGRAPHIC DESCRIPTION OF THE HOUSEHOLD

3.1	Are you the head of the household (single select) (Tick √)	Y	N
3.2	What is the gender of the Respondent? (single select) 1= Male 2= Female		
3.3	Respondent Marital Status: (single select) (Tick √)		

1	Single	
2	Married	
3	Separated/Divorced	
4	Widow(er)	

3.4	Age of respondent (in years)? (Skip to 3.7 if respondent is head of household)	
If respondent is not the head of the household, answer 3.5 and 3.6		
3.5	What is the gender of the household head?	
3.6	What is the age of the household head? (Age in years. Respondent to estimate, where it is not possible to get the actual age) 1= 18 to 25years 2= 26 to 35 years 3 = 36 to 60 years 4 = above 60 years	
3.7	What is the size of your household? (number)	
3.8	What is the highest level of formal education completed by household head? 1 = Never attended school 2= primary 3 = secondary (form 1 -2) 4 = Secondary (form 3 – 4) 5 = Advanced level 6 = Tertiary	
3.9	What is the highest level of formal education completed by respondent? 1 = Never attended school 2= primary 3 = secondary (form 1 -2) 4 = Secondary (form 3 – 4) 5 = Advanced level 6 = Tertiary	
3.10	a) Vulnerability Attributes:	

State the,		Total	M	Age	F	Age
1	Number of chronically ill members					
2	Members with disability					
3	Number of orphans					
4	Number of pregnant or lactating members					
5	Number of elderly members					
7	Children of school going age					
8	Number of children in school					
9	Number of children out of school (5-17yrs)					

b) If there are children out of school state the reasons for dropping out or not attending school…….

3.11	Category of land on which responding household is settled: 1 = Old resettlement 2 = New resettlement 3 = Communal area 4 = Commercial farming area 5 = Urban
3.12	Has the household been given formal authority to settle, farm etc where they are? 1 = Yes 2 = No
3.13	Time home was established i.e. when they settled in the area 1 = 0 – 5 years 2 = 6 – 10 years 3 = 11 – 15years 4 = 15 – 20 years 5 = Above 20 years
3.14	What is the primary occupation of Household Head? Choose one answer only (CIRCLE APPROPRIATE BOX) DO NOT PROMPT RESPONSES 1 = Farming/agriculture 2 = Agricultural labour/farm worker 3 = trading business/buying and selling 4 = Formal employment 5. other specify
4. AWARENESS AND KNOWLEDGE OF CLIMATE HAZARDS	
4.1	Have you ever heard about climate change? 1 = Yes 2 = No
4.2	What do you understand by climate change? _____
4.3	a) Have you received any education and awareness on climate related hazards? 1 = Yes 2 = No b) If yes who provided the education? 1 = Agritex 2= Met department 3= NGO 4=other

<table>
<tr><td>4.4</td><td>List the climate-related hazards you know and how often do you experience these hazards?
<table>
<tr><td>Hazard</td><td colspan="4">Frequency</td></tr>
<tr><td></td><td>Frequently</td><td>Occasionally</td><td>Seldom</td><td>Never</td></tr>
<tr><td>1=Tropical cyclones</td><td></td><td></td><td></td><td></td></tr>
<tr><td>2 = Extreme temperatures</td><td></td><td></td><td></td><td></td></tr>
<tr><td>3 = Hail</td><td></td><td></td><td></td><td></td></tr>
<tr><td>4 = lightning</td><td></td><td></td><td></td><td></td></tr>
<tr><td>5 = drought</td><td></td><td></td><td></td><td></td></tr>
<tr><td>6=mudslides</td><td></td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>4.5</td><td>a) Have you noticed any changes in climate? 1=Yes 2=No
b) Which signs of climate change have you noticed (with respect to your area)?
1 = Floods
2= droughts
3 = Shortening of the rainy season
4 = prolonged dry spells
5 = strong winds
6 = poor rainfall distribution</td></tr>
<tr><td>4.6</td><td>What do you think are the causes of Cyclone Idai?_____</td></tr>
<tr><td>4.7</td><td>a) Do you share/have any spiritual beliefs on what caused Cyclone Idai?
1= Yes 2= No
b) If yes specify _____</td></tr>
<tr><td colspan="2">5. IMPACTS OF HAZARDS</td></tr>
<tr><td>5.1</td><td>What was the status of your livelihoods before Cyclone Idai?
1 = growing
2 = Stable
3 = unstable
4 = collapsing</td></tr>
<tr><td>5.2</td><td>What were your main sources of income before the Cyclone?
1 = cash crops,
2 = fruit agriculture
3 = trading/vending
4 = alluvial mining
5 = saw milling
6 = remittances</td></tr>
</table>

	7 = formal employment
5.3	What was your income per month before cyclone? 1 = under 100 2 = 101 to 200 3 = 201 to 300 4 = 301 plus
5.4	What is your income per month after cyclone? 1 = under 100 2 = 101 to 200 3 = 201 to 300 4 = 301 plus
5.5	What are the major threats to livelihoods in your area? 1 = Climate Change 2 = bad economy 3 = politics 4 = unresolved trauma from cyclone 5 = new crop and livestock diseases 6 = other specify
5.6	What was the impact of Cyclone Idai on your sources of livelihoods? 1 = lost business goods and assets 2 = lost my fields with trees/crops 3 = lost livestock 4 = lost grain 5 = lost farming equipment 6 = lost land
5.7	What is the estimated cost of your losses? 1 = under USD200 2 = 201-500 3 = 501-1000 4 = 1001 plus

5.8 What are the social impacts of Cyclone Idai?

1 = loss of life/livestock

2 = psycho-social

3 = special groups

4 = missing members

5 = loss of property

6 = loss of key documents

7 = loss of arable land

8= increasing conflicts within the community

5.9 In your opinion, how do you rate the level of impact of Cyclone Idai on women, using the following indicators? (Tick)

Impact	Very severe	Severe	Average	Limited
Loss of economic security due to death of spouse				
Psychological trauma due to loss of spouse or children				
Increased economic vulnerability				
Increased vulnerability to ill-heath				
Increased sense of powerlessness due to loss of a male spouse				

5.10 In your opinion, does any of the following apply to youths as a result of Cyclone Idai? (Tick)

Impact	Very severe	Severe	Average	Limited
Loss of economic security due to death in the family				
Psychological trauma due to loss of family members				
Increased economic vulnerability				
Increased vulnerability to ill-heath				
Increased sense of powerlessness due to loss of parents				

5.11 In your opinion, does any of the following apply to internally displaced persons living in or outside tents? (Tick)

	Yes	No
Increased sense of loss due to lack of own shelter		
Increased sense of economic vulnerability due to loss of livelihoods		
Psychological trauma/disorientation due to loss of property		

	Lack of privacy in tents		
	Increased sense of powerlessness due to lack of own space		
	Increased vulnerability to ill-heath due to living conditions		
	Sense of vulnerability in case of any future weather hazards		
	Sense of hope in securing new built shelter or getting relocated		
	Sense of being abandoned by actors who initially responded		

5.12 Have you or members of your family ever settled in the temporary shelters during Cyclone Idai? 1=Yes 2=No

If no skip to 5.17

5.13 If yes to 5.12, for how long ……..

5.14 How were the conditions in the temporary shelters?

Item	Conditions (poor, fair, good, excellent	Provider of the services	Comments
Type of shelter			
Water supply			
Sanitation (toilet facilities)			
Health education			
Medication supply			
Food			
Supplementary feeds for children and elderly			
Lighting			
Other, specify			

5.15 Based on your experience in the temporary shelters, what could be improved next time?
.....

5.16 What was the status of prices of food items during Cyclone Idai?

1 = remained static

2 = rose but comparable to other areas

3 = abnormally rose to unaffordable levels

5.17 What environmental changes have you observed that could be attributed to Cyclone Idai?
_____

5.18 Are you aware of any human rights issues during disaster response? 1 = Yes 2 = No

5.19 In your opinion, were there any human rights violations during and after the cyclone in terms of the following?

	Yes	No
Denial of food aid along political lines		

	Sexual exploitation and abuse of women and girls in need of relief aid		
	Forced relocations from land at the hands of any public officer		
	Right to timely medical assistance		
	Right to protest or to demand accountability on any alleged mishandling of relief aid by state and non-state actors		
	Denial of right to temporary shelter on any unfair grounds		
	Any discrimination on access to relief aid on grounds of gender?		
	Any discrimination on access to relief aid on grounds of ethnicity/social background?		
	Any discrimination on access to relief aid on grounds of marital status?		

5.20	a) Who violated the rights in 5.16? _____ b) Did you report the violence? 1 = yes 2 = No If No, what stopped from reporting _____ c) If yes how do you rate the quality of the response? 1=Excellent 2=Good 3=Fair 4=Poor 5=Very Poor
6. RESPONSE TO HAZARDS	
6.1	Did you receive any early warning about cyclone Idai? 1 = Yes 2 = No If No Skip to 6.7 6.2 what was the source of the information? 1 = Fellow villager 2 = Radio Television 3 = Phone message 2= social media 3= traditional leader 4= government officials 5= other , specify
6.3	How much time did you receive the information before the Cyclone? _____
6.4	What were the shortcomings of the information? 1 = It came too late 2 = it was inadequate to warn people of the pending danger

	3= it was misleading 4 = affected by previous experience 5 = other, specify
6.5	Did you share the information with someone else? 1 = Yes 2 = No
6.6	a) Did you take any safety precaution after receiving the information? 1 = Yes 2 = No b) If yes what precaution did you take 1 = moved to safer areas 2= monitored reports from radio/TV on what was safe to do 3 = Stayed indoors 4 = Nothing
6.7	What is the preferred channel of communication for such hazards? 1 = Traditional leadership 2 = Radio 3 = Television 4 = Phone message 5 = social media 6 = government officials 7 = security personnel
6.7	Who first assisted you during the Cyclone? 1 = Community members 2 = security officers 3 = Red cross 4 = other government agents specify 5 = NGO 6=other specify
6.8	Who else assisted you during and after the Cyclone? 1 = social welfare 2 = security agents 3 = NGOs 4= Faith Based Organisations 5=Private Organizations 4=None 5=All 6
6.9	Who is assisting you now? 1 = social welfare 2 = NGOs 3 = churches

	4=Private Organization 5=None
6.10	Which type of organization assisted you during cyclone IDAI in the following areas?

Area	Type of Organisation		
	CBO	NGO	Government
Relief & Psycho social support			
Water sanitation hygiene (WASH)			
Shelter			
Health cluster			
Search and rescue			
Roads and Infrastructure			
Power and energy			
Agriculture			
Education			

6.11 How do you rate the quality of humanitarian assistance rendered in the following areas? Put a tick under each selected option

Area	Rating			
	Very Good	Good	Average	Poor
Relief & Psycho social support				
Water sanitation hygiene (WASH)				
Shelter				
Health cluster				
Search and Rescue				
Roads and Infrastructure				
Power and energy				
Agriculture				
Education				

How do you rate the performance of government and/or non-government actors on the issues below using the following evaluation scale?

Issue of concern	Rating			
	1 (Very Poor)	2 (Poor)	3 (Average)	4 (Good
Ensuring access to education of affected children and youths?				

	Consulting widely and inclusively on any plans for relocations?						
	Resolving any existing land squabbles						
	Ensuring restoration of roads and communication infrastructure						
	Ensuring access to availability and access to health facilities						
	Ensuring the needs of the elderly and the disabled are catered for.						
	Providing shelter to those left homeless.						
	Providing safety nets to the vulnerable and affected families						
	Alleviating economic suffering as a result of disrupted livelihoods.						
	Restoring livelihoods of affected populations.						

6.12	Did women and girls receive aid related to menstrual hygiene 1= Yes 2= No 3= Do not know
6.13	How do you rate the amount or quality of aid related to menstrual hygiene 1=Very poor 2= Poor 3= Average 4=Good 5= Very good)
6.14	Was there aid on sexual and reproductive health issues of pregnant or lactating women and girls? 1= Yes 2= No 3= Do not know
6.15	How do you rate the amount or quality of aid on sexual and reproductive health issues of pregnant or lactating women and girls? 1= Very poor 2= Poor 3= Average 4= Good 5= Very good).
6.16	Was there preference given to pregnant and lactating women and girls in the provision of humanitarian aid? 1= Yes 2= No 3= Do not know
6.17	Were there efforts to ensure optimal access to clean water by pregnant women and girls? 1= Yes 2= No 3= Do not know
6.18	What would you say was the quality of assistance you got during and after the disaster? 1 = Excellent 2 = very good 3 = good 4 = poor 5 = very poor
6.19	Have you observed any cases of corruption in relief distribution? 1= YES 2= NO _____
6.20	How would you rate response timeliness?

	1 = timely 2 = late 3 = very late
6.21	a) How would you rate the community response immediately after the disaster and now? 1 = Excellent 2 = very good 3 = good 4 = poor 5 = very poor b) Why? (Any response given respondent to explain)
6.22	Do you have any indigenous knowledge systems that help you to prepare for emergencies? 1=YES 2=NO If No Skip to 6.23 If yes, name them_____
6.23	How do you rate the effectiveness of these indigenous knowledge systems that are in place? 1=Not effective 2=Not sure 3=Effective 4=Very effective
7. GOVERNANCE	
7.1	a) Are you aware of your rights to the land you occupy 1 = Yes 2 = No If No skip to 7.2 b) If yes who told you? _____ c) When were you told? _____ d) How were you told? _____
7.2	a) Are you aware of your responsibilities over the land you occupy? 1 = Yes 2 = No If No skip to 7.3 b) If yes specify _____
7.3	a) Do you think that some settlements of houses and fields were in places that made the impact of the cyclone worse? 1=YES 2=NO If No skip to 7.4 b) Specify
7.4	a) Are you aware of local by-laws (*mitemo yemunharaunda*) regarding the land you occupy? 1 = Yes 2 = No If No skip to 7.8 b) If yes specify _____
7.5	Which by-laws (*mitemo yemunharaunda*) exist in your area that could have helped to reduce the impact of the cyclone?
7.6	How do you rate the enforcement of (*mitemo yemunharaunda*) by-laws by the community? 1 = very good

	2 = good 3 = weak 4 = very weak
7.7	If weak or very weak indicate reasons? 1 = low awareness of existence of by-laws 2 = no understanding of existing by-laws 3 = weak local organizations 4 = corruption 5 = low penalties 6 = it interferes with livelihoods
7.8	a) Were there village assembly (*musangano wasabhuku)*/Area committee meetings held in your areas for the last 12 months? 1 = Yes 2= No If No skip to 7.11 b) If yes how frequent _____
7.9	Did any member of your household attend the meetings? 1 = Yes 2 = No
7.10	What issues connected to Cyclone Idai were discussed at these meetings, if you still remember? (multiple responses) 1=Hazard, vulnerability and capacity assessment 2 = Disaster risk identification 3=Risk reduction planning and management 4=Formulating community preparedness plan 5=Formulating emergency and disaster response, evacuation and first aid plans 6=Conducting mock drills / emergency drills 7=Cannot remember
7.11	What measures did you take in response to Cyclone Idai? ……. ……..
7.12	What was the significance of your response in reducing the impacts of the emergency? 1=No significance 2=Low significance 3=Medium significance 4=High significance 5=Not sure
7.13	How do you rate the capacity of local organizations from village to ward level? 1 = very strong 2 = strong 3 = neutral 4 = weak 5 = very weak

7.14	What is needed to strengthen village assembly/ Area assembly committees in your area?
7.15	How do you rate the capacity of district level organizations? 1 = very strong 2 = strong 3 = neutral 4 = weak 5 = very weak
7.16	Local and district organizations that support our livelihoods work well together? 1 = strongly agree 2 = agree 3 = neutral 4 = weak 5 = very weak
8. RECOMMENDATIONS FOR EARLY WARNING SYSTEMS	
8.1	Do you think your community has the necessary information and/or resources to prepare for flooding and landslides? 1= Yes 2=No
8.2	If your community does not have resources, what additional information and/or resources do you feel your community needs? ……
8.3	What are your recommendations as the best communication channel to disseminate weather hazards information? _____
8.4	What recommendations do you have for management of humanitarian assistance? _____
8.5	What are the recommendations for disaster mitigation? _____
8.6	What are the recommendations for disaster response? _____
8.7	What are the recommendations for disaster recovery? _____
8.8	What are the recommendations for disaster preparedness? _____
8.9	What measures can be used to reduce Climate Change _____
8.10	Any comments----------

THANK YOU FOR YOUR TIME

Annex 2: Household questionnaire for KTA 3

Cyclone Idai Research - Agroecology & Land-use Theme (Dec 2019 / Jan 2020)		
Respondent no: …….	Ward (number & name): ……..……..	
Sex: M / F *(circle one)*	Age: ……	
Land owned ……. Ha / managed ……. Ha	Primary source of income: *(circle one)*	
Are you HH head? Yes / No	Farming / trading / building / piece work / Other ……	
Farming Type: What kind of farming do you practice? *(tick one)*		
☐ Agroecology (permaculture, organic, agroforestry, HLLM)		
☐ Conventional (using only hybrid seed, fertiliser etc)		
☐ Both (ie. Organic in home garden / inorganic ferts on drylands)		
1	SETTLEMENT DESIGN: Who is involved in settlement design in your area: (*circle one*) a) Village head b) Ward councilor c) Other farmers d) District Administrator e) RDC f) Other…….	
2	ENVIRONMENTAL REGULATIONS: i) Who is responsible in the design of environmental regulations? *(circle as many as appropriate)* a) Fellow farmers b) Traditional leaders c) RDC d) EMA e) Police f) Extension services ii) Which of the following regulations are adequately enforced? *(circle any as appropriate)* a) Stream bank cultivation b) Veld fires c) Overgrazing d) Evasive species e) Deforestation f) Illegal settlements g) none	
3	LAND-USE DESIGN: Do you practise any of the following? *(circle any as appropriate)*	

	a) Zoning b) Pit coding c) Contours d) Terracing e) Catchment management f) Enterprise choice g) External energy	
4	SOIL MANAGEMENT: Which of the following practices do apply to your farm land to protect the soil? (*circle any as appropriate*) a) Mulching b) Minimum tillage c) Manuring d) Composting e) Terracing f) Swales g) Contouring h) Biological barriers i) none	
5	WATER MANAGEMENT: Which of the following practices do apply to your farm land to improve water harvesting and drainage? (*circle any as appropriate*) a) Terracing b) diversion drains c) contours (dead level) d) contours (drain-away) e) roof-top harvesting f) grey water re-cycling g) none	
6	CROP MANAGEMENT: What techniques and practices do you apply to protect your crops: (*circle any as appropriate*) Crop rotations b) intercropping c) integrated weed, pest & disease management d) push-pull (attractants/repellents) e) natural/organic sprays f) natural fertilisers g) synthetic/inorganic fertiliser h) herbicides i) pesticides j) other……	
7	LIVESTOCK MANAGEMENT: i) How diverse is your livestock enterprise? (*circle any as appropriate*) a) Cattle b) goat c) sheep d) donkey e) broilers f) layers g) roadrunners h) ducks i) fishing j) others……. ii) What techniques and practices do you apply to your livestock production: (*circle any as appropriate*)	

	a) Ethnoveterinary medicines b) controlled breeding c) conventional chemical parasite control d) dehorning e) tagging f) artificial insemination g) cross-breeding h) branding	
8	PASTURE & RANGELAND MANAGEMENT: How do you manage the rangeland and pasture your livestock accesses: (*circle any as appropriate*) Balancing of grazers & browsers b) paddocking c) silvo-pasture d) grass-legume mixtures e) fertilisation f) controlled grazing g) stocking rate management h) grass species composition measurements i) none	
9.	CATCHMENT LEVEL: Does your community currently engage in the following catchment level management activities to manage run-off and soil loss: (*circle any as appropriate*) Afforestation b) Gully reclamation c) terracing d) wetland management e) upland grazing & species management f) protection of sacred spaces g) none	
10	APPROPRIATE TECHNOLOGIES: Which of the following energy methods have you adopted over the past 12 months: (*circle any as appropriate*) a) Zesa b) solar c) biogas d) energy efficient stoves e) natural gas (LPG) f) none	
11	LAND-USE & CYCLONE IMPACTS: Which land use system was more susceptible to the effects/impact of the cyclone? (*circle one*) a) Agroecologically managed farmlands b) conventionally managed farmland c) grazing lands d) forest plantation areas e) undisturbed areas	
12	FARMING SYSTEMS: Which farming practice/land use system suffered more destruction under the cyclone? (*circle one*) a) Agroecology farmlands b) conventional farmland c) grazing lands	

	d) forest plantation areas e) undisturbed areas	
OPEN QUESTION: What have you noticed about which landscapes fared better during the cyclone?		
B: Social resilience		
1	KNOWLEDGE GENERATION: Where does the community get knowledge on social learning and survival? (*circle any as appropriate*) Own knowledge b) Expert knowledge c) Look and learn visits d) Other farmers e) Indigenous knowledge systems f) Local leadership g) Spiritual knowledge	
2	INCLUSIVE AND JUST LEADERSHIP: Local leadership involves all stakeholders in decision making systems eg. agriculture development: *(circle only one)* Never b) Sometimes c) Always	
3	FAMILY & COMMUNITY COHESION: Our family and communities solve problems together in the following: (*circle any as appropriate*) Disputes b) Food security issues c) Environmental reclamation d) Stock theft e) Gender based violence	
4	RESPONSIVE & INCLUSIVE COMMUNITY STRUCTURES: Community reaction time to a problem/threats/vulnerabilities has been: *(circle only one)* Quick response b) Slow response c) No response Your community preparedness includes the following groups*? (circle as appropriate)* Women groups b) Youth groups c) Churches d) Political structures e) Traditional leadership f) NGOs g) Government h) Disabled persons	

5	EQUAL OPPORTUNITIES FOR WOMEN & YOUTHS: Which of the following involve women, youths and disabled people in decision making: (*circle any as appropriate*) a) Education b) Income c) Food security d) Health e) Access to land f) Input distribution	
6	HEALTHY & APPROPRIATE HOME DESIGNS: Which home designs have you applied at your own homesteads: (*circle any as appropriate*) Ventilated kitchen b) Round thatched kitchen c) Granary d) Drying cribs (*dandara)* e) Brick reinforcement f) Small livestock pens g) Wind breaks	
7	HEALTH VISITS & MEDICINE: Over the last 12 months, how many times have you visited a health centre? *(circle one only)* 1-3 times b) 4-7 times c) 8 - 10 times d) we can't afford to attend	
8	SOCIAL FARMING: What kind of farming practices do you share with others: (*circle any*) Seed b) Labour (*nhimbe*) c) *Zunde raMambo* d) Knowledge e) Skills f) Exchange of crop and animal germplasm g) Collective herding h) none	
9	DIVERSITIFED SOCIAL ACTIVITIES: Which kind of inclusive social activity do you participate in? (*circle any as appropriate*) Sports clubs b) Seed fairs c) Cooking competitions d) Weaving clubs e) Saving and lending clubs f) Farming clubs	
OPEN QUESTION: Do you find joy in your farming activities? Why?		

C: Resilient Livelihoods		
1	LAND TENURE: In your opinion, land in your area is fairly distributed. *(CIRCLE one)* a) Strongly agree b) Agree c) Disagree d) Strongly disagree e) I'm not sure	
2	SEED SOVEREIGNTY: How many seed varieties/types do you currently save? *(circle only one)* a) 0 b) 1-3 c) 4-6 d) 7-9 e) 10-15 f) 15 and above Are you involved in any of the following seed initiatives: *(circle any as appropriate)* a) OPV seed sharing b) Participatory seed breeding c) Seed storage d) Seed marketing	
3	POST HARVEST & LOSS CONTROL: What kind of methods do you use to preserve your grain? *(circle as many as appropriate)* a) Burning ash b) botanical c) smoking d) Chirinda Matura e) tablets f) Other…….	
4	FOOD SECURITY & NUTRITION: How many months of the year are you food secure (when you eat 2 meals per day)? *(circle only one)* 3 b) 6 c) 8 d) 9 e) 12 Do you currently grow and regularly consume the following *(circle as appropriate)* Meat b) leaf veg c) small grains d) fruits e) root veg	
5	VALUE ADDITION: Do you add value to your produce? A) yes b) no If yes, what techniques do you use: a) drying b) jams c) grinding d) smoking e) other…….	
6	FARMER DEVELOPED INNOVATIONS: Which areas have you developed innovations? *(circle any as appropriate)* Livestock b) Field crops c) Horticulture d) Water management	

	e) Soil management f) Soil fertility g) Seed systems h) Pests and diseases i) Other……	
7	INNOVATIONS & RECOMBINATIONS: Where do you draw innovations that you merge with your own? *(circle as many as appropriate)* NGOs b) Government c) Fellow farmers d) Media e) Nature f) Universities g) Spiritual leaders h) Other……	
8	MARKET LINKAGES: Our produce have a guaranteed established market. *(circle one)* a) Strongly agree b) Agree c) Disagree d) Strongly disagree e) Not sure	
9	DIVERSIFIED LIVELIHOODS: How many livelihood options do you pursue? *(circle any as appropriate)* Agricultural b) Mining c) Trading d) Remittances e) Hired labour f) Other……	
10	SURPLUS HH INCOME: Over the last year, what have you been able to invest in? *(circle any as appropriate)* Buy kitchen utensils b) buy livestock c) Solar system d) Farm equipment e) House improvement f) Small business g) Other…….	
11	ENTREPRENEURSHIP: Which entrepreneurial projects are you involved with? *(circle any as appropriate)* a) Bee keeping b) Fishing c) Petty trading d) Brick moulding e) Crafting f) Catering g) Dressmaking h) Hair dressing i) Building j) Carpentry k) Wild harvests l) Other……..	
12	GENDER & DECISION MAKING: I am able to do the following without my spouse's permission: (*circle*	

	where appropriate) Take formal work b) Animal decisions c) Farming land use d)Seed sovereignty e) Make own decisions when the spouse is absent	
OPEN QUESTION: How can social farming buffer households from the effects of cyclones/droughts and recovery?		

Annex 3: Key Informant Interview Guide, KTA 3

Landscape Resilience

1. How have land-use practices changed over time?

Two years before cyclone……
……
……
……

After cyclone
……
……
……

2. Who has been responsible for these changes? Give names and the role played on landscape changes……
……
……
……

3. After the cyclone, what did you notice about which landscape were most resilient, and why do you think that was?.....
.....
.....
.....

4. What changes did you notice in the landscape after the Cyclone?

Field……
……

Grazing land……
……

Forest areas……
……..

River banks……
……

Homesteads……
……

How would you compare how the landscape around your community fared during Cyclone Idai with previous extreme weather events (such as Eline in 2000, and the storm of 1992 or any other drought)?.....
.....

.....
.....

Social Resilience

In the aftermath of the cyclone how were you / your neighbors able to support others to recover (sharing seed, loaning equipment, assisting with labour for planting etc ….)

……
……
……

Do you think that your community would work together to undertake large earthmoving projects to:

a) create terracing to stabilise soil and reduce run-off……

b) dig small dams to collect, sink and store water?
……

If yes, why? Who do you think would initiate those activities?.....

If no, what are the reasons?.....
.....

a) In your opinion, is there a difference in how agroecological farmers and conventional farmers work collaboratively together to solve problems?
……
……

Is there a difference between how women, youth and men work together under different landscape use?.....
.....
.....

Livelihood Resilience

Recovery strategies applied - What are the strategies used before and after Cyclone and production levels before the cyclone and how long it took / will it take to return to those levels……
……
……

a) What kind of innovations (new solutions) or experiments have been applied - and in what combination?
……

……
……..

Do you think they have been useful in mitigating the worst impacts of the cyclone and/or droughts? If yes, why or how?.....
.....
.....

Given the chance to rebuild your community after the cyclone, how would you rebuild it so that it was better than before - what would 'building back better' mean to you? And who would be involved?.....
.....
.....

How would you compare earnings from farming over the 12 months before and 12 months since the cyclone under AE and Conventional farming?.....
.....
.....
.....

Anything you would like to say about your farm land in relation to extreme weather conditions……
……
……..

Annex 4: Pit Coding Tool

Comparative Study into Functional Agroecological Systems As Tools for Mitigation and Adaptation to Climate Change and Disaster Risk amongst Vulnerable Communities

Research Hypothesis: Agro-ecological practices and sustainable land-use management systems are effective in reducing the vulnerabilities of resource-poor/disadvantaged communities to climate change and disaster risk impacts.

Activities 5 & 6 together are:

i) Field transects/exchanges (x 4 wards Chikukwa, Nyahode, Biriiri and Chakohwa -Mhandarume will be included in passing for soil infiltration measurements) will be carried out to assess how the fields, gardens, orchards, grazing areas and forests were comparably affected in areas under agro-ecological practice, conventional small-scale practice in each ward and agro-industrial practice for Biriiri. Transects will include groups of farmers (made up of an Agricultural Extension Worker, a local elder/traditional leader and three others) to run on Cyclone affected sites and non-affected adjacent sites in order to assess effect impinged on land management. A checklist will be used to describe each landscape with farmers determining what constitutes resilience or lack of resilience in each production system. This checklist will be developed together with farmers. Important information during this phase will include cropping diversity, tillage, mulch management, soil nutritional management (where farmers use "farmer friendly" tests indicate adequacy or deficiency using their own indicators - nitrate (B-743 LAQUAtwin Nitrate meter - general purposes will be brought from MSU to measure nitrates during farmer exchanges between 0 to 45 cm soil depth) and pH measurements will be carried out by principal researchers during this period), soil texture, soil structure, bulk density, determination of soil moisture (gopher probes and other farmer developed methods), identification of soil biological organisms (earth worms, termites, ants etc), methods of manuring and composting, agroforestry, forestry density and diversity, general ground cover, soil and water conservation mechanisms, animal diversity, animal management methods, pasture types, pasture density and diversity.

i) Sampling of sites

The referred 4 wards were purposively sampled with Chikukwa being the best ward during the formal survey in the South-East Cluster while Nyahode was the least performing. In the Western Cluster Biriiri was selected as being the one with the most affected terrain from the Cyclone though it performed well in the formal survey while Chakohwa was the least performing. Within each production system, a double diagonal sampling system for non-uniform fields will be done to collect soil samples using hand hoes to a 30 cm depth, pasture diversity, tree diversity etc. The 15 samples will be collected after every 10 m. The soil will be composited and various physical, chemical and biological (earthworm, termite activity etc) analysis will be carried out together with farmers. With reference to farmer friendly tests will follow methods developed by The Permaculture Association as suggested by *Dr G McAllister* (Warburton-Brown and Kemeny, 2015). For more in-depth lab analysis, a 2 kg sample will be taken for drying and sieving. On pasture density and diversity, 5 samples using a 1 m x 1m quadrant will be used or alternatively 15 samples using a 30 cm x 30 cm quadrant.

ii) Soil surveys by principal researchers will include pit coding, soil sampling for lab analysis, soil infiltration and soil water balance (TSURO to advise communities reasons behind taking soil samples through AEW)

Five soil pits will be dug to compare the soil profile between agroecological and conventional farming systems. These pits will be 1 m x 1 m up to parent material. **(Pits will be covered after the pit coding process)** An extra 10 pits will be dug in grass covered and forested areas at Biriiri to describe the causes of landslides in the area. A tap measure will be used to determine the depth of each soil horizon (Fig 1). Slices of soil will be obtained to determine soil structure by co-researchers. AEWs and co-researchers who will participate in soil profiling of major and minor horizons need to be trained on how to characterise soil pits for land use assessments. Further soil samples will be taken for in-depth lab analysis from the top 15 cm in pastures, 30 cm in cropping fields and 60 cm in forested areas. Of importance in the soil analysis will be soil carbon, nitrogen, phosphorus, potassium, pH and other minerals.

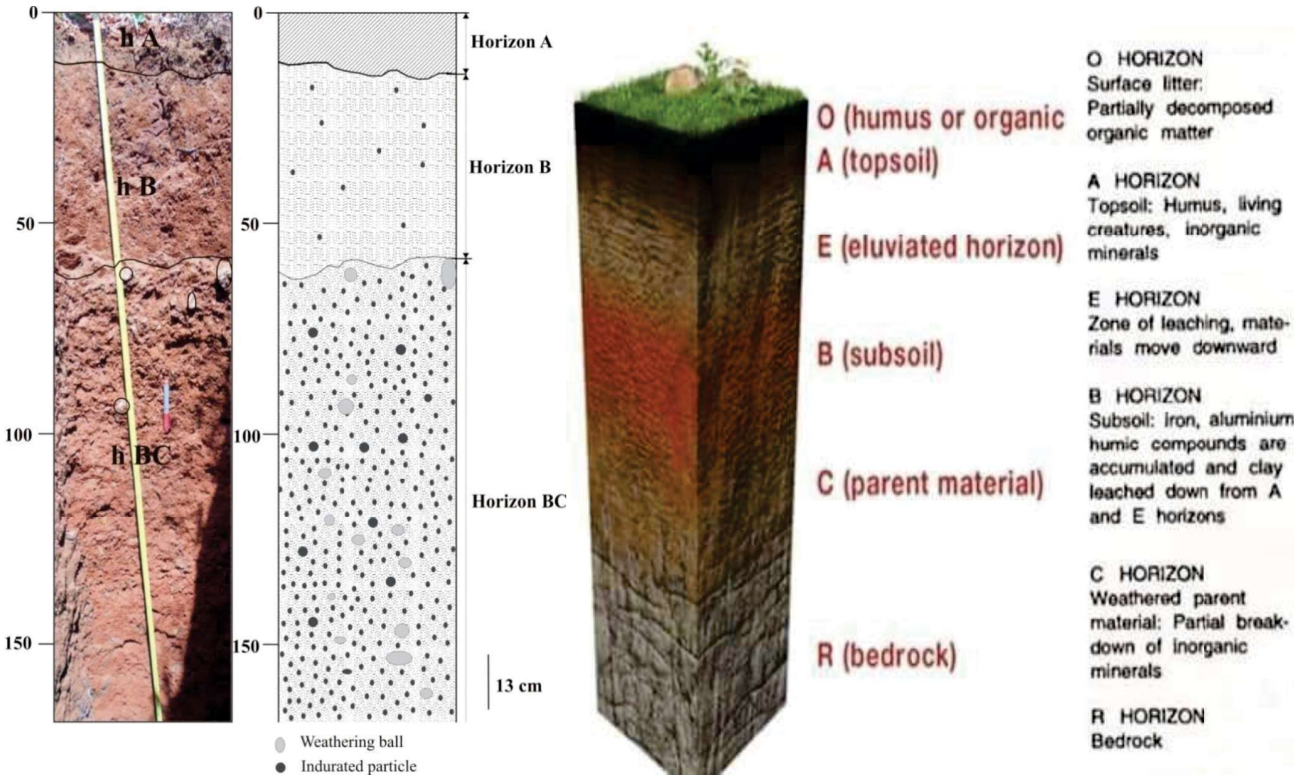

Fig 2: Example of different soil horizons found in a soil pit

Infiltration

The double ring inflitrometer test will be used to measure infiltration in each of the five sites per production system.

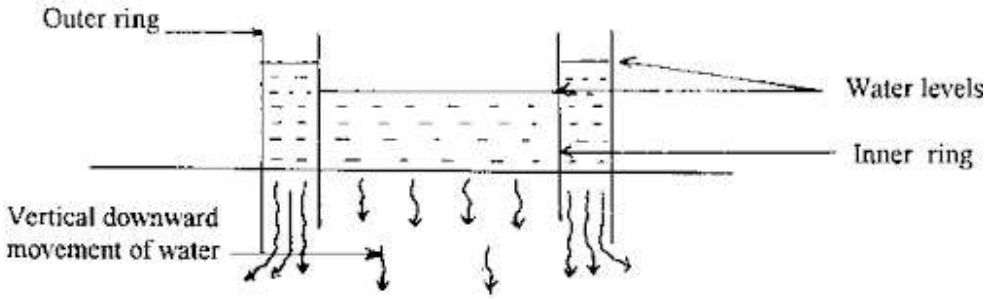

Fig 3: The double ring infiltrometer for measuring soil infiltration rates (will use basic food tins as suggested by the Permaculture Association)

Water Balance

Gopher probes to be brought from the Midlands State University will be used to measure changes in water balance between AE and CF fields between 0 to 150 cm soil depth. An access tube will be inserted in each of the five sites at Chikukwa and Chakohwa (20 in total). The sites within each ward should be as homogenous as possible. AEW will use probes to measure changes in soil water every week up to 8 weeks. The major aim of this method is to determine the farming method that results in reduced evapotranspiration.

iii) Key informant interviews and observations on issues that needs to be clarified including information gaps will be done concurrently.

a) Define the types of AE and CF farming methods……
……
……
……
…….

b) On farms where both AE and CF are practised, which crops or farming methods are AE?.....
.....
.....
.....

c) How is composting and manuring done? Which tree/plant species are used in composting?.....
.....
.....
.....

List other types of manure used under AE and CF……
……
……
……
……

d) To what extent have farmers adopted soil and water conservation structures?.....
.....

.....
.....

e) How can your seed systems and participatory breeding methods be improved?.....
.....
.....
.....

f) To what extent have farmers included biological barriers as both reducing external energy like wind and rains including in nutrient recycling and provision of fruits, firewood etc?
……
……
……
……
……..

g) What are the pros and cons of evasive species on their environment?.....
.....
.....
.....

h) What are positives for controlled grazing and carrying capacities?.....
.....
.....
.....

Annex 5: Veld Condition Assessment Tool, KTA 3

Assessment of Grazing Areas

.

The following criteria based on floristic composition will be used;

The proportion of plants which decrease, increase or invade under degrading landscapes

Ecological Status

Ecological conditional classes are as mentioned in Table 1.

ECOLOGICAL STATE	CLASSIFICATION	Score
Excellent	75 – 100 % of climax species	9-10
Good	50 – 75 % of climax species	7-8
Fair	30 – 49 % of climax species	5-6
Poor	5 -30 % of climax species	3-4
Very Poor	<5% of climax species	0-2

Process

Veld condition score sheet

Ward……. Farmer……..

Site Position……Date of Survey…….

	ASSESSED SITES							
Criteria	A	B	C	D	E	RATING	SCORE	VELD FINAL RATING
	SCORES							
Grass spp composition						Excellent	10-9	40+
Ground cover						Good	8-7	30-40
Forage Production						Fair	6-5	20-30
Litter and plant residues						Poor	4-3	10-20
Soil compaction and erosion						Very Poor	2-1	0-20
Veld Final Rating								

Grass spp Composition

- Excellent = 75 – 100% made of decreaser species
- Good = 50-75 % decreaser species
- FAIR = 30-50% decreaser species
- Poor 5-30% decreaser species
- Very poor <5% decreaser species

Ground Cover

- Excellent 9-10 no bare spaces (90-100%)
- Good 7-8– occasional bare spots (70-80%)
- Fair – 5-6 cover thin and patchy (50-60%)
- Poor – 3-4 large bare spaces (30-40%)
- Very Poor 1-2– Bare spaces with little noticeable cover (10 -20%)

Forage production

e.g highest carrying capacity expected = 1:15

Present carrying capacity = 1:25

Percentage forage production = 15/25 * 100 =60%. Thus, giving point score of 6 for forage production.

Litter and Plant residues

- Excellent – Abundant residue. 90-100% of litter made of desirable grass spp (9-10)
- Good – moderate amounts of litter. 70-80 %of litter from non-forage spp (7-8)
- Fair – very uneven litter. 50 – 60 % of litter from undesirable invader plants (5-6)
- Poor – inadequate litter. 30-40% of litter mostly tree leaves (3-4)
- Very Poor <20% litter cover (1-2)

Soil Compaction and Erosion

- Excellent -No evidence of soil movement (9-10) -90-100%
- Good – Slight soil movement but difficult to recognize, litter piled against plants (7-8) – 70-80%
- Fair – moderate soil movement, noticeable soil compaction but not excessive (5-6) 50-60%
- Poor – Soil movement advanced, no plant cover or litter, large bare spaces & gullies (3-4) -30-40%
- Very Poor – Severe soil movement, sub soil exposed and clear erosion & gullies (1-2) 10-20%

Annex 6: Names of Co-Researchers, KTA 3

WARD	NAME OF CORE RESEARCHER	CELL NUMBER
Biriiri -ward 17	Marinda Terence	0773971075
	Majokwiro Queen	0774151618
	Ngarivhume Rudo	0775190335
	Dzaerera Nomatter	0776973109
	Mandeya Rostand	0782201875
Ngorima B ward 22	Mundeta Clever	0782954793
	Mawacha Cosdence	0771968641
	Nyakazeya Washington	0779581851
	Ngaaite Godfrey	0779160297
	Mwadzura Jennifer	0775051062
	Muzondi Winnet	0786351226
Chakohwa -ward 3	Nenhowe Samuel	0773800695
	Utete Mercy	0783164838
	Mwazika Sibongiso	0783256182
	Chiminya Winnet	0784667701
Chikukwa -ward 10	Musango Pardon	0775403760
	Mutambikwa Sarudzai	0777008706
	Muchakubvura Aaron	0772828883
Martin-ward 11	Mufute Farai Lovemore	0773068830
	Ngorima Shylet	0778373590
	Murata David	0774051132
	Chenjerai Ezekiel	0778865723
Chayamiti -ward 6	Mukwindidza Themba	0775654162
	Gwekwe Ottilia	0779145691
	Mwapenya Rhodah	0773122609
	Madzianike Rita	0782654957
	Makamanzi Ednah	0774832943
	Masakure Ever	0783339912
Nyahode-ward 13	Sigauke Freeman	0772688210
	Mhlanga Emely	0776938374

	Chimusoro Stephen	0714074316
Ngorima A-ward 21	Baradza Emilia	0779951278
	Zithi Emmah	0775090889
	Makerekete Abigale	078660591

Annex 7: Ethics/Consent Form

Building Resilience to Natural Disasters

in populated African Mountain Ecosystems.

The Case of Tropical Cyclone Idai in Chimanimani, Zimbabwe

Research co-ordination: TSURO Trust

You are invited to take part in a research study commissioned by the TSURO Trust. The study is a collaboration between a team of experienced researchers from organisations and universities across Zimbabwe and internationally and takes place in accordance with a strict ethics procedure to protect those taking part. The study will take place over six months: Oct 2019 **-** April 2020. A further action research phase will be carried out over 12 months until April 2021.

Your contribution will take the form of either a **one-to-one interview**, a **focus group discussion** with others, or a **survey** (circle as appropriate). Before you take part, it is important that you have read and understand the accompanying **Research Information Leaflet** – which is your own to keep and take home.

Confidentiality

If you consent to your contribution being digitally recorded, it will be stored in a safe location until it is transcribed. It will then be destroyed to protect the information you have provided alongside your identity. It is important that you take your time to decide if you want to take part in this study.

For any further information

Please contact us if you have any further questions or concerns. You can contact us via Solomon Mwacheza at the TSURO Trust: 026 2784 / 3049/2804.

1	I have read and understand the information leaflet on this study, and have been given the opportunity to ask questions	Yes	No
2	I understand that my contribution is voluntary and that I can withdraw at any time, along with any information I have provided	Yes	No
3	I understand that all the information provided will be treated in the strictest confidence	Yes	No
4	I agree to have my interviews digitally recorded	Yes	No
5	I consent for information collected about me to be used in related academic publications	Yes	No
6	I agree to volunteer in this study	Yes	No

---------- ---------- ----------

Your Name Your Signature Date

---------- ---------- ----------

Researchers Name Researchers Signature Date

Annex 8: Summary Information Needs for KTA 4

Forestry info from Forestry Company & the RDC Chimanimani:

1. Land size under commercial forests by a) operating company, and b) 'crop/tree type';
2. Timber production (volumes harvested) over the 2017 to 2019 period;
3. Sector size in terms of number of employees in 2017, 2018 and 2019;
4. Market channels by type of timber 'consumed' and volume distributed;

Crop and livestock assessments and food security issues in Chimanimani:

1. Summary or characterization of the agricultural system in terms of its crop and other diversities;
    a. Land under plantation agriculture;
    b. Grazing land;
    c. Land legally and illegally settled
    d. Income estimates by agricultural subsystem (fruits, crops, livestock and others) by ward;
2. Agro-ecological classification across the district in terms of size/percent of land area;
3. Conservation works 2017-2019 and how these were affected by Cyclone Idai;
4. Seed systems for crops and fruits as well as tubers e.g. bananas, magogoya, madhumbe, pineapple;
5. 2016/17 to 2018/19 season crop estimates for major crops;
6. 2016/17 to 2018/19 season crop outturn;
7. 2016/17 to 2018/19 livestock numbers by type;
8. Livestock distribution in the district by type;
9. Yields per hectare differences between agro-ecological and conventional agric systems;
10. Number of food insecure households during the 2017, 2018 and 2019 lean seasons;
11. Agro-dealers and major buyers of agricultural produce;
12. Agro-processors from household-level firms to bigger enterprises;
13. Irrigation schemes (spatial location and status/performance);

SME data from responsible Ministry Chimanimani:

1. Total number of registered SMEs by sector for 2017, 2018 and 2019;
2. Total number of registered SMEs by gender of owner for 2017, 2018 and 2019;
3. Sector size in terms of number of employees in 2017, 2018 and 2019;
4. Loans extended to SMEs by sector for 2017, 2018 and 2019;
5. Enterprise success rate as measured by a) performing loans, b) job creation for 2017, 2018 and 2019 by sector;
6. SME challenges and responses (past, present and future)

Mining & other economic data from OPC Chimanimani:

1. Overall size of the mining sector by mineral type for 2017, 2018 and 2019 as measured by value of output;
2. Sector size in terms of number of employees in 2017, 2018 and 2019;
3. Sector challenges and responses (past, present and future);
4. Size of other economic sectors in the district in terms of both value of output and number of employees as follows:
    a. Plantation agriculture (tea, coffee and timber);
    b. Fruit agriculture (banana, pineapple etc);
    c. Tourism;
    d. Manufacturing;

State of the environment from EMA and RDC Chimanimani

1. Data on fines for environmental infractions for 2017, 2018 and 2019 by ward and type of infraction e.g. streambank cultivation, fire, sand abstraction etc;
2. Fire outbreaks recorded 2017-2019 by ward;
3. EIA's conducted 2017-2019 by project type and summary of mitigation ideas suggested;
4. Number of natural resource conflicts by ward and category i.e. in relation to mining, forestry and non-timber forestry product extraction etc.);

5. Quality (and effectiveness) of available conflict management or resolution mechanisms;
6. Environmental management challenges and responses

Business licensing trends, building permit applications and payments to Chimanimani RDC

1. Total number of licensed businesses by type (e.g. retailers, bottle stores etc) for 2017, 2018 and 2019;
2. Development and building permits issued by type of development (e.g. house construction etc) for 2017, 2018 and 2019;
3. Development levy collection efficiency by ward for 2017, 2018 and 2019;
4. Overall Council budget performance measured in terms of variance analyses:
    a. Whole budgets for 2017, 2018 and 2019;
    b. By revenue source;
5. Key 'programs/projects' funded by Council in terms of sectors for 2017, 2018 and 2019

Fruit trade data from relevant farmers' associations in Chimanimani

Data on cereal wholesaling and distribution from GMB ;

1. Maize grain inflows and outflows for 2017, 2018 and 2019 buying and selling seasons;
2. Small grains inflows and outflows for 2017, 2018 and 2019 buying and selling seasons;
3. Local sales if possible by ward;
4. Outside sources of grain (e.g. inter-depot movements directed to GMB Chimanimani)

Small stock production trends

Role of NGOs in livelihoods (which, where, outcomes & issues)

Banking (financial services) information from CBZ, POSB and Micro-finance Institutions:

1. Top 50 bank/MFI clients by sector;
2. Lending or loan books by sector;
3. Non-performing loans (NPLs) by sector;

Information from Chimanimani RDC

1. Land ownership & structure across the district (large-scale commercial farming to smallholders);
2. Key economic actors (top 40-100 businesses by key sector);
3. Political organizations in the district and key political actors (top 40-100 politicians);
4. Existing Council by-laws and resolutions with a bearing on livelihoods, environment and local governance;
5. Sector and spatial distribution of NGO interventions (projects and programs) before, during and after Cyclone Idai (GIS Maps);
6. Traditional institutions (Map showing chieftainship boundaries, number of headmen and village heads), their performance and relevant issues with a bearing on good local governance;

Information/data required of the Ministry responsible for Women's Affairs

1. Gender-based Violence (GBV) cases before, during and after Cyclone Idai;
2. ASHR issues (state and partnerships responding to issues before, during and after Cyclone Idai);
3. Support to girl children in the district by type of support and ward;
4. The partners that the Ministry has closely worked with over the years and in responding to Cyclone Idai;

Information required of the Ministry responsible for Education

1. Summary of education services in the district (formal and informal) including enrolment (primary, secondary and tertiary 2017-2019);
2. Education infrastructure (classroom, housing and WASH facilities);
3. Key educational indicators:
    a. Pass rate (2017-2019) disaggregated by level (primary and secondary) & gender;

b. Dropout rates (2017-19) disaggregated by level (primary and secondary) & gender;

4. BEAM reach (and thus performance) for the years 2017-19;
5. Child marriage cases by school zone (cluster);
6. Children with disabilities enrolled in schools in the district 2017-2019 (as a measure of inclusion);
7. Number of schools affected by Cyclone Idai by type of impact e.g. WASH damage, classrooms, access road etc. and state of response;
8. State and performance of School Development Committees and others structures in the district overall and regarding Cyclone Idai response management;
9. The partners that the Ministry has closely worked with over the years and in responding to Cyclone Idai;
10. Comment on Ministry capacity (technical, financial, equipment etc.);

Information required of Ministry responsible for social welfare

1. Policy documents on Early Warning Procedures and Institutions (EWP/I) as well as Alternative Technologies (AT) relevant to disaster risk management (DRM);
2. People living with disability in terms of numbers by Ward between 2017 and 2019;
3. State and performance of Child and Social Protection structures in the district overall and regarding Cyclone Idai response management;
4. Cash-based and non-cash programs/projects underway in the district from 2017-2019 including actual CI responses by partner, ward where implemented and reach (target group);
5. BEAM implementation and reach over the years;
6. Psychosocial support (PSS) services provided in the district in terms of reach (2017-2019) with Cyclone Idai -specific data;
7. Number of child-headed households and other 'social welfare cases' by ward supported/reached 2017-19;
8. Child labour issues in the district by ward;
9. Complaints received in relation to Aid administration before (2017-19), during and after Cyclone Idai and the responses offered (handling procedures and outcomes);
10. Key Informants on Social Protection issues in the district that can shed more light on issues before, during and after CI
11. The partners that the Ministry has closely worked with over the years and in responding to Cyclone Idai;
12. Documentation like MOUs and other operational agreements with agencies involved in social protection activities before, during and after Cyclone Idai (CI);
13. Comment on Ministry capacity (technical, financial, equipment etc.);

Annex 9: Capacity Assessment Form for Institutions, KTA 4

Name of Organization: (e.g. Ministry of Local Government and Public Works, Plan International etc.)

……
……

Department/Unit/Office: (e.g. Office of the District Development Coordinator)

……
……

Number of full-time employees

Total: …… **Establishment**: ……

Rate **(by ticking the appropriate box)** the following critical capacity dimensions with respect to your organization's **Chimanimani operations/office**

Dimension	Rating (1 being **inadequate** & 5 **very adequate**)				
	1	2	3	4	5
Staff numbers	1	2	0	3	1
Staff skills or competences Conceptualize & deliver rapid responses	1	1	1	2	2
Mobilize financial & other resources for your work	0	1	3	2	1
Relate with or partner other strategic organizations	0	0	2	2	3
Staff motivation/morale	0	1	5	0	1
Your organization's performance during Cyclone Idai	0	1	1	1	4
Your organization's performance since Cyclone Idai	0	1	1	3	2
Your organization's **operational resources currently** ICT Equipment including Internet Connectivity	1	0	2	1	3
Office space	3	1	0	2	1
Office furniture	3	1	1	1	1
Office consumables (printing paper)	1	3	1	1	1
Vehicles for fieldwork (includes fuel & servicing)	4	1	0	1	1
Your organization's engagement with and supporting of the community (EXTENSION EFFECTIVENESS)	0	0	2	5	0
Quality of **development planning** in the District	0	0	6	1	0
Quality of development coordination	0	2	2	3	0
Your organization's top/priority **capacity need (1)**					
Top/priority **capacity need (1)** to enhance development planning and coordination					

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