

Final Report

MITIGATION OF THE IMPACTS OF CYCLONE IDAI IN THE BUPUSA TRANSBOUNDARY BASINS OF MOZAMBIQUE AND ZIMBABWE

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Prepared by the Centre for Applied Research with Hatfield Consultants Africa
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The authors' views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States government.

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Abbreviations

ACP	African, Caribbean and Pacific
AfDB	African Development Bank
BBB	Build Better Back
BUPUSA	Buzi, Pungwe and Save River Basins
CAMPFIRE	Communal Area Management Program for Indigenous Resources
CAR	Centre for Applied Research
CBNRM	Community Based Natural Resource Management
CCA	Climate Change Adaptation
CENOE	Regional Emergency Operation Centers
CERP	Cyclone Emergency Recovery and Resilience Program
CPU	Civil Protection Unit
DCP	Department of Civil Protection
DMF	Disaster Management Fund
DNDRH	Directorate of Water Resources Management
DRM	Disaster Risk Management
DRMC	Disaster Risk Management Committee
DRR	Disaster Risk Reduction
EBA	Ecosystem Based Adaptation
EMA	Environmental Management Agency
EU	European Union
EWS	Early Warning System
GACOR	Reconstruction Coordination Office
GAR	Global Assessment of Risks
GDFRR	Global Facility for Disaster Risk reduction and Recovery
GoM	Government of Mozambique
GoZ	Government of Zimbabwe
GRI	Global Risk Index
HCA	Hatfield Consultants Africa
ICP	International Cooperating Partners
IDP	Internally Displaced Person
IFRC	International Federation of Red Cross & Red Crescent Societies
INFORM	Index for Risk Management
INAM	National Institute of Meteorology
INGC	National Institute for Disaster Management
IOM	International Organization for Migration
MICOA	Ministry of Environment
MPD	Ministry of Planning and Development
NB(A)	Nature-Based (Adaptation)
NCPC	National Civil Protection Committee
NCPF	National Civil Protection Fund
NGO	Non-Government Organization
OECD	Organization for Economic Cooperation & Development

PERC	Post Event Review Capability
PDNA	Post Disaster Needs Assessment
PIERRP	Post Cyclone Idai Emergency Recovery and Resilience project
RINA	Rapid Impact and Needs Assessment
RWP	Resilient Water Program
RLA	Rural Livelihood Assessment
SA	Sendai Framework Key Area
SADC	Southern African Development Community
SEP	Stakeholder Engagement Plan
UN	United Nations
UN-ECA	UN-Economic Commission for Africa
UNDP	United Nations Development Program
UNDRR	United Nations Office for Disaster Risk Reduction
UNICEF	United Nation's Children Fund
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNOPS	UN Office for Project Services
USAID	United States Agency for International Development
WASH	Water, Sanitation & Hygiene
WMO	World Meteorological Organization
ZINWA	Zimbabwe National Water Authority
ZIRP	Zimbabwe Idai Recovery project
ZRRF	Zimbabwe Recovery and Resilience Framework

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1 Introduction

This report discusses **responses to and mitigation measures** for the impacts of Cyclone Idai in Mozambique and Zimbabwe, particularly in the Buzi, Pungwe and Save (BuPuSa) transboundary river basins. An earlier report discussed the **impacts** of the cyclone based on geospatial and socioeconomic assessments (CAR and HCA, 2020). The report is an output of the project “Impact assessment and Strengthening Community Resilience” in Mozambique and Zimbabwe. This project is part of the Resilient Waters Program (RWP), funded by the United States Agency for International Development (USAID) and implemented by Chemonics.

One of the findings of the Impact Report is that high vulnerability at the national, community and household level causes more damaging impacts (CAR & HCA, 2020). In this sense, vulnerability and resilience are opposites. Key to resilience building is therefore reducing vulnerabilities at all levels. For example, livelihood diversification reduces household vulnerability, and social cohesion and community capital reduce community vulnerability. At the national level, sufficient human and financial resources as well as effective governance disaster risk reduction structures reduce vulnerability.

At least four challenges are critical to disaster risk management (DRM), reconstruction and mitigation in future:

- a. **Full integration of DRM and climate change adaptation (CCA) in development planning.** Climate change is happening and cyclones such as Idai will recur, so disaster risk reduction and management (DRR and DRM) need to be fully integrated in development planning to achieve sustainable development. *“As we know, after the event is before the next event”* (Venkateswaran *et. al.*, 2020, p.4);
- b. **DRR and DRM must be anchored at the community level.** Communities need to be fully involved in DRM and be sufficiently equipped to be prepared and quickly act on early warning system (EWS) information. Reaching and empowering communities is not easy and often time consuming, particularly when infrastructure has been damaged, as was the case with Cyclone Idai. Therefore, community DRR structures and capacities need to exist prior to events to ensure timely and adequate community actions as well as to take preventive measures;
- c. **Community resilience must be enhanced.** Community based DRR structures need to be established and strengthened where they already exist. Moreover, livelihoods need to be diversified;
- d. At the national level, governments need to establish an **enabling environment with sufficient human and financial resources**. This is hard for low-income countries, and both Mozambique and Zimbabwe require significant international support. Such support has been indispensable in the case of Cyclone Idai relief. International support involves many government and non-government agencies, whose activities need to be efficiently coordinated to reduce the pressure on limited capacities in the countries; and
- e. **International support is often more readily available for short-term relief efforts than for long-term rebuilding and recovery efforts.** Yet, real solutions lie in prevention and different and more sustainable and resilient development. **Prevention is known to be cost-effective.** According to

the Zurich-based Flood Resilience Alliance “we already know that every US\$1 invested in prevention saves on average US\$5 in future losses.”(<https://www.zurich.com/en/sustainability/our-role-in-society/flood-resilience>).

These challenges will be discussed in detail later.

Based on experiences with earlier cyclones, both countries have greatly strengthened their DRR and DRM structures, their meteorological and monitoring networks; there has been more work done at the community level for EWS and DRM, particularly in Mozambique (e.g. IFRC, 2007a and b).

Figure 1 summarizes several key opinions expressed in the Idai Post Event Review Capacity study (PERC; Norton, *et.al.*, 2020).

Figure 1: Some views and quotes from the PERC.

Expectations about the cyclone

“Many officials and much of the public were initially excited to hear Idai was expected to impact Zimbabwe because typically, tropical storms bring much needed moisture rather than inflict damage. Even among those who appreciated that Idai was a greater threat than past storms, they failed to fully appreciate its potential intensity and impacts” (p.19).

“Many of the interviewees in Zimbabwe noted that even in hindsight, having seen the storm impacts, they would be at a loss to know what areas would be safe if an Idai-like event were to hit elsewhere in the Zimbabwe highlands” (p.20).

Livelihood impacts

“The people most impacted by Idai and Kenneth are still suffering more than one year after landfall – the visits and discussions with people in the camps near Buzi have been burnt into my memory and left me with yet another sense of urgency to act.” (p.5).

“Before the storm we were raising our children to be engineers, doctors, and nurses, but now we can’t do that. The storm has pushed us backwards” (Community member in Mozambique, p.41).

Disaster risk management structure

“Good progress had been made by Malawi, Mozambique and Zimbabwe in recent years, both to manage the initial response and to support early recovery. In particular, we found many examples of where these countries have successfully learned from past events and made changes which reduced the scale of impacts from Idai and Kenneth. Nonetheless, we also found that so much more can and still needs to be done to embed proactive disaster risk management and resilience-building in current policies, practices, and budgeting’.(p.5).

Disaster risk management

“Mozambique’s recovery and reconstruction plan, for example, has the potential to act as a vehicle for integrating DRR and preparedness actions into the recovery phase while also addressing the entry points highlighted in this study. Such an approach could serve as an example for the region as a whole, to take a more comprehensive approach for building back better while reducing future risk at the same time” (p. 49).

“Rather than seeing humanitarian response and development as separate domains, the global community must recognize that humanitarian response is required in areas where development and DRR have been insufficient and where, consequently, delivering aid alone will be a never- ending effort. Instead, stakeholders must begin to think creatively about where development and DRR can be integrated into or efficiently sequenced with humanitarian response, and donors should commit to and follow through on funding both. While ultimately, this may mean spending more upfront, the outcomes over the longer term should reduce the amount spent on response and recovery” (p.49).

Annex A summarizes the personal story about changes that Cyclone Idai and the relief and recovery efforts have made for a female-headed household in Mozambique.

2 Disaster risk management structures and post Idai projects in Mozambique and Zimbabwe

In recent years, both Mozambique and to a lesser extent Zimbabwe have improved their DRR and DRM structures to the extent that Mozambique is sometimes viewed as a DRR/DRM model for other countries (see the Idai Impact Report; CAR & HCA, 2020). Below, we first describe the situation in Mozambique together with Cyclone Idai relief and recovery projects (2.1), followed by Zimbabwe (2.2). As both countries depend on external support for relief and recovery, international financial support to each country is reviewed in section 2.3.

2.1 Mozambique

Mozambique has well developed DRR and DRM institutions, led by the National Institute for Disaster Management (INGC) with three key DRR areas, covering the entire DRM cycle:

- a. Emergency actions and relief;
- b. Disaster prevention and mitigation actions; and
- c. Post-disaster reconstruction actions through the Reconstruction Coordination Office GACOR.

The INGC is decentralized and has four regional emergency operation centers (CENOE) as well as local disaster risk management committees (DRMC). DRM is financed from a special Disaster Management Fund (DMF) and from ministerial DRR budgets. Each sector and district integrate DRR and climate change adaptation (CCA) in their planning and budgeting (UN-ECA, 2015). Funds and capacities for DRR and CCA are however limited, particularly at the district and local level. The Ministry of Environment (MICOA) is responsible for climate change adaptation¹ and the Ministry of Planning and Development (MPD) also plays a key role in DRM (UN-ECA, 2015). The country has a National Strategy for Climate Change Adaptation and Mitigation (2013-2025; GoM, 2012). A Pilot Program on Climate Resilience (UN-ECA, 2015) under the MICOA and the MPD aims to create resilience in areas such as critical road infrastructure, agriculture, coastal areas, and water management (UN-ECA, 2015). The National Institute of Meteorology (INAM) is responsible for weather forecasts and has an EWS in place.

Major DRM milestones are shown below:

In 1999:

- a. Establishment of a National Disaster Management Policy;
- b. Creation of the National Institute for Disaster Management (INGC), Coordination; and
- c. Council for Disaster Management and the Technical Council for Disaster Management.

In 2006:

- a. Establishment of the CENOE's and the National Civil Protection Unit;
- b. Approval of the Master Plan for Prevention and mitigation of Natural Disasters; and
- c. Establishment of Local DRMCs.

In 2014:

¹ Key areas identified with respect to climate change are: coastal protection, EWS and preparedness, prepared cities, resilience in the private sector, water demand management and efficiency, food security, preparing people, dealing with extremes, and DRR strategy (UN-ECA, 2015).

- | |
|--|
| <ul style="list-style-type: none"> a. Adoption of Disaster Risk Management (Law 15/2014),
<u>In 2017:</u> b. Master Plan for Disaster Risk Reduction for the period 2017-2030. |
|--|

Source: WMO, 2019.

Water resource management is led by the Directorate of Water Resources Management (DNDRH), which has regional offices (Ara Centros). The Ara Centro in Beira covers the BuPuSa area and is currently being merged with the Ara Centro Zambeze under the new name Ara Centro. The DNDRH is responsible for water resource management and has a Department of International Rivers for transboundary water resource management.

The Post Disaster Needs Assessment PDNA (GoM, 2019) estimated the recovery costs of Cyclone Idai at US\$2.9 billion². The largest cost items are housing, transport, and food security. The distribution of the estimated recovery costs is as follows (GoM, 2019):

- a. **Short-term relief (1 year):** US\$1.5 billion, mostly for housing followed by industry, agriculture, education & health;
- b. **Medium-term relief and recovery (2-4 years):** US\$0.3 billion, mostly for transport, agriculture & health; and
- c. **Long-term recovery (5 years and above):** US\$0.6 billion, mostly for transport.

The Mozambican Government received US\$384 million of humanitarian relief in 2019 (see section 2.3); at least US\$300 million of this can be attributed to relief for cyclones Idai and Kenneth (see section 2.3).

Government developed two Idai and Kenneth recovery programs. The first one is the Cyclone Emergency Recovery and Resilience Program (CERRP) that deals with the medium to long-term reconstruction needs for Idai and Kenneth. The CERRP budget is a US\$230 million grant³ (World Bank, 2019b). The budget is modest compared to the estimated US\$2.9 billion recovery costs identified in the PDNA. The CERRP program covers rebuilding of houses and critical infrastructure in affected areas, and increasing climate change resilience in the Beira area, including coastal protection and rehabilitation of other parts of the drainage system in the city of Beira (Table 1). While both are important preventive measures, large funding gaps remain for medium to long term recovery and mitigation; and it is unlikely that the DRM Fund and sectoral DRM allocations can fill these gaps.

Table 1: Details of CERRP.

Components	Activities	US\$ million
Recovery and reconstruction of cyclone affected areas	Repair and construction of housing for selected vulnerable communities. Repair and reconstruction of critical public infrastructure Recovery of the private sector and economic activities.	80

² This covers the costs of rebuilding of infrastructure and other assets, taking into accounting the need to build better and DRR for resilience building as well as the costs incurred to recover the production of good & services and access to them (GoM, 2019).

³ World Bank grant of US\$150 million, a Dutch government grant of US\$60 million and a funding gap of US\$20 million.

Building climate resilience	Focus on Beira and surroundings: Repairing and significantly strengthening coastal protection. Expanding the rehabilitated drainage system to reduce flooding in vulnerable parts of the city. Capacity building of relevant units within the city administration to strengthen operation and maintenance.	120 (60 co-financing)
Project implementation, monitoring and evaluation	Stakeholder Engagement Plan (SEP) participation of citizens. Community and citizen engagement will contribute to the identification, design, implementation, and monitoring of key project activities.	no budget specified.
Contingency emergency response component	provide immediate response to an eligible crisis or emergency, as needed. This would finance emergency works in the case of another disaster event by including a "zero-dollar" Contingency Emergency Response Component (CERC). With stakeholder consultations	no budget specified.

Source: World Bank, 2019a and b.

The second program is the Mozambique Recovery Facility established by the Government of Mozambique and United Nations Development Program (UNDP). This program has three components (<https://reliefweb.int/report/Mozambique>):

- a. Livelihood recovery and women economic empowerment:
 - Identification of early economic recovery and income generation needs;
 - Emergency employment for disaster affected people, driven by communities and gender focused;
 - Support for micro, small and medium enterprises.
- b. Housing and community infrastructure:
 - Construction of key community and public infrastructure at the local level;
 - Rehabilitation of houses in rural and peri urban areas targeting the most affected vulnerable people and Building-Back-Better (BBB); and
- c. Support for Government's Reconstruction Cabinet.

Both recovery programs have a strong emphasis on communities and vulnerable groups and include active stakeholder participation through Stakeholders Engagement Plans (SEP). Infrastructural support focuses on housing as well as community and critical infrastructure. Small, micro and medium size companies are also supported.

Mozambique has an EWS that extends to and involves communities. The INAM issues early warnings based on weather and climatic information country-wide; the INGC has an institutional preparedness warning system that indicates the level of preparedness of institutions to handle a disaster (WMO, 2019). Village DRMCs were established at least ten years ago. Assisted by the EWS, these committees succeeded in reducing the impacts of Idai through preparation and relief efforts (Figure 2). The operations of the committees can, however, be improved by focusing more on disaster prevention, readiness, and adaptation for disasters (UN-ECA, 2015; IOM & INGC, 2019). Generally, the EWS information has been useful, but it needs to be more detailed and more action oriented.

Figure 2: Village DRM committees and community based EWS.

Out of the 498 villages in the Idai affected area, 70% had a DRM committee and evacuation plan (UN-ECA, 2015; and IOM-DTM survey); 82% of the villages have public buildings as emergency shelters (2,394 in total with capacity of 601,224 people).

Community-based EWS has 4 key components: 1. knowledge of risks; 2. monitoring, analysis and forecasting of hazards; 3. communication/alerts/ warnings; and 4. local response capabilities. Community-based EWS requires strong community ownership, basic equipment (e.g. transport, emergency supplies and communication), and training.

Countrywide, 855 communities have local DRR committees. Communities with DRM committees have had less adverse impacts than those without (UN-ECA, 2015, p.26). However, the committees' challenges include high turn-over among members/ volunteers, lack of incentives and inadequate information flows from national to local level. The focus on the committees remains with disaster response and relief rather than preparedness. Strengthening of community engagement and resilience would recognize communities as key players, use indigenous knowledge raise awareness raising and assist with e.g. evacuation drills.

Sources: UN-ECA, 2015; IOM & INGC, 2019.

In brief, the main reconstruction and mitigation measures in Mozambique have been:

- a. Immediate relief through food aid, water, sanitation and hygiene (WASH) measures, evacuation and relocation of households and communities to shelters and camps;
- b. Rebuilding of critical damaged public infrastructure, housing and water points and sanitation facilities;
- c. Resettlement of households and communities to suitable low risk areas, including the provision of public services and support for rebuilding of household assets (e.g. houses, fields etc.). Details about the progress of resettlement are not known.

2.2 Zimbabwe

The Department of Civil Protection (DCP) leads the DRR/DRM efforts in Zimbabwe. It is backed by out-of-date legislation (Civil Protection Act, Chapter 10:06 of 1989⁴) and has a National Civil Protection Fund (NCPF), which finances its DRR activities. The DCP operates at the national, provincial and district level through Civil Protection Units (CPU). The National Civil Protection Committee (NCPCC) has relevant stakeholders from government and outside government. One percent of the national government budget is meant to be available for DRR activities through the NCPF⁵. DRR is led by the 2012 National DRM Strategy and the National Climate Change Response⁶. For Cyclone Idai, the Provincial Administrator of Manicaland

⁴ A draft 2015 DRM bill is yet to be finalized.

⁵ This would be US\$77.7 million in 2019. Over the period 2012-2018, the DCP received on average only 0.6% of its ministerial budget (Chatiza, 2019).

⁶ A good practice is to integrate DRR and CCA (OECD, 2020). Namibia has done so by adopting "The National Strategy for Mainstreaming Disaster Risk Reduction and Climate Change Adaptation into Development Planning in Namibia 2017-2021" (UNDRR, 2019).

led relief efforts, supported by Chimanimani & Chipinge District coordinators. Thirteen technical subcommittees were established at provincial level.

In terms of water resources, the Department of Water Resources, the Zimbabwe National Water Authority (ZINWA) and catchment councils are key institutions. The ZINWA is the key liaison institution for BuPuSa. Other relevant (semi-) government institutions include the Environmental Management Agency (EMA), Rural District Councils (as custodians of district natural resources and involved in the CAMPFIRE program), and the Forestry Commission, which manages state forests and protects private forests, trees and forest produce. Communities, the private sector, and non-government organizations (NGO) as well as International Cooperating Partners (ICP) are key partners in DRR and represented in the Civil Protection Platform. Every citizen is obliged to be involved in efforts to avoid disasters.

The Idai recovery needs are estimated to be at least US\$557 million⁷ (Rapid Impact & Needs Assessment or RINA; GoZ *et al.*, 2019, p.3), mostly for transport (US\$197 million), agriculture (US\$59 million), housing (US\$36 million) and environment (US\$37 million). WASH would require US\$28 million), while US\$92 million is needed for DRM. The DRM costs are meant to develop the medium-term DRR/DRM Strategy with the following priority activities:

- a. Strengthening of the National DRM framework: bill, policy, and strategy;
- b. Institutional strengthening and capacity development;
- c. Strengthening of DRM financing;
- d. Community engagement & resilience;
- e. Awareness raising;
- f. Flood risk mapping and evacuation drills;
- g. Flood risk assessment & hazard mapping;
- h. Integrated flood management plan for major basins; and
- i. Cyclone & flood forecasting & EWS.

Several Idai recovery projects were developed by Government with ICPs, including the following ones. The Government developed the Zimbabwe Recovery and Resilience Framework (ZRRF) with technical support from the World Bank, UNDP and the African Development Bank (AfDB) to support cyclone-affected communities. (GoZ & UN, 2020⁸). The ZRRF guides the long-term recovery efforts of Government and ICPs and is meant to coordinate the implementation of the RINA recovery and resilience building interventions. It includes the following activities (www.gfdrr.org/en/development-and-operationalization-zimbabwe-recovery-and-resilience-framework):

- i. Develop and align the national recovery vision, guiding principles, and priorities to long-term development objectives; and
- ii. Establish a cross-sectoral framework of recovery interventions, informing investment interventions supported by external partners.

⁷ This is based on the low range recovery cost for housing. The high range of housing costs would increase the total by US\$210 million.

⁸ It is part of the ACP-EU Natural Disaster Risk Reduction Program: a joined initiative of ACP (African, Caribbean and Pacific), EU, The World Bank and the Global Facility for Disaster Risk Reduction & Recovery (GDFRR).

The approved amount for the period October 2019-September 2020 is modest at US\$225,000. The Zimbabwe Idai Recovery project (ZIRP) offers immediate relief (1 year) as well as support for medium (2 to 4 years) and long-term (5 years and above) recovery (Table 2). UNOPS coordinates the projects' implementation. The ZIRP budget is modest at US\$72 million. Short-term support covers food aid, cash grants to households, support for agriculture, and basic health services, all aimed at improving rural livelihoods. Medium-term support targets rehabilitation of critical infrastructure and community-led risk reduction.

Table 2: Zimbabwe Idai Recovery project (ZIRP; 1993-2023; US\$ million).

Component	Amount in US\$ million	Activities
Providing immediate support for Cyclone recovery	27	Livelihood restoration through cash transfers to provide food assistance and unconditional cash transfers for vulnerable groups
		Restoration of agricultural production, including distribution of agricultural inputs for small farmer households and the restocking & treatment of livestock & poultry
		Revitalization of basic health services, including GBV, SEA & child protection
Medium term cyclone recovery & resilience building	33.4	Support rehabilitation of critical community infrastructure Support community level structural risk reduction and mitigation efforts
Providing Project management and technical assistance	8.6	UNOPS project management Technical assistance for a range of activities to be determined on a need's basis.

Source: UNOPS, 2019.

A Post Cyclone Idai Emergency Recovery and Resilience project is implemented with support from the AfDB (US\$25 million). The project focuses on rebuilding critical public infrastructure and restoring essential services to boost local economic development and livelihoods in communities most severely affected by the Cyclone Idai.

The total budget of the projects is around US\$100 million, some 20% of the recovery needs as assessed in the RINA (GoZ *et.al.*, 2019). The recovery projects put a strong emphasis on livelihood recovery through cash transfers, food aid and rebuilding agriculture for vulnerable groups, rehabilitation of infrastructure and community-based DRR and mitigation (e.g. slope protection and environmental rehabilitation) as well as active stakeholder participation through the Stakeholders Engagement Plans (SEP).

In summary, the relief and mitigation measures taken include:

- a. Livelihood support through food aid, cash grants and support for small-scale agriculture;
- b. Sheltering of displaced persons in camps as well as with other households;
- c. Resettlement of displaced persons to new areas;
- d. Rebuilding of critical public infrastructure, including irrigation infrastructure;
- e. Development of a medium-term DRR and DRM strategy; and

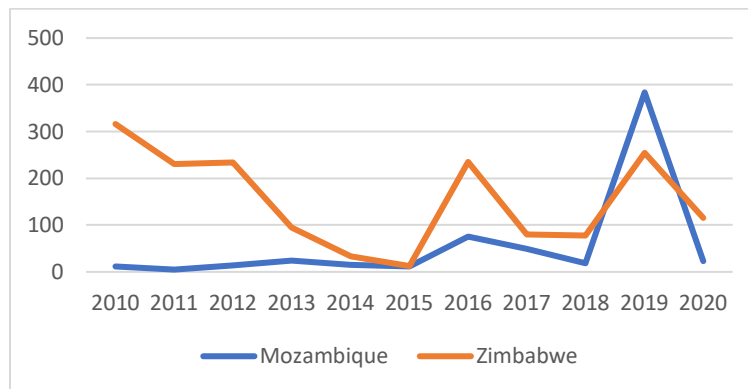
- f. Support for rebuilding of damage houses.

2.3 International financial support

The 2019 Global Assessment Report (GAR; UNDRR, 2020) found that at the global level development assistance for DRR has been volatile, ex-post and marginal. International financial support for Mozambique and Zimbabwe is mostly destined for relief efforts (e.g. droughts and floods). Only a small part is earmarked for recovery projects and DRR. Given the financial and capacity constraints of both countries, international financial support and assistance are indispensable for relief and DRR/DRM. In terms of sources of international funding, UN agencies provide 30 to 40% of the funding to Mozambique and Zimbabwe, other governments, and multilateral agencies just over 50 % and NGOs around 10 %. Most funding targets the cluster “food security and livelihoods”.

International financial assistance can be categorized in funding for humanitarian relief, usually after an appeal by governments and UNDP, and in funding for DRR and development efforts. A wide range of bilateral and multilateral agencies as well as NGOs offer humanitarian assistance. The United Nations Office for Project Services (UNOPS) keeps a database on humanitarian aid, which provides details about the amount of aid provided, the funding sources, and the beneficiary clusters (www.fts.unocha.org). The data base contains details of responses to humanitarian appeals and information on funding beyond the appeals. The data base shows that Mozambique received on average US\$57 million per year of international funding in the period 2010-2020; the figure jumped to US\$384 million, presumably due to support for interventions for cyclones Idai and Kenneth (Figure 3). Zimbabwe received almost three times the amount of Mozambique, i.e. on average US\$153 per annum over the same period, mostly for food aid. Over the period 2010-2020 to-date, financial assistance to Zimbabwe totaled US\$1.7 billion while Mozambique received US\$629 million (Figure 3). The human aid appeals amount to around 2 % of GDP in Mozambique and 1 % in Zimbabwe.

Figure 3: Humanitarian Relief Funding to Mozambique and Zimbabwe (2010 to June 2020; US\$ million).



Note: 2020 figure is for the period January-June.

Source: www.fts.unocha.org.

Figure 3 clearly shows the volatility of humanitarian relief funding, probably linked to the occurrence of disasters and possibly to ICPs' response fatigue as well as global economic stress. The increase of funding in response to Idai relief efforts is clear.

Linking appeals to recovery needs, the humanitarian appeals for Mozambique in 2019 and 2020 covered 40 % of the estimated short- and medium-term recovery needs for Idai identified in the PDNA. For Zimbabwe, the figure is 89 %. Recognizing that the humanitarian appeals cover more than Idai (e.g. also Kenneth and COVID-19), international funding clearly does not provide sufficient funds to recover from Cyclone Idai. This is confirmed by our consultations (chapter 4) and Norton *et.al.*, 2020.

The Zimbabwe Government together with UN-agencies appealed for International Humanitarian Assistance in 2020⁹ (GoZ & UN, 2020). According to the Humanitarian Response Plan (Figure 4), 7 million people require support (not only because of Idai), of which 5.7 million are targeted for support by a total of 47 ICPs. US\$715 million is requested under the appeal and another US\$85 million for COVID-19¹⁰. The humanitarian assistance request is divided over several clusters: more than half is destined for food security (US\$483 million; 4.2 million people are seriously food insecure, February 2020), followed by WASH and health (around US\$65 each), education (US\$42 million), social protection (US\$21 million), nutrition (US\$18 million) and shelter (US\$11 million). Smaller amounts are set aside for refugees, camp management and communication/ coordination. It is not yet clear how much of the requested will be funded.

Figure 4: Idai impact assessment in Humanitarian Response plan 2020.

A year after Cyclone Idai hit Zimbabwe, 128,270 people remain in need of humanitarian assistance across the 12 affected districts in Manicaland and Masvingo provinces, particularly in the districts of Chimanimani (14,839 individuals), Chipinge (63,245 individuals) and Buhera (8,565 individuals). Almost all (97 %) of the Internally Displaced Persons (IDPs) reside with host communities; only 3% shelter in 4 established IDP camps, accommodating 224 households (953 individuals) in Chimanimani.

Out of the 25,160 households in need of shelter support, only 3,000 are currently receiving it, and a significant number of households in host communities is still in need of transitional shelters.

At least 87 % of the IDPs in Chimanimani, Chipinge and Buhera districts have returned to their original homes which were not properly repaired. In January 2020, Manicaland province received fresh violent windstorms, significantly increasing damage to houses already impacted caused by Cyclone Idai.

Emergency shelter (tarpaulins) are now uninhabitable, while others are staying in makeshift structures. Relocation of IDPs is not feasible in the short term and it is anticipated that IDPs will remain in the camps for the next 6 to 12 months.

Source: GoZ and UN, 2020.

⁹ In 2019, international assistance amounted to US\$240 million. "Close to 2 million women, men and children with critical and life-saving interventions under the Humanitarian Appeal, in support of the Government-led response. Nearly 1.8 million people received food assistance support, complementing the Government's distribution of food to 3.8 million people. An estimated 1.3 million people were provided with clean water and safe sanitation; 600,000 people have benefited from essential health services; and over 16,000 boys and girls were covered by child protection services" (GoZ and UN, 2020).

¹⁰ The total figure of the Humanitarian Response Appeal exceeds the estimated Idai recovery needs and the total budget of the recovery projects.

3 Literature on mitigation and disaster risk management

This chapter reviews literature on mitigation and DRR. It first deals with the global risk assessment system (3.1.) followed by a review of the work of the Zurich Flood Resilience Alliance (3.2) and a review of ecosystem-based DRR adaptations (also known as nature-based solutions) in section 3.3.

3.1 Index for Risk Management (INFORM)

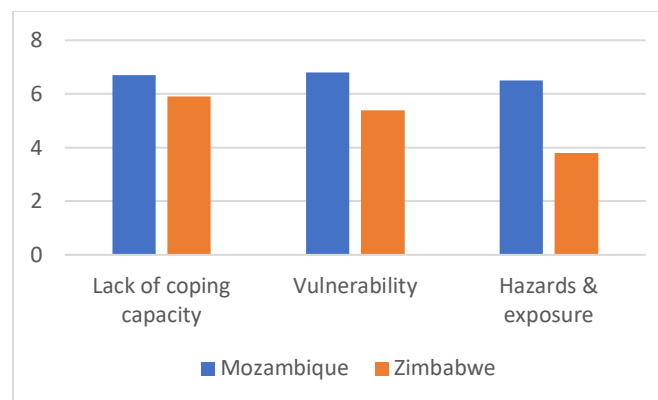
The EU developed a global risk index (GRI) that shows the vulnerability of countries to disasters. Generally, the higher the risks are, the greater the vulnerability and the more limited countries' potential for own mitigation measures is. The GRI has three multidisciplinary components:

- a. **Coping capacity** in terms of institutions and infrastructure;
- b. **Socio-economic vulnerability**, in particular vulnerable groups; and
- c. **Exposure** to natural and human hazards.

These components cover national, provincial, and local factors. National and provincial factors provide the 'enabling or disabling' environment for community operations and resilience. The local factors are associated with the (in-)ability of communities to act.

Mozambique and Zimbabwe are "high risk" with high exposure, vulnerability, and a limited coping capacity (Figure 5). In other words, both countries have a low resilience to handle disaster such as Cyclone Idai. Mozambique is ranked 19th highest risk country out of 190 countries with an overall score of 6.2 (range from a low of 0 to a high of 10) and Zimbabwe is ranked 47th (overall score 5.1). Mozambique has higher risks in each component, meaning that its potential for mitigation and preventive measures is more limited, and that the country depends more on international support.

Figure 5: Global Risk Index (INFORM¹¹) for Mozambique and Zimbabwe (2020).



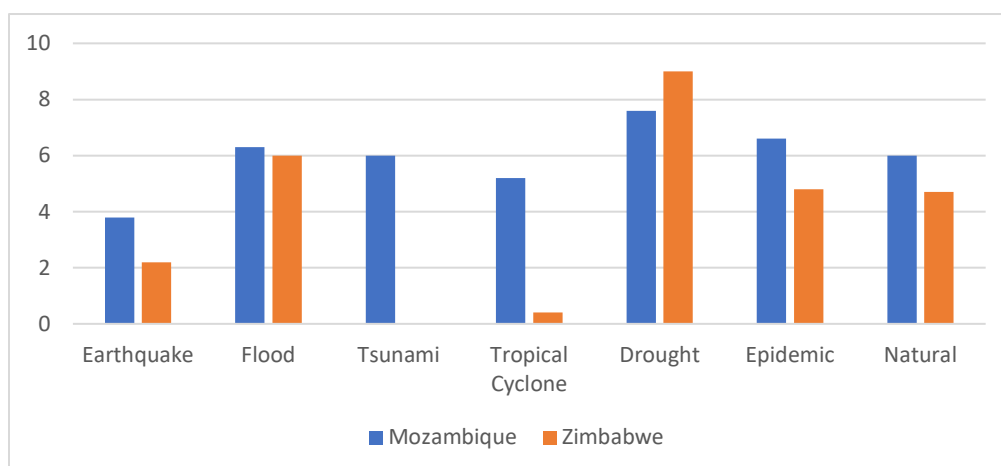
Source: INFORM data on <https://ec.europa.eu/jrc/en/publication/index-risk-management-inform>.

A more detailed analysis of the GRI component "hazards and exposure" shows that natural factors represent a greater risk than human ones in both countries: for Mozambique 6.0 and 4.7 respectively and

¹¹ INFORM is Index for Risk Management.

for Zimbabwe 4.6 and 3.6, respectively. This is mostly due to their existing DRR structures, which provide some capacity to handle disasters (Figure 8). In terms of natural risks (Figure 6), droughts are the highest risk in both countries, while floods, tsunami (Mozambique) and epidemics are also common natural risks. The risk of tropical cyclones is high in Mozambique, but low in Zimbabwe. Clearly, DRR and DRM institutions in both countries face the challenge of having to handle different types of disasters.

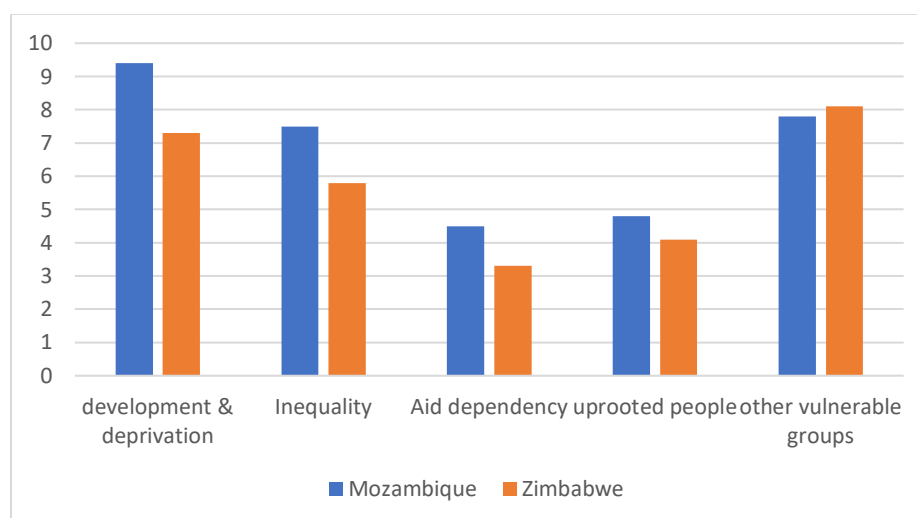
Figure 6: Type of natural risks and country scores (2020).



Source: <https://ec.europa.eu/jrc/en/publication/index-risk-management-inform>.

Socio-economic vulnerability is high because of underdevelopment, inequality, and the existence of vulnerable groups (Figure 7). This directly affects community and household resilience. Generally, socio-economic vulnerability risks are higher in Mozambique.

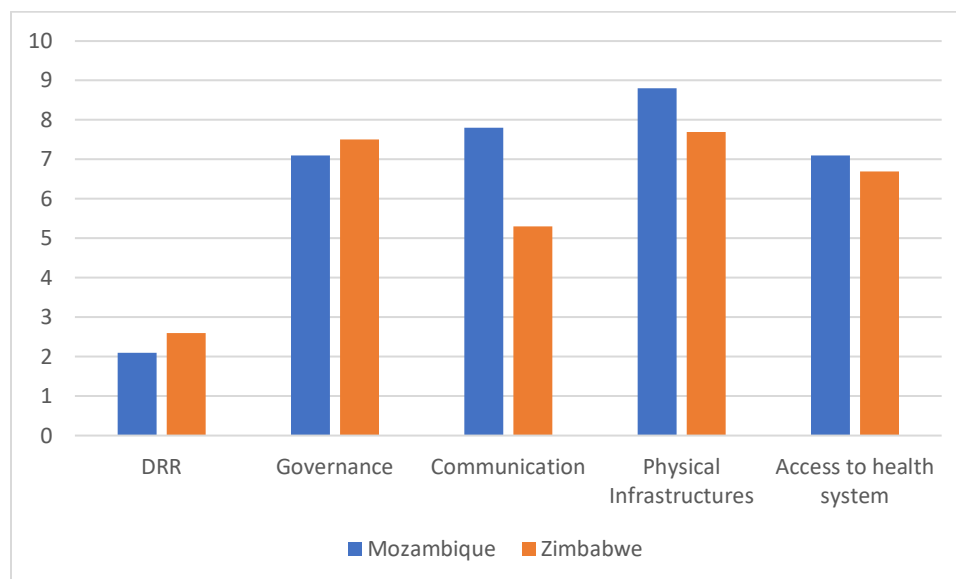
Figure 7: Components and score of socio-economic vulnerability (2020).



Source: <https://ec.europa.eu/jrc/en/publication/index-risk-management-inform>.

Both countries have established DRR structures in place with lower DRR risks (see chapter 2 and Figure 8). However, governance, communication, and physical infrastructure (e.g. roads and WASH¹²) are the highest risk components.

Figure 8: Risks of coping ability in Mozambique and Zimbabwe (2020).



Source: <https://ec.europa.eu/jrc/en/publication/index-risk-management-inform>.

3.2 Zurich Flood Resilience Alliance

The Zurich Flood Resilience Alliance¹³ conducted a Post Event Review Capability (PERC) study for Cyclone Idai (Norton *et.al.*, 2020). The alliance also developed a PERC manual based on the experiences of a number of earlier PERC studies (Venkateswaran *et.al.*, 2020) and a community flood resilience measurement tool (Keating *et.al.*, 2017). PERC studies are conducted **after the event** during the recovery phase. The Flood Resilience Measurement tool is carried out **before events**. While damage assessments such as PDNA or RINA are normally done as soon as possible after the event to identify priorities and mobilize resources, PERC studies are best applied later after the event to monitor the progress with relief, mitigation, and recovery interventions. It would be useful to repeat the PERC after some time to review progress with medium and long-term recovery and preparedness. The flood management tool could be used by communities to assess their resilience and ability to engage in relief and recovery efforts.

The Idai PERC is based on a literature review and interviews with over 100 stakeholders from government, UN agencies, donors, NGOs, communities, and academia (Norton *et.al.*, 2020). It focuses on **opportunities** for better handling of future cyclones, particularly at the community level, and **lessons learned**. The Idai PERC study identifies three key opportunities to reduce vulnerability (Norton *et.al.*, 2020):

¹² Water, Sanitation and hygiene.

¹³ The alliance is a consortium of the private and public sectors as well as NGOs, academia: Institute for Social and Environmental Transition and the International Federation of Red Cross & Red Crescent Societies, Practical Action and Zurich Insurance Group. The PERC study included the impacts of Kenneth and also covered Malawi.

- a. **Strengthening of EWS and climate services** together with capacity building (preventive);
- b. Supporting the **rebuilding of resilient houses, WASH infrastructure and DRR efforts** (mitigation and prevention); and
- c. Supporting **agricultural and livelihood diversification** to improve livelihood resilience (absorption).

According to the PERC study (Norton *et.al.*, 2020) the efficiency and effectiveness of humanitarian assistance efforts need to be enhanced through collaboration and the study concluded that:

- i. The creation of DRM institutions and structures in both countries has helped coordinated responses, allocation of resources and post disaster assessments (PDNA and RINA);
- ii. Increased forecasting accuracy has improved EWS and both countries disseminated warnings several days before the cyclone struck;
- iii. The WASH support programs assisted to contain cholera and other flood related diseases;
- iv. As shown in Beira, well-maintained urban drainage systems can reduce flood damage;
- v. Significant financing gaps delayed the relief and recovery efforts. Investments in CCA and DRR do not sufficiently reach communities; and
- vi. Most interventions focus is on short-term humanitarian aid which reduces the chances of a more resilient recovery. Investments are still mostly re-active and need to become more pro-active.

The main challenges that emerged from the interviews include strengthening of disaster risk awareness, improving EWS to make the warnings actionable, identification and protection of critical infrastructure, developing and scaling up of disaster-resistant housing and integration of DRR and CCA in recovery and development programs.

In Mozambique, the INGC works generally well, in cooperation with NGOs and ICPs and respond fast to handle disasters, but its resources and capacity are limited (Norton *et.al.*, 2020). In Zimbabwe, DRR resources are concentrated at the national level leading to a slower local response. Moreover, the DRR Act is out-of-date. In both countries, DRM remains largely responsive and needs to become more pro-active. *“The intensity and destructiveness of Cyclones Idai and Kenneth in 2019 – particularly how they combined with existing food insecurity and crop failure- are representative of a new normal rather than an exceptional extreme”* (Norton *et.al.*, 2020, p.15). In terms of EWS, the intensity and scale of Idai surprised the population and the inadequate protective infrastructure hampered rapid action. End-to-end EWS requires active community participation in EWS development and the resulting actions to be taken, e.g. through hazard mapping, evacuation and safe shelter identification and development and hazard resistant construction. *“All of our Mozambique community-level interviews relayed that their communities received warnings. However, most of them also relayed they did not know how to translate those warning into concrete action they could take to protect themselves and their homes”* (Norton *et.al.*, 2020, p.18). *“There is clear need, particularly given how climate change is leading to new and more intense weather events, for significant community support around risk identification, development of risk reduction strategies including evacuation plans, and the development, with communities, of early warning messages that they understand and know how to act on”* (Norton *et.al.*, 2020, p.36).

In terms of critical infrastructure, most of the infrastructure was damaged or destroyed, hampering quick responses and relief efforts. For example, all bridges and communication systems with Chimanimani were destroyed/lost and there was no storage of essential reserves at the local level. In Mozambique local rescue material was in short supply, or not adequately maintained. Furthermore, political challenges

inhibited a quick response in some areas (e.g. Gorongosa; Norton *et.al.*, 2020, p.25). Scenarios and contingency plans should be developed to handle failure of critical infrastructure and equipment. Such plans should include CCA measures and maintenance of infrastructure and the associated equipment.

The choice of equipment and material is important in that more local materials and resources should be used, and maintenance must improve. Donors tend to avail equipment and material from their own countries, which cannot easily be maintained or operated efficiently. *If several motors, that could be repaired locally, were purchased instead of one new boat of equal value, both donors' investments and communities' ability to save people during floods would be maximized*" (Zurich flood alliance, 2019, p.5). Wise use of local know-how and materials could improve the resilience of buildings in safer places¹⁴. This already happens on a small-scale but needs to be upscaled. The PERC report identifies roads, communication, rescue equipment, hospitals, clinics as key critical infrastructure (Norton *et.al.*, 2020, p.40).

Resettlement emerged as a significant and sensitive challenge¹⁵. Community consultations are essential but do not sufficiently happen (e.g. in Zimbabwe; Norton *et.al.*, 2020, p.30). Safer sites need to be identified but social community and family structures need to be maintained; households should be supported with basic infrastructure, be able to make a living and diversify their livelihoods (e.g. agricultural and economic diversification). Resettlement planning and implementation is still on-going and as it takes a long time, some people move back to their old, risky areas, exposing them to the same risks as before Idai.

According to the Idai PERC study external funding focuses mostly on the short and medium-term. More long-term support is necessary to build resilience, mitigate and prepare for the next event. A good example is food aid. Food aid has been forthcoming on a large scale, but the distribution of agricultural inputs for the next crop season has been patchy and is underfunded (Norton *et.al.*, 2020). The shift towards longer term approaches requires the full integration of human relief response, DRR and CCA efforts and development planning. It also requires a basin-wide transboundary approach. The long-term approach also requires investments in ecosystems such as mangrove restoration, upstream re-afforestation and land rehabilitation and coastal protection and restoration. *"Concrete flood walls along Beira's coastline were heavily damaged by Cyclone Idai's storm surge. Rather than replace these with similar structures, the government and donors should explore Ecosystem-based Disaster Risk Reduction Solutions, such as coastal revegetation, that might provide substantially better protection over time, as sea level rises"*. (Norton *et.al.*, 2020, p.46).

The experiences of earlier PERC studies have been captured in a manual for the preparation of PERCs (Venkateswaran *et.al.*, 2020). Resilience is defined in the manual as *"the ability of a system, society or community to pursue its economic and social development and growth objectives while managing its risk over time in a mutually reinforcing way"* (after Keating *et.al.*, 2014). Resilience has three components:

- a. Systems (what?): ecosystems and infrastructure;

¹⁴ GRECO designed cyclone resistant housing but there are no funds for large-scale implementation (PERC, 2020,p.28). As a result, most homes are rebuilt with the same poor material and design.

¹⁵ No details of resettlement plans and the state of implementation were found.

- b. Institutions (how?): rules, norms, beliefs, conventions etc. that shape behavior and access to information, resources etc.; and
- c. Agents (who?): these are people and organizations with capital sources: financial, physical, human, social, and natural.

The manual distinguishes five stages in a PERC: desktop review, understanding the physical conditions, fieldwork with interviews and site visits, institutional landscape mapping, and finally analysis and synthesis.

The Flood Resilience Measurement tool is a standardized, community-based approach that is done before the event. It is based on the capital approach as well as sustainable livelihoods (Keating *et.al.*, 2017). It consists of 88 multi-faceted/ dimensional indicators covering five types of capital (human, physical, natural, social and financial), ten themes (life & health, assets & livelihoods, , education, energy, food, governance, natural environment, transport & communication, waste and water), two context types (enabling environment and community), four stages of the DRM cycle (coping, preparedness, prospective and corrective) and four Rs (redundancy, resourcefulness, rapidity and robustness). It has been piloted in 77 villages. It is a multi-dimensional resilience measurement tool, that could be used by communities as it focuses on the community level and on social capital.

3.3 Nature-based DRR

Interest in nature based DRR is growing, for example in South Africa (see e.g. DEA & SANBI, 2017 and Swanepoel and Sauka, 2019 for coastal cities). Nature-based DRR covered around 5 % of the World Bank's DRM portfolio and just under 10 % of the projects in the period 2012-2018 (World Bank & WRI, not dated; www.naturebasedsolutions.org). Nature-based DRR uses ecosystem functions (production, regulation, recreation, absorptive etc.) and comprises natural activities to mitigate risks; it can be applied to coastal areas (e.g. rehabilitation of damaged mangrove forests, salt marshes, restoration of sandy beaches and dunes), urban flooding (e.g. green roofs, permeable pavements, open spaces and constructed wetlands) and river flooding (restoration of flood plains and river beds and banks, inland wetlands and upstream forestry) and land rehabilitation (e.g. after landslides or floods). Nature-based solutions such as restoration of flood plains often require resettlement of people away from the flood plains and need to be supported by effective land use planning and resettlement programs. Nature based solutions can be labor intensive and create post event employment .

For Idai mitigation, the restoration of Mozambique's coastline, the restoration of inland wetlands and swamps/ marshes and damaged mangrove forests and afforestation upstream of the rivers are nature-based solutions. Slope stabilization and environmental rehabilitation are incorporated in Zimbabwe's Idai recovery projects. The restoration of the coastline and flood plains by resettling communities away from low areas is part of Mozambique's recovery program. These measures need to be supported by flood and cyclone hazard mapping as well as amended and integrated land-use planning. Moreover, nature-based measures require the support and knowledge of local communities, and are therefore by nature, community based (e.g. community-based natural resources management or CBNRM). Table 3 summarizes the main principles of nature-based solutions (or ecosystem-based adaptations), which can be applied at the BuPuSa and lower spatial levels.

Table 3: Principles of nature-based solutions.

Principles	Comments	BuPuSa relevance & applications
Adopt a system-scale perspective	Addressing nature-based (NB) solutions for climate change adaptation and disaster risk reduction should start with a system-wide analysis of the local socio-economic, environmental, and institutional conditions, spatial scale, time horizon and local conditions.	Adopt the 3 BuPuSa basins (and the area as a whole) as the system cutting across Mozambique and Zimbabwe. In practice, prepare a BuPuSa integrated assessment-monograph.
Risk & benefit assessment of full range of solutions	A thorough assessment of risks and benefits of the full range of possible measures should be conducted, covering risk reduction benefits as well as social and environmental effects.	Identify key areas for NB-interventions such as coastline, rivers, mangroves and mountains; identify NB solutions.
Standardized performance assessment	Nature-based solutions for flood risk management need to be tested, designed, and evaluated using quantitative criteria.	Design and evaluate the NB-interventions
Integration with ecosystem conservation & restoration	Nature-based solutions for flood risk management should make use of existing ecosystems, native species, and comply with basic principles of ecological restoration and conservation. Restoration, conservation, and management of eco- systems are crucial elements of the implementation of nature-based solutions for flood risk management.	Implement the nature-based solutions as part of a broader, longer term mitigation and preparedness approach
Adaptive management	Nature-based solutions for flood risk management need adaptive management based on long-term monitoring. This ensures their sustainable performance	Monitor the performance of NB-interventions & carry out the necessary maintenance.

Source: expanded from World Bank, 2017.

4 Views of project consultations

The PERC study, discussed in section 3.2, is largely based on the views of over 100 people in Mozambique, Zimbabwe, and Malawi. Here, we briefly discuss the consultations held for this project. The consultation process was modified because of COVID-19. The originally planned country visits were replaced with video meetings (2 in Mozambique and 2 in Zimbabwe) and a questionnaire for key stakeholders. To-date we have conducted meetings with government staff in Zimbabwe and Mozambique; meetings with non-government organizations were also held in both countries (in Zimbabwe only with UNESCO and World Bank). A total of 23 completed questionnaires were received, which represents a response rate of 23%. The circumstances for consultations remain difficult because of continued lockdowns and associated limitations (e.g. poor home internet; mobilization difficulties).

A separate consultation report is currently being finalized. Below, we share some of the preliminary views on mitigation and preparedness. These are illustrative and not necessarily the priority ones:

- a. Disasters like Idai have high opportunity costs: they divert limited finances and human resources to relief and recovery efforts;
- b. Relief and recovery are still on-going. To-date many people are still displaced or live in damaged houses; the response in terms of work done vary widely but all agree that a lot of work remains to be done. Covid-19 has slowed down the recovery process, as financial and human resources were diverted to fight the pandemic. Relief efforts have not been enough to-date and respondents suggest that progress with relief and recovery may be at best halfway. Full recovery will take a very long time, possible 10 years. At the same time, some ICPs are closing their “Idai support activities”;
- c. Resettlement is essential but it a difficult and sensitive process that requires extensive consultation and planning. When it takes too long, people move back to high-risk areas;
- d. While early warnings were issued and have benefited communities, they need to be strengthened, become more community-based and action-oriented. EWS needs to be based on good data;
- e. Both countries faced serious challenges prior to Idai, which made it difficult to timely and adequately respond. These include economic (e.g. debts, poverty, food shortages and hyper-inflation) as well as political problems;
- f. Both countries have DRR and DRM structures in place that assisted early relief and recovery. The structures need to be further strengthened, particularly at the local level;
- g. DRR and DRM activities need to be expanded to the shared river basin level: e.g. an integrated data collection network, data sharing and transboundary flood modelling and a basin-wide DRM Strategy);
- h. The cluster response is useful and worked particularly well for WASH and food security (see also Annex A), where support structures were already in place;

- i. Improved land use planning (avoiding high risk areas) and 'building-back-better' are needed to mitigate and be better prepared for the next cyclone;
- j. Increasing the resilience and maintenance of critical infrastructure is essential but requires funding;
- k. Monitoring networks, good data, and data sharing within countries and between the basin countries are critical to anticipate possible impacts and support relief efforts.
- l. The DRR approach needs to move more towards preventive and pro-active approaches.
- m. Modern communication and new technologies, including RS and GIS) need to be used and DRR should not rely on a single communication and transport mode.
- n. Adequate equipment and supplies (e.g. transport, communication, and essential basic needs) need to be stored at the local level to strengthen local disaster preparedness;
- o. A transboundary DRM strategy needs to be developed with interventions such as data collection and sharing, flood/ drought forecasting and EWS.

5 Mitigation analysis

This report focuses on mitigation measures, and the analysis covers measures that **have been taken** and measures that **could be taken in future** to prevent and mitigate impacts. Mitigation of a disaster is defined as “*the lessening of the potential adverse impacts of a hazardous event or physical hazards*” (source: www.undrr.org). The DRR and DRM cycle commonly distinguishes four phases:

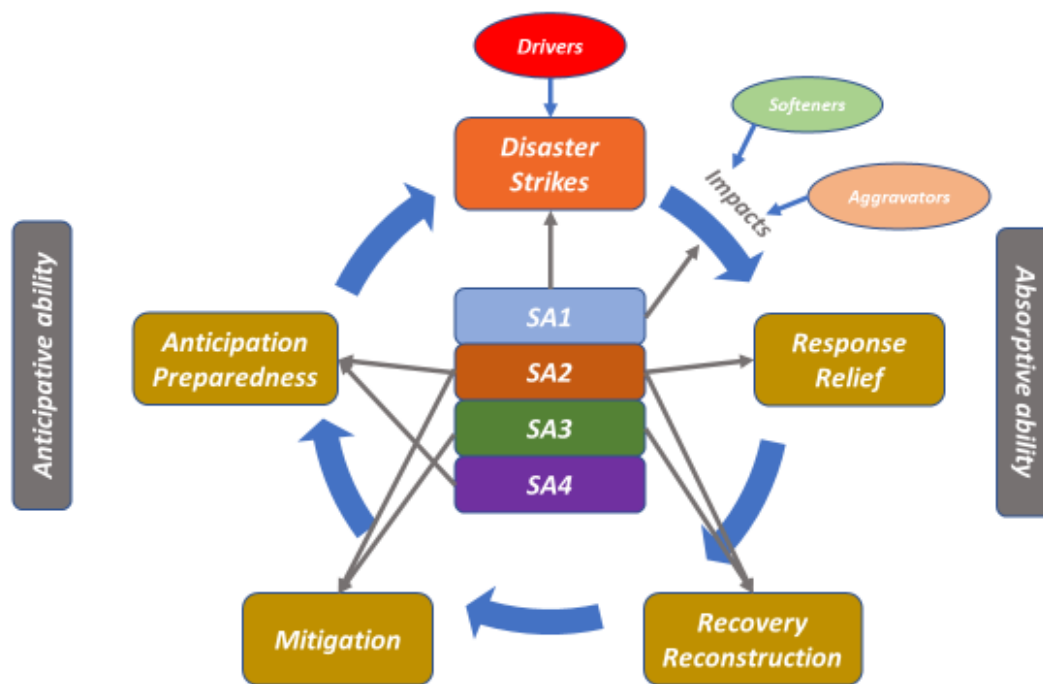
- a. **Response and relief.** Responses are “*actions taken directly before, during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected*” (www.undrr.org). Response and relief are short term (up to 1 to 2 years);
- b. **Recovery and rebuilding;** Recovery aims at “*restoring or improving of livelihoods and health, as well as economic, physical, social, cultural and environmental assets, systems and activities, of a disaster-affected community or society, aligning with the principles of sustainable development and “build back better”, to avoid or reduce future disaster risk*” (www.undrr.org). Recovery and rebuilding are typically short and medium term (e.g. up to 5 years);
- c. **Mitigation and prevention.** Prevention refers to “*Activities and measures to avoid existing and new disaster risks*” (www.undrr.org). No timelines exist for mitigation and prevention. This must be a continuous effort; and
- d. **Preparedness.** Preparedness refers to the “*knowledge and capacities developed by governments, response and recovery organizations, communities and individuals to effectively anticipate, respond to and recover from the impacts of likely, imminent or current disasters*” (www.undrr.org). Countries and communities should always be prepared.

Increasingly, mitigation measures are incorporated in recovery and rebuilding interventions as the above terms show. For example, recovery and rebuilding efforts in the PDNA and RINA assessments include Building-Back-Better (BBB), resilient building designs, building codes, resettlement plans and livelihood diversification. Mitigation is linked to preparedness as preparedness contribute to **actual** impact reduction. Therefore, this chapter will also include preparedness measures.

Facilitated by their strong DRR structures, both governments with ICPs quickly assessed the relief, damage and recovery needs through the PDNA in Mozambique and the RINA in Zimbabwe (GoM, 2019 and GoZ *et.al.*, 2019). The PDNA assessment model has been used in many countries. A review found that PDNAs are useful to prioritize interventions, mobilize relief and recovery assistance, and to facilitate collaboration and coordination between the multitude of organizations involved in relief and recovery (Jeggle & Boggero, 2018). Jeggle and Boggero (2018) further argue that PDNAs should be owned and driven by national governments; better private sector coverage and community participation are also needed as shown in the Mozambique Idai PDNA. Community participation is now integrated in Idai recovery projects in both countries through stakeholder engagement plans.

Figure 9 shows the DRM cycle with linkages to the four Sendai key areas and the four abilities of the SADC Resilience Framework. The figure shows the DRR cycle and where the Sendai key areas and the abilities of the SADC Resilience Strategy Framework fit in.

Figure 9: The DRM cycle with Sendai key areas and SADC resilience strategy abilities.



Notes: transformative ability applied to the entire DRM cycle; SA are Sendai key areas. SA1 = understanding the disaster; SA2= strengthening DRM structures; SA3 = Investment in DRR and SA4 = disaster preparedness. the diagram can be used at different spatial levels (e.g. community, district, province, country and BuPuSa).

Below, we analyze the recovery, mitigation and preparedness measures in terms of the Sendai framework (section 5.1), the SADC Resilience Strategy framework (SADC, 2019) in section 5.2, and sustainable development/ livelihoods (section 5.3). These are the conceptual models that constitute the analytical framework of this project (see this project's inception report; CAR and HCA, 2019).

5.1 Cyclone Idai in terms of the Sendai key areas

The Sendai framework is the first component of the framework used in this project. The framework identifies four key areas for DRR/DRM action each of which is discussed below. Disaster impacts will be reduced or better absorbed if:

- The nature of the disaster and the associated risks are better understood;
- Disaster risk management is strong;
- Sufficient funds are invested in DRR to increase resilience; and
- Disaster preparedness is adequate.

The countries have made significant progress in the areas a and b (especially Mozambique) and to a lesser extent with d. DRR funding remains a major constraint despite the financial assistance of ICPs.

5.1.1 Understanding disaster risks

The understanding of cyclones has generally improved due to better data, forecasting models and experiences from previous cyclones. However, further enhancement of the understanding is necessary, particularly in view of the changing nature of cyclones due to climate change. This project focuses on cyclones, but it is noted that other disasters also occur, droughts are the most common disasters in both countries, and require a different DRM approach. The multitude of types of disasters is challenging for DRR/DRM institutions.

Each cyclone has unique characteristics due to their natural, locational and socioeconomic context, as well as the cyclone's specific features such as windspeed, rainfall and intensity, storm surges, flooding and landslides. For example, Cyclone Idai made landfall twice, and the second landfall was more destructive. Another example: Cyclone Idai differed from Cyclone Kenneth in windspeeds and location, but a combination of two cyclones within such a short time spell was new in southern Africa. Local communities perceived the intensity of Idai as unique. This highlights the importance of detailed forecasts and informed EWS as well as building a cyclone data base with details of past cyclones, their risks and impacts¹⁶.

The risks of cyclones like Idai are real and cyclones occur frequently; on average every second year in Mozambique (WMO, 2019). Due to climate change the intensity of cyclones is increasing as shown by Idai and Kenneth. Views on their frequency differ. While the common view is that climate change increases the frequency of cyclones, the 2019 Idai WMO report argues that the frequency will be decreasing, while intensity increases. This disparity in views needs further investigation.

Disasters, including Idai, affect vulnerable groups most. The poor tend to live in high-risk areas and poorly built structures, with limited infrastructure, and they often depend on subsistence agriculture, all of which results in limited coping capacity and adaptation options.

Idai shows that disaster risks need to be understood at the basin level. Impacts in upstream Zimbabwe had serious impacts on Mozambique (e.g. additional floods from high water levels in rivers upstream). Similarly, impacts downstream have adverse impacts upstream. For example, disruption of transport and communication networks in Mozambique made relief efforts in Zimbabwe more difficult.

A summary of factors that aggravate and ameliorate or soften Idai impacts is provided in Table 4. The table shows that **both countries and their communities had multiple aggravating factors**, making the cyclone's impacts more severe. However, Idai also generated more cohesion and solidarity at community level and cooperation between different segments in society (government, NGOs, faith-based organizations, private sector, communities and individuals). Even prior to Idai, most households were poor, depended on food aid and experienced livelihood stress and insecurity. In Mozambique, their location in high risks areas worsened their vulnerability. At the country level, government deficits caused financial constraints and limited DRR structures' implementation capacities, and Zimbabwe faces a range

¹⁶ Currently, cyclones are largely treated on a case-by-case base, missing the history of cyclones.

of socio-political-economic challenges, which for example made it difficult for ICPs to work through government. Infrastructure was not adequately maintained or rundown, hampering rapid responses and increasing damage. HIV/AIDS is widespread in both countries putting strains on households and government health systems and budgets. Access to ARVs was affected, putting HIV/AIDS patients at risk. Without earlier investments in DRR structures, the situation would have been worse. EWS assisted and so did community DRR committees in Mozambique.

Table 4: Summary of factors influencing Cyclone Idai risks and impacts.

Aggravating factors	Ameliorating factors – softeners
Lack of details and action-orientation of early warning; information about the strong winds was inadequate	No springtide during Idai landfall
Limited understanding of and awareness about cyclone's intensity risk at an institutional and individual level	Presence of trees in residential areas
Inadequate building and land use planning regulations for extreme events such as Idai	Partial rehabilitation of Beira's drainage system
Serious pre-Idai food insecurity due to droughts in both countries	Good existing DRR structures and procedures. Mozambique has village DRR committees with evacuation plans and designated shelters
Pre-Idai refugees and asylum seekers in Zimbabwe	Both countries have early warning systems.
Poor development and maintenance of public infrastructure	Improved weather information and forecasting & EWS
High incidence of poverty – livelihood stress – lack of savings/ buffers	Quick response from non-state actors (e.g. ICPs, NGOs & and private institutions) in terms of funding and technical assistance
Rural livelihood dependency on agriculture and lack of diversification	Availability of WASH contingency stock at provincial level (e.g. Zimbabwe)
People living in high risk areas, low areas, and informal settlements	Solidarity and cooperation within communities and sharing of resources, knowledge, experiences and ideas
Serious budgetary constraints of governments	
High incidence of HIV-AIDS	
Limited implementation capacity of DRR, particularly at the local level	
Difficult macro-economic conditions, government	
Lack of DRR preparedness (Zimbabwe) Mostly reactive DRR orientation	
Climate change aggravates intensity of cyclone and causes sea level rise	
Insufficient local search and rescue means	
Most people lived-in high-risk areas	
Break down of communication	
Unequal distribution of support and people seeking to profit	

Socio-political economic challenges in Zimbabwe (e.g. hyperinflation)	
Government funding constraints	

Sources: own analysis, project consultations and WMO, 2019; Chamiza, 2019; INGC, 2010; Norton *et.al.*, 2020. Note: this table will be updated with results from the consultations.

Generally, information about climatic hydrological conditions has improved, leading to a better understanding of cyclone risks. There is however a need to share data between countries, use data for modelling, forecasting and scenario development, and to make the data and results of the analysis timely available to all DRM institutions and affected parties. In addition, data are needed about the livelihood strategies in the basin to anticipate possible impacts of cyclones on livelihoods and communities. The establishment of a data base for BuPuSa is recommended.

5.1.2 Strengthening disaster risk management

The countries have strengthened DRM, especially Mozambique. As recognized in the Zimbabwe's RINA assessment (GoZ *et.al.*, 2019), the DRR/DRM structures and strategies need to be further strengthened and expanded to transboundary river institutions such as BuPuSa, LIMCOM and ZAMCOM, and be enhanced at community level. This is particularly important for Mozambique which lies downstream of many major southern African rivers¹⁷. Moreover, DRR capacity at the district level needs further strengthening together with the communication lines between national, district and local institutions.

Both countries have established DRR/DRM structures, institutions and funding mechanisms. The structures mostly involve government ministries and departments. In Zimbabwe, the Civil Protection Council also involves non-state actors. In Mozambique, local DRMCs exist with volunteers. A number of NGOs are active in DRR and DRM in both countries.

Although both countries have a dedicated DRR/DRM fund and ministerial DRR budget allocations, they experience funding and capacity constraints, and continue to depend on external support. Capacity, funding, and equipment constraints remain prominent particularly at the district and local levels, hampering rapid responses, recovery, mitigation and preparedness.

The DRR enabling environment need further improvement, particularly in Zimbabwe for example through the finalization and adoption of the new draft DRR Act in Zimbabwe. It is also important to coordinate and integrate DRM and CCA in development planning as disasters are recurrent, DRR and CCA are linked and countries have limited implementation capacities (UN-ECA, 2015; OECD, 2020). This requires synthesizing of the policies and strategies and close cooperation between the implementing institutions.

Bi-directional communication between national, district and local levels is vital for effective DRM. When Cyclone Idai struck, communication systems broke down for some time, hampering rapid actions and information sharing. Communication channels are an important component of the critical infrastructure; backup channels are necessary when a particular communication mode fails (e.g. mobile networks in Beira).

¹⁷ Apart from the Buzi, Pungwe and Save: the Zambezi, Limpopo and Nkomati Rivers.

Cyclone Idai has shown that disaster drivers and impacts transcend national boundaries. Therefore, BuPuSa needs to be actively involved in DRM in its basins, for example through the development of a BuPuSa DRM plan, including regular basin wide data collection and sharing as well as basin wide weather, hydro, and flood risk forecasting.

5.1.3 Investing in DRR for resilience

Investments are needed for recovery and rebuilding of infrastructure, houses and buildings, but more importantly for building longer term resilience through DRR. Without DRR investments, countries and communities will be exposed to the same or worse disaster risks in future. We noted in chapter 3 that global DRR investments are inadequate. Most international funding is destined for immediate response and relief interventions (UNDRR, 2019). Development assistance for DRR (mitigation, prevention and preparedness) amounted to US\$5,2 billion in the period 2005-2017: only 4% of total humanitarian assistance (UNDRR, 2019, p vii).

The picture for Cyclone Idai is the same as shown in Chapter 3. While national DRR Funds exist in Mozambique and Zimbabwe, national funds are insufficient, and both countries rely on international funding. International funding was rapidly mobilized and significant, but it fell short of the needs as assessed in the PDNA and RINA. The relatively low level of DRR funding hampers resilience building for future cyclones. And yet, resilience building at the national and community level is critical for effecting changes and long-term sustainability. It is also more cost-effective on the long term: *“we already know that every US\$1 invested in prevention saves on average US\$5 in future losses.”* (<https://www.zurich.com/en/sustainability/our-role-in-society/flood-resilience>).

As DRR and CCA are intricately linked and regular feature in both countries, investments in CCA and DRR/DRM should be integrated in the development planning process. This already happens to a limited extent, but it should become standard practice and part of the development planning and funding processes and mechanisms (Norton *et.al.*, 2020).

Investments require that the basic **critical infrastructure** be in place and maintained well and that alternatives are in place when infrastructure components fail (e.g. a road). Critical infrastructure should include **‘hardcore or engineering’ infrastructure** and **green infrastructure**. The former refers to constructed infrastructure (roads, buildings, communication networks, dams). Cyclone Idai has clearly shown the importance of properly maintained drainage systems in Beira. The latter refers to investments in biodiversity and ecosystem services to help people adapt to the adverse effects of climate change and disasters. It covers nature-based solutions such as mangrove rehabilitation, rehabilitation of coastal ecosystems, urban greening and generally land rehabilitation (see section 3.3).

At the local level, Idai has shown that communities need shelters, evacuation plans, transport/boats, and communication equipment to be prepared and respond effectively to disasters (Norton *et.al.*, 2020). Moreover, local storage facilities are needed for emergency supplies ((e.g. food, basic medicines, water purification) to facilitate rapid availability and access.

5.1.4 Enhancing disaster preparedness

Disasters can no longer be dealt with in an ad-hoc manner (UNDRR, 2019). As quoted earlier in this report: “As we know, after the event is before the next event” (Venkateswaran *et.al.*, 2020, p.4). Preparedness requires commitment, implementation capacity and funding. Governments appear committed, have reasonable implementation capacities but experience severe funding constraints.

The INGC and the DCP are responsible for disaster preparedness in Mozambique and Zimbabwe respectively. Both organizations have district offices and in Mozambique also local DRMCs. At district and local level, the capacities and funding are limited. In Zimbabwe, preparedness at the local level is more limited, and response interventions were initiated from the national level.

Communities have been empowered to implement DRR at the local level, but to-date such efforts remain mostly re-active. In Mozambique, some local DRMCs have evacuation plans, shelters, and some relief equipment that softened the local impacts. Some communities were involved in monitoring of weather conditions and water levels at certain places along the Buzi basin in the past, whose data were used as an input into EWS¹⁸ (IFRC, 2007a).

The EWS has enhanced the preparedness. Generally, EWS data and information have improved and early warnings were sent out to communities. According to Norton *et.al.*, (2002), some DRRs in Sofala Province responded by preparing evacuation plans, shelters and prepositioning of supplies. However, most communities did not ‘translate’ the warnings into action, partly due to the unprecedented scale and intensity of Idai. Warnings in Zimbabwe were also insufficiently actioned because of misunderstandings (rain is welcome to break the drought) and the inability to appreciate the intensity and magnitude of the impacts.

Preparations were made at the country level; no transboundary preparations were made at BuPuSa level. When the hydrometric stations in Zimbabwe were destroyed, the upstream water flows ‘surprised’ the downstream lowlands in Mozambique. When transport networks were disrupted in Mozambique, relief efforts for eastern Zimbabwe were hampered. Clearly, preparedness at the transboundary river basin level needs to be improved by (re-)construction of the network of hydrometeo stations, river flow and flood modelling, mapping of high-risk areas, and development of disaster scenarios. In addition, building up a repository of data and experiences of the previous cyclones in the BuPuSa area would increase the understanding of and preparedness for cyclones, and through sharing between countries boost transboundary DRR. This repository would include geospatial and socio-economic information together with (qualitative?) information gathered from communities themselves.

5.2 Cyclone Idai and the key capacities of SADC Resilience Framework

The SADC Resilience framework is the second component of this project’s framework. It is important as both countries are members of SADC, and SADC is currently working on strengthening regional DRR and DRM response and preparedness mechanisms (to be completed by the end of 2020).

¹⁸ It is not known if this project still exists after being handed over to district authorities in 2006.

Countries and communities are more resilient, i.e. are better able to reduce and absorb the impacts of disasters, when they have adequate **adaptative, absorptive, anticipatory** and **transformative** abilities. These abilities are at the core of SADC Resilience Strategy Framework (SADC, 2019). Below, we review each ability. The abilities are driven by different types of capital (or ‘pivots’ see also section 3.2) and associated with Sendai key areas and components of the DRM cycle (see Figure 9). Increased abilities will lead to a more robust infrastructure, food security, social protection, environmental protection, integrated and informed decision making, and a better understanding of the risks (SA1) , including CCA and sustainable urban centers (SADC, 2019).

5.2.1 Anticipative ability

Anticipative ability refers to being well **prepared** prior to a disaster that will minimize the adverse impacts. The anticipatory ability of social systems is to **foresee and reduce** the impact after a disturbance through preparedness and planning (Bahadur *et al.* 2015 quoted in SADC, 2019). It is thus linked to the Sendai key area of “Preparedness” (see 5.1.4). The greater the anticipative ability is, the better the preparedness can be, but it needs to be translated into action through effective EWS.

Prior to the land fall of Cyclone Idai, weather forecasts were prepared with details of the possible land fall date, the location, and the intensity of the cyclone. In Mozambique, this information was transferred to institutions and communities by INAM through EWS for community action and by INGC to institutions for DRR readiness. INAM and INGC used different coding schemes, apparently causing some confusion, and possibly delaying action (WMO, 2019). The communities with active DRMCs were able to prepare and implement their evacuation plan and use their shelters. However, key equipment was often inadequate or poorly maintained, causing operational problems.

The impacts of Idai were much more severe than expected, indicative of inadequate anticipation, with some believing that the cyclone would break the drought and that it could have positive effects. The community DRMCs still tend to be more reactive, i.e. response and relief oriented than pro-active and anticipative (Norton *et al.*, 2020). Cyclone Idai showed that the anticipative ability and preparedness need to be further enhanced at the community level by e.g. training and awareness raising campaign, storage of local emergency supplies, maintenance of basic DRR and relief equipment and action oriented EWS messages.

Community anticipation existed to some extent, particularly in Mozambique through the local DRMC and EWS. However, gaps existed in:

- ✓ Appreciation and anticipation of the intensity of the disaster;
- ✓ Action-orientation nature of the EWS; and
- ✓ Conditions of local DRR relief facilities and equipment.

5.2.2 Absorptive ability

Absorptive ability or persistence refers to various (coping) strategies by which a system **moderate or buffer the impacts** of shocks on their livelihoods and basic needs (Béné *et al.*, 2012 quoted in SADC, 2019). The more resilient the system such as a community is, the better and the faster it can cope with the

impacts of shocks. Greater absorptive ability reduces the magnitude of the required response or relief efforts.

Governments and communities have been unable to absorb the impacts of Cyclone Idai due to the scale and intensity of the disaster; as a result, they have not yet been able to rebuild livelihoods. Significant external funding and technical assistance was mobilized to cope with the impacts. Pre-Idai assistance with WASH and food aid helped to quickly absorb and limit impacts and contribute to reconstruction. For example, water purification contributed to the containment of disease outbreaks. Food aid could quickly be mobilized and distributed as food distribution preceded Idai. The livelihood dependency on agriculture, i.e. the most severely affected economic sector, contributed to the collapse of rural livelihoods and to dependency on external aid (see also Annex A). Pre-Idai existing widespread poverty in both countries had already eroded people's absorptive ability. In Zimbabwe, most rural households lived under stress prior to Idai and had no or little savings left.

Livelihood diversification, rebuilding of assets (Building-Back-Better or BBB) and savings would strengthen people's absorptive ability. At the basin level, ecosystem-based adaptation (EBA) could increase the absorptive ability of the basin together with well-maintained critical infrastructure such as dams. Operational guidelines for dam management such as those developed for the Save River could reduce the disaster risks and diversify livelihoods (CRIDF, 2019). Rehabilitated and expanded mangrove ecosystems would form buffers for storm surges, and in the case of Idai, rehabilitation of part Beira's drainage system resulted in less flooding in these areas.

Reviews of earlier cyclones in Mozambique suggest that cash hand-outs, assistance to small, micro and medium enterprises (SMMEs) and supply of farming implements for the next agricultural season were successful in rebuilding livelihoods (World Bank, 2005). Cash payments and emergency employment generation are part of the post Idai recovery programs in both countries (see chapter 2). The same World Bank review concluded that recovery efforts usually benefit from large scale international publicity and the resulting additional funding that the publicity generated (World Bank, 2005). While Cyclone Idai drew significant global publicity, funding gaps remain. As a result, recovery is incomplete, and for example many people still live in temporary shelters (e.g. Norton *et.al.*, 2020 and project consultations).

The absorptive ability of governments was low as reflected in the global risk ranking (section 3.2). Communities' absorptive abilities were limited prior to Idai due to:

- ✓ Widespread poverty;
- ✓ Food insecurity and dependency on food aid; and
- ✓ Dependency on subsistence agriculture and lack of economic diversification.

Cyclone Idai has further limited the absorptive ability due to losses of livelihood sources and assets. Dependency on external support has increased.

5.2.3 Adaptive ability

Adaptive ability is the capacity to **learn, combine experience and knowledge, adjust responses** to changing external drivers and internal processes, and continue operating (Berkes *et al.*, 2003 quoted in SADC, 2019). Adaptive ability supports recovery and mitigation measures. The adaptive ability in both

countries has improved with the development of DRR and CCA structures, improved data, and experiences from earlier cyclones. However, it is still limited due several factors, including:

- a. Unfavorable and unstable macro-economic conditions;
- b. Financial and human resource constraints;
- c. Limited baseline and monitoring data; and
- d. Limited DRR capacities particularly at district level.

The Idai follow-up support projects jointly driven by governments and ICPs reflect some adaptive ability with clear focal areas such as agricultural support, livelihood support, coastal zone protection, expansion of the Beira drainage rehabilitation system and resettlement programs and restoration of critical infrastructure and housing.

Resettlement is an interesting case of adaptive ability. While it is widely accepted that it is “best” to move households and communities from high-risk to lower-risk areas, resettlement is hard and slow to implement in practice. This is due to the complexity of the required preparation (e.g. identification and mapping of suitable resettlement areas as well as service provision), the need for full participation and cooperation of communities and the need to create a conducive environment for livelihood diversification and improvement. A variety of cultural and social factors also play a key role. The progress of resettlement programs could not be verified, nor their performance.

Other examples of adaptive ability emanating from Idai are the perceived need to adapt building regulations, to **build-back-better**, and to strengthen **integrated land use planning**.

Communities had to adapt on the short term and did so by social networking and mutual support, hosting of IDPs etc. However, communities’ adaptive abilities, particularly for long-term interventions were constrained because of:

- ✓ Local financial and human resources constraints for DRR;
- ✓ Lack of local DRR equipment and strategic reserves;
- ✓ Lack of upscaling of BBB design and construction;
- ✓ Difficulties in relocating to low risk areas from high risk areas (i.e. resettlement).

Covid-19 has led to diversion of human and financial resources and reduced the countries’ and communities’ adaptive ability.

5.2.4 Transformative ability

Transformability ability seeks “*to create a fundamentally new system when ecological, economic or social structures make the existing system untenable*” (Walker *et al.*, 2004, p.5 quoted in SADC, 2019) so that shocks will no longer have major impacts. It is the ability to transform systems and structures to better handle disasters. It covers all stages of the DRR cycle, all other abilities and refers to communities as well as governments (as shown in Figure 9).

Several transformative abilities are important. Firstly, the ability to transform from the focus on short-term relief and response to a balanced long-term approach of DRR. This shift is much talked about but slow, indicative of actual transformative ability constraints. Secondly, empowerment and greater participation of communities in DRR and DRM is desired by many; this transformative process is on-going

in Mozambique but needs to progress further in Mozambique and be established in Zimbabwe, possibly linked to the community based CAMPFIRE approach. According to the OECD (2020) countries seek to integrate DRR and CCA planning and governance structures to better handle disasters and climate change. This transformative process requires that CCA and DRR are integrated in development and land use planning and management. Thirdly, DRR needs to be upscaled to the transboundary level, which requires direct BuPuSa involvement as well as involvement of other transboundary basins, in which Mozambique and Zimbabwe participate (e.g. Limpopo and Zambezi). This transformation is just starting and needs to be developed.

Transformation is not the prerogative of government as it refers to society at large, and includes the private sector, communities, faith-based organizations, and NGOs. Idai relief and recovery have seen good examples of partnerships. Collaboration between governments and ICPs has been effective for relief and response interventions. However, ICPs need to support longer term recovery and countries' and communities' opportunities to grow and diversify, become more resilient and to develop their own abilities rather than relying on external funding and technical assistance.

Idai demonstrated the benefits of collaboration between government, communities, and the private sector. This became apparent in Chimanmani when the town was completely cut off. Communities and private sector joined hands in rapid relief efforts. Public-private-community partnerships are important to overcome resource scarcity and develop social capital, the benefits of which extend beyond DRR. Communities need to actively participate and implement to make DRR benefit from local knowledge as well as their (self-) interest in mitigation and prevention. This requires further awareness raising, training, funding and equipment. The involvement of communities in weather and hydro monitoring, EWS, mapping, strengthening of the community DRMCs (Mozambique) and expansion of CAMPFIRE/CBNRM (in Zimbabwe) are possible examples.

As argued earlier, ICPs are currently indispensable for humanitarian relief, recovery and mitigation. To optimize long-term results, ICPs need to be flexible in addressing local needs, to sourcing local material, equipment, and human resources/ companies and to make it a longer-term commitment to develop better and build resilience (Norton *et.al.*, 2020).

Generally, the ability to adapt, absorb, anticipate and transform grows with more monitoring, better data collection and analysis. Scientific and applied research abilities are therefore needed to support these abilities and achieve the necessary transformation. This requires, among others, meteorological and hydro monitoring networks, flood and high- and low-risk areas mapping, land-use and land-cover mapping, poverty and livelihood monitoring and agricultural practices and production monitoring. Examples of useful maps for mitigation and preparedness are shown in Annex D: BuPuSa basins, settlement and population distribution, frequency of cyclone exposures and rainfall intensities. Overlays of maps can show expires of agriculture and population to high rainfall and cyclones. The full set of maps will be provided at the end of the project. Figure 10 provides some details about the usefulness of medium and high-resolution imagery for DRM. The combination is most useful and costs effective; the potential of high-resolution imagery is expected to increase while the costs are decreasing. In addition, water abstractions from the three rivers need to be monitored or estimated. It would be useful to explore the feasibility of EBA solutions in the basins, together with the construction and improved management of dams (e.g. as done in the Save River).

Figure 10: DRM applications and potential of medium and high-resolution imagery

Medium resolution imagery

With free access to data and the datasets medium-resolution imagery programmes can provide cost effective platforms for wide-area mapping and monitoring. Medium resolution data are widely used for terrestrial mapping and monitoring applications, and there are a many accepted processing methodologies and algorithms available to support land, river basin and DRM programs:

- Sentinel 1 and 2 imagery is available on a variety of internet-based platforms, and directly from the EU Copernicus program;
- With a catalogue stretching back to the 1970s, the USGS Landsat Program provides equivalent access to data through the Earth Explorer platform; and
- The Google Earth Engine provides access to a script-driven cloud-computing geospatial analysis environment, which also has full catalogue access to both programmes described above.

The analysis of the above data sets gains confidence with ground truthing and field work. This is a requirement for future work.

In the case of basin-wide monitoring, medium-resolution data can be highly effective for landcover mapping, monitoring and change detection. Regular landcover mapping at basin scale is now an achievable goal, making post disaster event assessments easier to conduct.

The introduction of GEE processing approaches means that organizations need less physical infrastructure, as the source data and processing software are on the cloud platform. This and other similar platforms provide a unique opportunity to overcome some financial, institutional, and physical (ICT infrastructure) obstacles that currently complicate the application of geospatial analysis in DRM.

Free medium-resolution remote sensing data are not appropriate for operational mapping of features less than a certain scale (1:50,000), and are not feasible sources for detailed mapping and monitoring activities required in DRM.

High resolution imagery

Fortunately, high-resolution imagery has become more cost effective and widely available and applied to areas, including DRM. It has advantages over medium-resolution imagery, mostly in terms of the level of detail available from these data, which enable the identification and extraction of smaller features on the earth surface. In the case of the current study, the value of high-resolution imagery was demonstrated through the damage assessment and damage density analysis. The features used in the damage assessment in this project were extracted manually, but automated feature extraction processes will soon enable feature rapid extraction and update. Other expected developments include the use of machine learning algorithms to automatically detect changes in state of buildings and other features.

In brief, transformative abilities can be strengthened by:

- ✓ Empowering communities to participate in DRR and DRM implementation (human resources, funding and equipment);
- ✓ Effective DRR and DRM collaboration between the public sector-private sector and communities (e.g. all are represented in Zimbabwe DRR and DRM Platform);
- ✓ Upscaling towards transboundary DRR and DRM management (e.g. BuPuSa, LIMCOM, ZAMCOM);
- ✓ Balancing ICP activities between relief and response support and reconstruction/ resilience building/ DRR; this also involves greater attention of relief and response efforts in the countries' national and local economies (e.g. sourcing local material and expertise); and
- ✓ Integrating DRR and CCA in development and land use planning.

5.3 Cyclone Idai and sustainable livelihood and development

Community resilience depends, among others, on the level and sustainability of rural livelihoods. Sustainable development and sustainable livelihoods are the third and critical component of the project's framework.

Sustainable livelihoods are determined by household income (in kind and in cash) and assets. Sustainable development of countries requires maintaining and expanding the capital base (physical, social, environmental, economic and institutional) and the ability of these assets to produce, generate income and support livelihoods.

The project's Impact Report found that people's livelihoods were already stressed prior to Cyclone Idai and that poverty was rife (CAR & HCA, 2020). Income levels were low and in Zimbabwe, household were already selling assets to survive. Cyclone Idai significantly worsened the livelihood crisis through loss of income, employment, agricultural produce as well as loss of household assets.

At the national level, the agricultural sector was hardest hit by the cyclone, reducing economic growth, and causing significant damage to the countries' infrastructure (health and educational facilities, roads, and communication networks). The PDNA and RINA estimated the damages and losses and the costs of rebuilding and reconstruction (GoM, 2019; GoZ *et.al.*, 2019).

Response and relief efforts prioritised saving lives and supporting livelihoods, as well as emergency repairs to critical infrastructure. This process is still on-going and will take time to complete. On-going post-relief¹⁹ recovery projects (chapter 2) focus on rebuilding of livelihoods and household assets and critical public infrastructure in a more resilient way; this is done in combination with resettlement schemes, improved coastal defence measures, and the process focuses on vulnerable groups that are most affected such as IDPs and the poor.

Household incomes were low prior to Idai and income losses due to Idai were high. In response, income support has been offered through cash payments and temporary employment (chapter 2). Agricultural

¹⁹ In practice, these overlap with relief efforts as relief is still much needed more than a year after Idai.

inputs are provided to restore future agricultural income. Rebuilding of household assets is supported through reconstruction of houses (BBB) and provision of WASH facilities; as stated above, this is not yet complete. Reconstruction includes resettlement schemes to reduce household vulnerabilities. Progress has been slow. While many capital assets have been damaged or destroyed, there have been some positive asset developments. Social capital development has been mixed. On the one hand, community and family structures were disrupted, gender-based violence and abuse of children increased, inequalities increased as vulnerable groups were most affected, and people were traumatized by the event. However, on the other hand, people and communities showed unity and togetherness in relief and recovery interventions and discovered that the private sector can be an effective partner. Many of the displaced persons and families were accommodated by friends and other families.

Key resilience concerns at the national level are building back better, resettlement to safer places, and the critical infrastructure with back up alternatives. At the household level, livelihood diversification is critical to increase household resilience. This will reduce dependency on subsistence agriculture, which is highly vulnerable to cyclones. Trade, tourism (adjacent to Protected Areas) and agro-processing opportunities could be pursued.

Natural capital losses include damaged forests, protected areas, coastal areas and mangroves as well as landslides and land degradation. The magnitude of the damage has not been assessed in detail (CAR & HCA,2020). Mitigation measures would include afforestation, land rehabilitation and rehabilitation of forest and protected areas.

Displacement has affected access to physical assets such as fields and pastures. This issue needs to be considered during the resettlement process. If families do not have access to fields, pastures, etc. they are likely to move back to their old place of dwelling with the associated, if not higher risks. The potential and benefits of nature-based adaptations should be further explored in the BuPuSa area. Several suggestions have been made in chapters 3 and 4. While creating more space for transboundary rivers has been successful in flood management in Europe, this is harder in BuPuSa where families are settled in the flood plains. So, the feasibility of some NBA measures depends on the success of resettlement programs.

6 Summary and conclusions

Relief and reconstruction efforts are on-going and are not yet complete. It may take several years before the countries and communities have fully recovered. The Covid-19 disaster delays the recovery process has complicated relief and reconstruction efforts due to diversion of financial and human resources. Relief and reconstruction were already underfunded if one compares the estimated relief and recovery needs with the (mostly relief oriented) external assistance. Both countries and their communities had limited resilience prior to Idai, and livelihoods were already stressed. Existing DRR/DRM institutional structures, including local DRMCs in Mozambique and EWS in both countries, and pre-existing presence of ICP interventions (WASH and food aid) assisted early relief efforts. A clearly outstanding feature of the Cyclone Idai was its intensity and ferocity (wind, floods, exceptional rainfall, landslides and storm surges), which was never experienced before and may well exceed the capacity of any DRM structure and the communities.

Countries and communities need to become more resilient to handle the next disaster better. This requires a longer-term approach, with different emphasis such as building back better, identification of critical infrastructure and their proper maintenance and a strong community emphasis and involvement. Moreover, it requires partnerships between different groups in society (communities, private sector, NGOs and government) and close cooperation between and coordination of ICPs.

The report identified a range of opportunities for mitigation, better reconstruction, better anticipation of and preparedness for the next cyclone. Critical areas are briefly summarized below.

DRR ownership and involvement

DRR assessments and interventions need to be **owned** by the countries involved. Governments should lead the DRR/DRM process, in particular anticipation, preparedness and responses; all stakeholders should be involved. Communities need to be actively involved and empowered through community DRMCs and local DRR plans.

DRR structures

The countries have DRR/DRM structures in place led by a single institution (DCP in Zimbabwe and INGC in Mozambique). Mozambique has local DRMC that are important in DRR and DRM efforts. In Zimbabwe, DRM and relief starts from the central government level, but then uses provincial and district CPUs. Local DRR/DRM capacities and funding need to be strengthened. In addition, DRR/DRM needs to be elevated to the shared river basin level (e.g. DRM Strategy for BuPuSa).

Communities

Communities need to be at the center of DRR and DRM. Some local DRMCs in Mozambique developed evacuation plans, shelter opportunities etc. but overall community engagement, empowerment and resilience need to be strengthened. Community resilience is weakened by widespread poverty, lack of savings and lack of livelihood diversification. Communities need DRR training and awareness in disaster response, response and reconstruction interventions, DRR funding, and equipment, improved EWS with their active participation, protection of critical infrastructure and scaling-up of resistant housing (BBB).

Interventions

Successful interventions include existing WASH programs that helped to contain disease outbreaks, urban drainage rehabilitation project that reduced flooding, intensive labor-based infrastructure works, creation of temporary employment and income opportunities, cash pay-outs, especially to vulnerable groups support livelihoods and the local economy; support of agricultural and other business recoveries, and building back better, establishment of basic local response infrastructure (e.g. shelter, evacuation plan, transport means, basic necessity supplies). The most vulnerable groups need special attention and protection such as the poor, children, disabled, women and the elderly.

Infrastructure

Cyclone Idai caused considerable damage to infrastructure, which hampered relief and rebuilding interventions. Countries should identify and maintain critical infrastructure, including alternatives in the event one infrastructure component fails. Generally, built up infrastructure needs to be reconstructed better and be made more resilient, considering climate change and new technologies. The feasibility of

new dams should be considered to control rivers flows and diversify livelihoods, together with improved dam operations (e.g. based on Save experience). The feasibility of green infrastructure and nature-based adaptations (e.g. parks, open spaces in town, use of flood plains as buffers for floods, coastal and mangrove protection, and land rehabilitation) needs to be assessed. Data infrastructure also need to be rebuilt and strengthened to ensure that basin wide weather, flood and landslide risk projections can be made. Equally important, regular livelihood assessment need to be made to predict household vulnerabilities and exposure to disasters. The Rural Livelihood Assessment in Zimbabwe is a good example.

Planning

Full integration of CCA, DRR and development planning is important to optimize and coordinate the use of countries' and communities' limited capacities. DRR and DRM need to be fully integrated in land use planning and urban and rural development plans and regulations. Post-disaster reconstruction strategies should balance the trade-offs between speed of and regulatory checks of interventions, emergency versus regular procurement, urban versus rural settings, on- versus off-budget expenditures and immediate rebuilding versus long-term planning.

DRR/DRM funding

Both countries, especially Mozambique, are vulnerable and remain dependent on external financial support on the short to medium term. Currently, most international funding is destined for relief and response; only 4% is destined for mitigation, anticipation, and preparedness. Unless more funds are invested in DRR, history is likely to repeat itself in future. DRR and DRM funding should be urgently increased to increase countries' and communities' resilience. While national DRM Funds, as both countries have, can be useful, such funds need to be sufficiently resourced, ring-fenced and transparently run. This is not the case in either country.

Resettlement programs

Resettlement programs are important mitigation measures, but their implementation is complex and requires considerable planning and community involvement. If delays occur in resettlement, households move back to their original homesteads and remain vulnerable. Resettlement needs to be based on proper assessments and data: use of local knowledge, experience, hazard mapping, leading to suitable resettlement sites, climate information for siting infrastructure & services, maintaining cultural aspects and relocation to areas where they improve their livelihoods. It should provide opportunities for livelihood diversification, diversification of farming techniques and training in production of higher value end products. Land tenure issues are important in relation to settlements.

International Collaborating Partners (ICPs)

The support of ICPs is currently indispensable in both countries. ICPs should, however, adopt a longer time horizon to support recovery and long-term sustainable development, increase funding for DRR in addition to the relief funding and where possible use local materials and capacities where possible in the ICP supported interventions. ICP coordination and collaboration with other agencies is also important to minimize the burden on already constrained DRM institutions in the countries.

Early Warning Systems (EWS)

Assisted by better weather forecasts, EWS has significantly improved in time and has helped to reduce loss of human lives and injuries, as well as damage. Further improvements need to be made by making warnings simple and action-oriented, using different communications and technology networks, including social media, and involving communities and raising community DRR awareness and compiling of a data and information base.

Data, maps and analysis/ modelling

DRR and DRM needs to be backed by sound statistical and information basis, including disaggregated data on the poor, gender, youth, elderly and people with disabilities. Investment in weather forecasting and DRM, esp. response have been good, but flood forecasting remains a challenge. Better forecasting has improved EWS warnings. Flood risk assessment and hazard mapping using RS and field surveys are important to prevent and mitigate the impacts of future floods. Annex D has examples of maps that can be further developed and combined (e.g. using overlays to identify high risk areas, exposed population, and economic activities). The local population and communities should participate in hazard profiling and proofing to build local preparedness. There is a need for research and core monitoring equipment and networks to understand and prepare for future disasters (e.g. hydro stations in rivers need to be urgently repaired).

Capacity building & training

Local capacity needs to be built to ensure psychosocial and material support essential to deal with long term effects for specific social groups and technical staff involved in aid efforts. A decentralized corps of trained DRM volunteers to support village DRR committees needs to be set up.

Transboundary water resource management

The countries need to repair the weather and hydrological monitoring networks, share information, and engage in hydro and flood forecasting and hydrological modelling at the basin level. Baseline data need to be collected for the transboundary basin, especially for the vulnerable groups. Development of integrated flood risk management plans for major river basins, including structural and non-structural measures, institutional framework, emergency responses and community engagement. Development of a comprehensive data base for the transboundary basins (like the Okavango Basin Information System); this should include data and experiences of earlier cyclones and other disasters in BuPuSa, LIMCOM and other transboundary basins.

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Annex A: Humanitarian assistance is still urgent one year after Idai: a personal story

Source: <https://www.unocha.org/story/mozambique-one-year-after-cyclone-idai-humanitarian-assistance-still-urgent> (14th March 2020).

Below an abbreviated version of the story from the above source.

OCHA's Saviano Abreu met Hortencia, one of the first survivors he talked to just after the disaster and now one year after the disaster. Living in the Mandruzi resettlement site in Dondo, she is an example of the critical importance of humanitarian assistance and the continued need for it! Hortencia, a single young mother-of-three, had lost everything in the Cyclone and had no means to go back to her small trade business or reconstruct her life without support. During this last year, humanitarian assistance was the only source of survival for many people.

- ✓ **Food assistance.** Hortencia and her children have had food on their table every day, as did more than 1.8 million people who received food assistance over the last year. If food assistance stops now, she has no other option to feed her children. Hortencia is growing some vegetables in the small garden she has on the resettlement where her family lives. But heavy rains and flooding destroyed part of her produce.
- ✓ **Educational support.** Hortencia's three kids are going to school, and just like more than 322,000 other children, they received crucial support and learning materials to prevent dropouts. Her sons are lucky to have public schools close to the resettlement site; a quarter of the 30,000 children displaced by Idai walk for more than one hour to attend school. Most of the 4,200 classrooms damaged by the cyclone are yet to be repaired. If temporary learning spaces were closed now, education would probably be stopped for these children.
- ✓ **Health care.** The whole family has been treated for malaria and received vaccines against cholera and measles. Disease outbreaks in Mozambique spiked after the cyclone, just when the health system was nearly collapsing with the destruction of 100 health centers, medical equipment, and essential medicine. Medical treatments in the resettlement sites and mobile clinics, and vaccination campaigns reached 850,000 people for cholera and 670,000 for measles. But one year on, clinics are still not functioning, and the public health system is unable to cover the needs of the population.
- ✓ **Shelter and housing.** Hortencia is sleeping in the tent of a neighbor one year after Idai. Although a tent is not a sustainable housing solution, this is still the only alternative for more than 90,000 people in resettlement sites while reconstruction efforts remain under-funded. In total, more than 146,000 families received temporary shelters. But the reality is that more support is urgently needed to make sure homeless families have dignified housing conditions.

All in all, I was happy to see that Hortencia and her kids have had at least their basic needs covered so far. Water and hygiene products have also been provided and women and children safe spaces in the camp give them some support to recover from trauma and fight for a better life. But I could not help but notice her deterioration during the last year. Despite high needs and dependence on humanitarian aid, organizations in Mozambique are being forced to scale down their response. Most have exhausted the funds and stocks will be depleted very soon. People of Mozambique still need support. And funding is urgent.

Annex B Ten essentials for making cities resilient

Corporate & City governance:

1. Organize for disaster resilience
2. Identify, understand, and use current and future risk scenarios
3. Strengthen the financial capacity for resilience

Integrated planning

4. Pursue resilient urban development and design
5. Safeguard natural buffers to enhance the protective functions offered by ecosystems
6. Strengthen institutional capacity for resilience
7. Understand and strengthen societal capacity for resilience
8. Increase infrastructure resilience

Response planning

9. Ensure effective disaster response
10. Expedite recovery and Build Back Better (BBB).

Governance, planning and responses feed into a comprehensive city resilience strategy and action plan. *

Source: UNISDRR, 2017.

Annex C: Good practices and lessons learned from cyclones

Ownership - participation

- ✓ Countries need to “own” DRR practices/measures/actions as well as the damage and needs assessments. Reconstruction strategies must be country owned and community driven, considering realities and institutional capabilities;
- ✓ There needs to be broad stakeholder participation, and involvement of non-traditional DRR interest groups;
- ✓ Future disaster preparedness & mitigation depends on government & donor commitment. Will it stay a priority with increasing budgetary pressures? Or will it revert back to the old reactive approach, i.e. response and relief?

DRR institutions

- ✓ Countries with effective institutional DRR arrangements respond faster and better to disasters. Stronger DRM institutions lead to better coordination of immediate response to the disaster, facilitating rapid resource allocation and damage and needs assessment as well as for reconstruction;
- ✓ Government capacity at all levels is critical to manage and anticipate disasters and responses;
- ✓ Institutions need to realize and prepare for different types of disasters; moreover, each disaster and its context is unique. The intensity of cyclones is more important and difficult to handle in DRR than the frequency;
- ✓ Community DRR committees are helpful to respond to disasters, but need to be better equipped, and trained and become more pro-active (e.g. mitigation and preparedness).
- ✓ Interinstitutional and interregional coordination of DRR and DRM is imperative and yet challenging. This includes effective and coordinated institutional DRR arrangements involving the large number of ICPs, NGOs and government agencies that typically get involved in disaster relief and reconstruction;
- ✓ Institutions such as INGC and DCP need to develop good practice guidelines and codes for recovery work for contingency planning and DRR.

Communities

- ✓ Community-based DRR helps to reduce death toll and asset losses. Communities are the first impact ‘recipients and possess indigenous knowledge. It is therefore essential that they directly participate in disaster prevention, EWS and where possible in relief and rebuilding efforts. Building of local DRR capacities and structures is essential. Community-based DRR structures need to be reviewed, build and strengthened;
- ✓ Challenges for community resilience building for DRR are strengthening DRR awareness, improving EWS, protecting critical infrastructure and scaling-up of resistant housing;
- ✓ Local DRR capacity needs to be built to ensure psychosocial and material support to deal with long-term adverse effects for specific social groups as well as for technical staff involved in relief efforts;

- ✓ Hazards can bring people and institutions together. Zimbabweans united in response to the Idai disaster across social, economic and political contexts
- ✓ Community engagement, empowerment and resilience need to be strengthened. Communities are key actors, have indigenous knowledge but need awareness raising, evacuation drills etc.)
- ✓ More diverse, sustainable and better livelihoods are essential for rural households to reconstruction and mitigation; poverty reduction and support for vulnerable groups is equally important;
- ✓ A decentralized corps of trained DRM volunteers could support rapid community responses to disasters;
- ✓ The social impacts are mixed. Disasters may increase social capital through the creation of new structures that strengthen safety net for future. Breaking of isolation of rural communities through new roads & bridges. Disaster decrease social capital by family displacements, traumatic experiences, GBV, etc.

Interventions

- ✓ Effective and successful DRR practices enhance resilience. Actions and practices should be replicable, where possible. Proposed/adopted DRM measures and practices need to be sustainable and sustained;
- ✓ Successful interventions include:
 - Existing WASH program helped to contain disease outbreaks.
 - Urban drainage rehabilitation limits flooding in towns
 - Intensive labor-based infrastructure works create temporary employment and income opportunities
 - Use of local contractors for support, recovery and reconstruction;
 - Cash pay outs, especially to vulnerable groups support livelihoods and the local economy;
 - Develop seeds & tools policies for support of agricultural and other business recoveries;
 - Good practices for recovery of complex livelihoods/ diversification
 - BBB can be implemented but may be difficult to scale up;
 - Establish basic local response infrastructure (e.g. shelter, evacuation plan, transport means, basic necessity supplies.
- ✓ Recovery interventions are better possible and more successful if disaster has a high profile and amount donated are large;
- ✓ Recovery programs offer opportunity to invest in upgraded services & infrastructure;
- ✓ Generally, communities have been able to resume livelihoods. However, asset depletion was neglected;
- ✓ The most vulnerable needs special attention and protection: poor households, children and disabled as well as gender equality.

Resettlement programs

- ✓ Resettlement programs need to be based on proper assessments and data: use of local knowledge, experience, hazard mapping, climate information for siting infrastructure & services, maintaining cultural aspects and relocation to areas where they improve their livelihoods. It has to include livelihood diversification, diversification of farming techniques and training in production of higher value end products.

- ✓ Land tenure issues are important in relation to settlements. Also need to map high-risk areas.
- ✓ Resettlement program needs to be independently evaluated with participation of communities and NGOs.

Planning

- ✓ DRM requires an integrated approach, including the social, economic and environmental dimensions;
- ✓ Full integration of CCA, DRR and development planning is important to limit the pressure on existing capacities.
- ✓ Capacity to move from DRM policy/strategy and plans to tangible action on the ground;
- ✓ There have been few evaluations of recovery process. Repeated PERCs could be useful to fill this gap and monitoring progress with relief and recovery.
- ✓ DRR preparedness is the best investment any government can make:
- ✓ There is need for risk-based land use planning;
- ✓ Post disaster reconstruction strategies should balance trade-offs between:
 - Speed and fiduciary controls
 - Emergency versus regular procurement
 - Urban versus rural settings;
 - On versus off budget expenditures and
 - Immediate rebuilding versus long term planning.
- ✓ Building practices and settlement planning need to change and incorporate DRR, including practical training and adjustment of building designs. Strengthening of rural and urban settlement and infrastructure regulatory regimes;
- ✓ Addressing urban and social risks in DRR and development planning. This includes establishing social and child protection systems sensitive to disaster situations as well as ecosystem-based solutions. It also refers to Invest in adaptive and resilience building measure to protect women and other vulnerable groups;
- ✓ Incorporate DRR in existing building regulations such as housing standards;
- ✓ Analysis and finalize DRM policy & legislation. Zimbabwe DRR Act is old and out-of-date. The new draft needs to be finalized and approved.

Funding:

- ✓ Provide adequate funding for DRM assessments. While a DRM funding is essential, a dedicated DRM Fund is most useful if it is viable, ring fenced and transparently run.
- ✓ Funding for DRR is a fraction of relief funding; DRR funding needs to be increased.
- ✓ Macro-economic growth impacts of major weather disasters are negative, large & persistent; fiscal impacts can be mitigated by policies.
- ✓ Environmental protection and EbAs need to be considered in new investments;
- ✓ Provision of additional resources to implement or monitor DRR and DRM strategies and regulations;
- ✓ Investments are needed in adaptive and resilience building measures to protect women and other vulnerable groups as these are most affected by disasters;

ICP:

- ✓ Adopt longer time horizon to support recovery and long-term sustainable development;
- ✓ Need to increase funding for DRR in addition to the relief funding;
- ✓ Use local materials and capacities where possible in the ICP supported interventions.

Data, research and analysis

- ✓ Adequate backing of DRR actions by a sound statistical and information basis, including disaggregated data on the poor, gender, youth, elderly and people with disabilities;
- ✓ Investment in weather forecasting and DRM, esp. response have been good, but flood forecasting remains a challenge. The meteorological system should focus on preparing for high-intensity storms.
- ✓ Better forecasting has improved EWS warnings. There is still a need to improve hydromet forecasting to make EWS more specific and less broad.
- ✓ Flood risk assessment and hazard mapping using RS and field surveys are important to prevent and mitigate the impacts of future floods. The local population and communities should participate in hazard profiling and proofing to build local preparedness.
- ✓ Early Warning information needs to be timely and efficiently distributed (e.g. using social media and smart phones).
- ✓ There is a need for research and core monitoring equipment and networks to understand and prepare for future disasters (e.g. hydro stations in rivers need to be urgently repaired);
- ✓ Strengthening DRR documentation and information management and sharing;
- ✓ Strengthen countries' capacity for independent research & analysis

EWS:

- ✓ Informed and simple warnings
- ✓ Raise local DRR awareness & preparedness
- ✓ Action--oriented;
- ✓ Community based
- ✓ Strengthen EWS (real time observation network, EWS and capacity);
- ✓ Build data & info base, use of social media & use of modern technologies for EWS and DRM.

Capacity building & training

- ✓ Build local capacity to ensure psychosocial and material support essential to deal with long term effects for specific social groups and technical staff involved in aid efforts
- ✓ Setting up of decentralized corps of trained DRM volunteers to support village DRR committees;

TWM

- ✓ Hydro and flood forecasting and hydrological modelling at the basin level is necessary to share DRR information.
- ✓ Need to collect better and share data at TWM level

- ✓ Need baseline data for the transboundary basins, especially for the vulnerable groups.
- ✓ TWM DRR strategy should have; data collection and sharing, repaired hydro stations, forecasting of floods and landslides, communication strategy between the two countries.
- ✓ Development of integrated flood risk management plans for major river basins, including structural and non-structural measures, institutional framework, emergency responses and community engagement.
- ✓ Development of a comprehensive data base for the transboundary basins (similar to the Cubango Okavango data base).

Communication

- ✓ Better and more reliable internet connectivity needed to assist data exchanges.
- ✓ No reliance on one communication mode only (e.g. cellular networks)
- ✓ Need communication strategy to ensure by ways communication and to hear community voices.
- ✓ Strategy needs to include TWM elements.

Building back better (BBB)

- ✓ Sufficient pilots and models exist for resistant building or BBB. The real challenge is to upscale the pilots and integrate BBB in urban and rural development plans and building regulations.

Sources: GoM, 2019; GoZ *et.al.*, 2019; UN-ECA, 2015; Community based DRR, 2010. PERC 2020, Zurich Alliance; Chatiza, 2019 & RINA, 2020); WB 2005 Review of Mozambique 2000 floods: Lessons learned. World Bank blog by Abhas Jha published in sustainable cities (accessed 6.2.20). 16.4.2019; World Bank, 2005.

Annex D: Selected key BuPuSa maps for mitigation and preparedness

Figure 11: The BuPuSa area with the Buzi, Pungwe and Save River basins

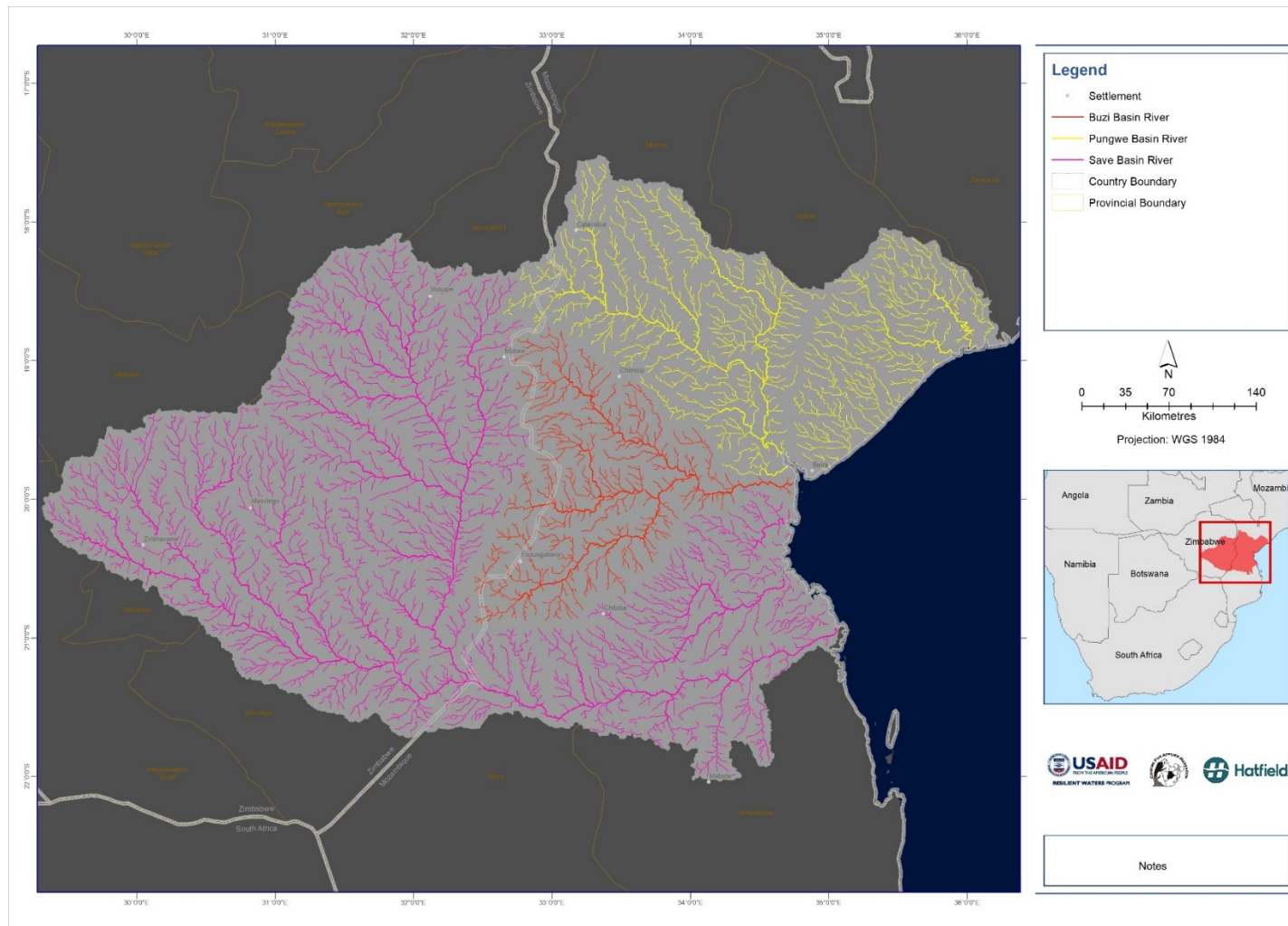


Figure 12: Location and size of human settlements in the BuPuSa area

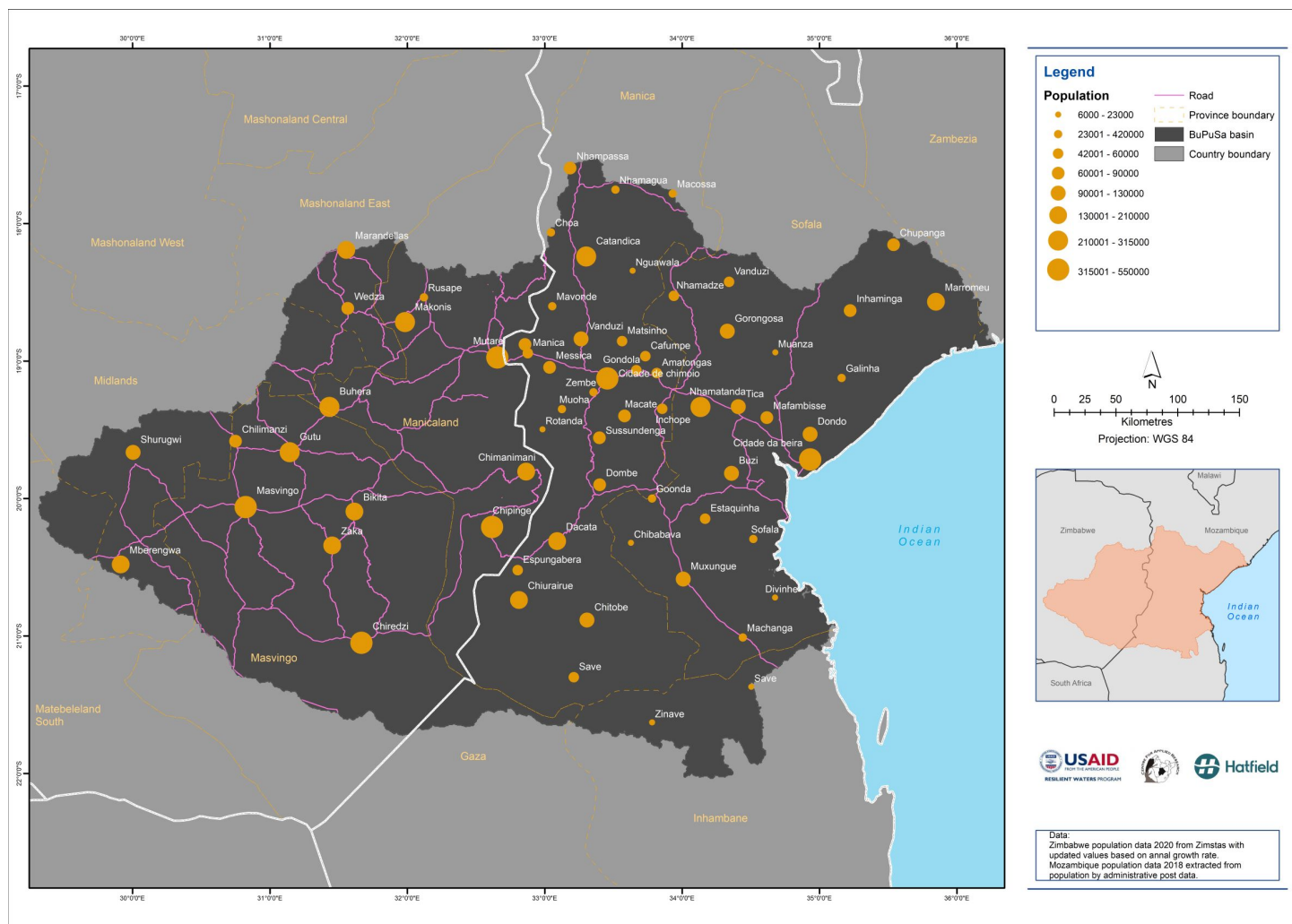


Figure 13: Rainfall intensity associated with Cyclone Idai

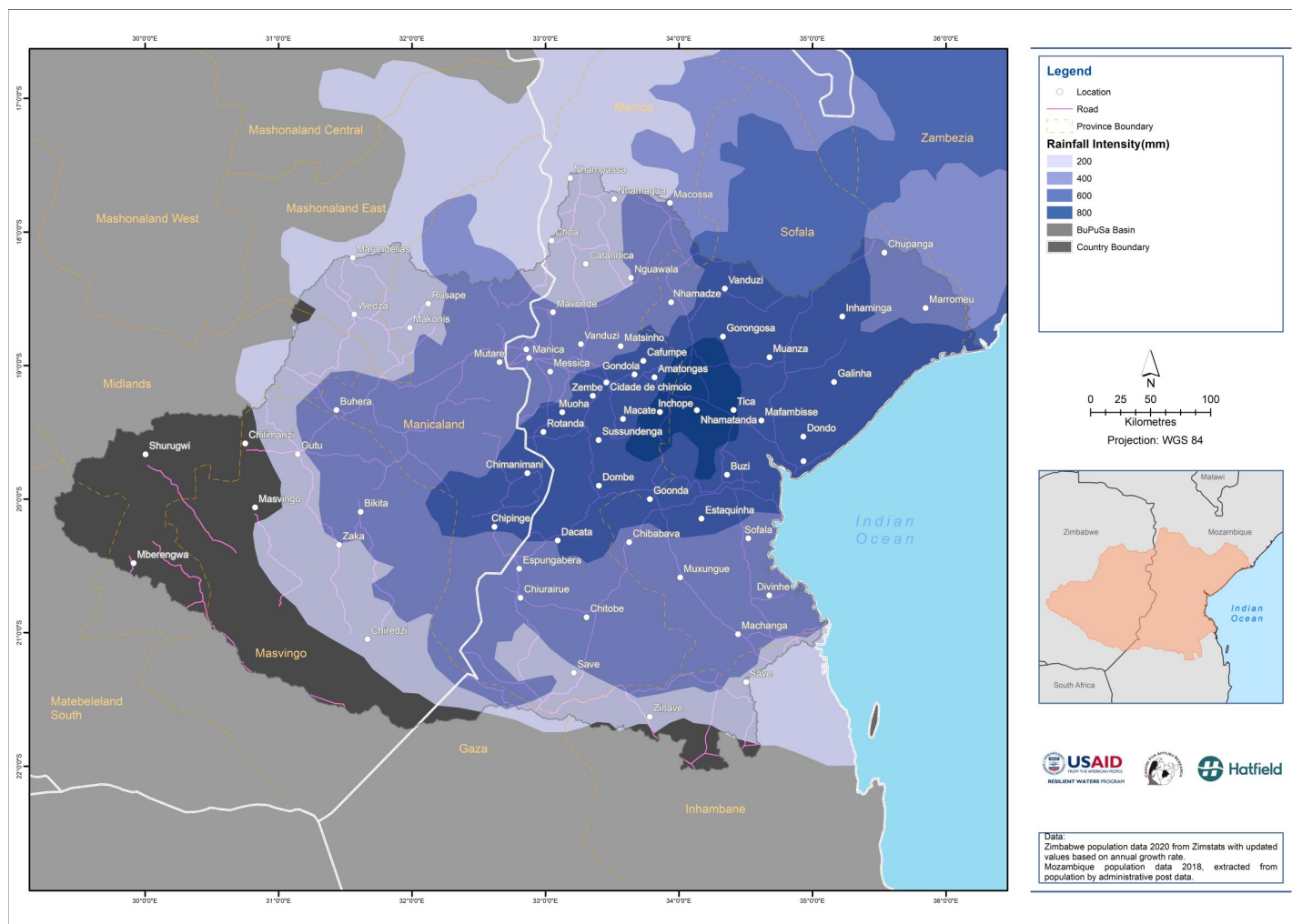


Figure 14: Cyclone occurrence in BuPuSa area (200-2019)

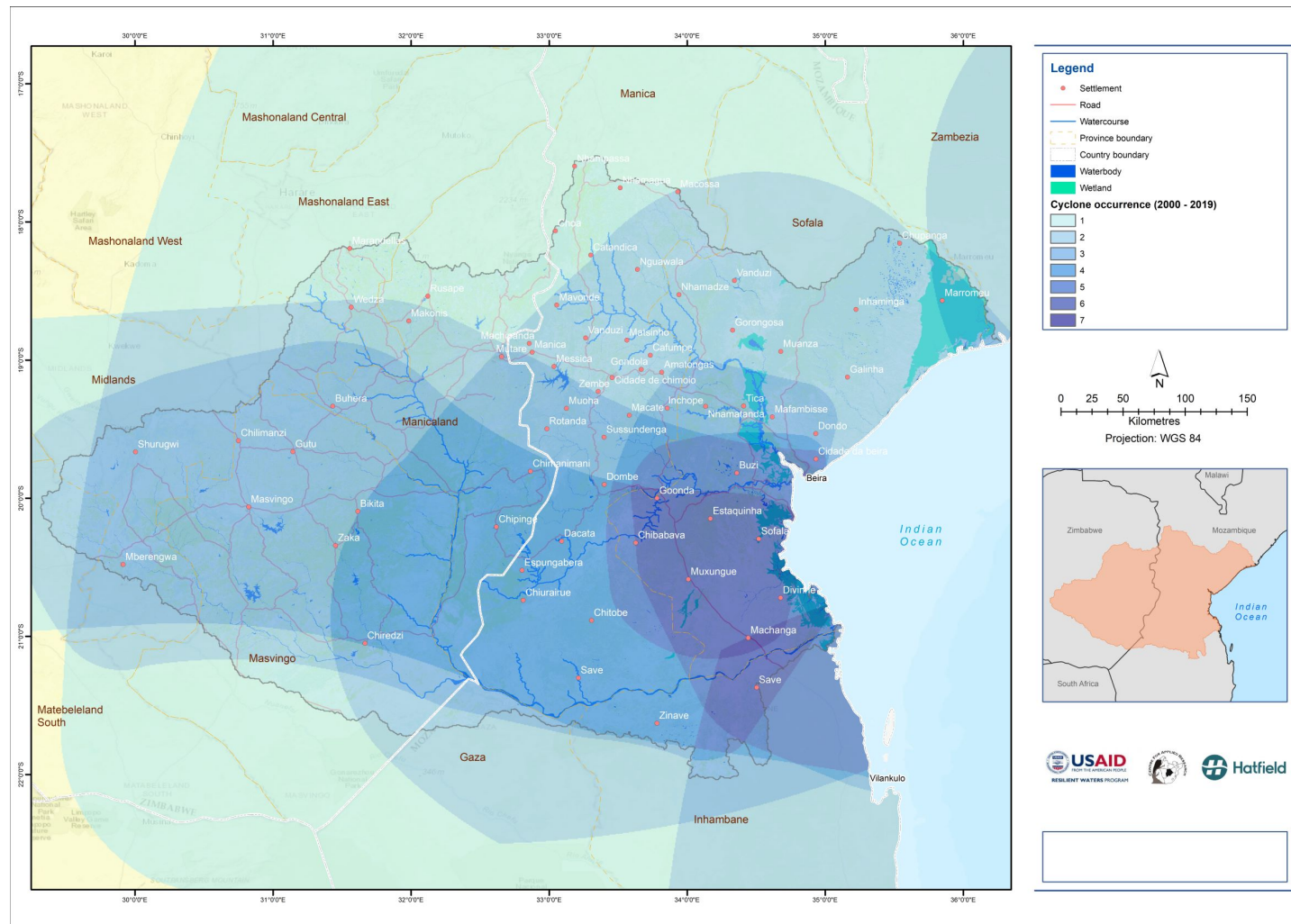


Figure 15: Rainfall intensity and settlements in the BuPuSa area

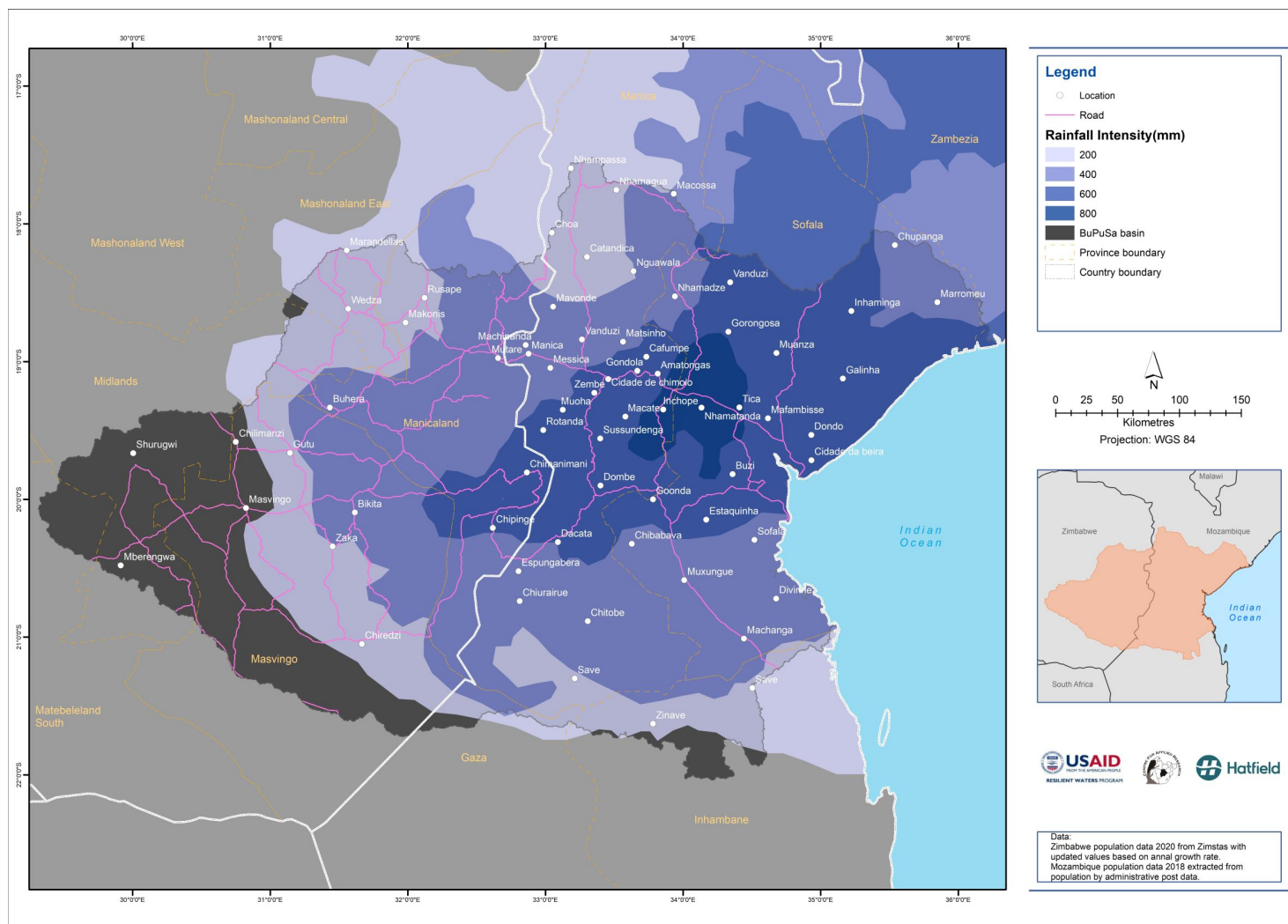


Figure 16: Rainfall intensity and agriculture in the BuPuSa area.

