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RESILIENT WATERS PROGRAM

EXECUTIVE SUMMARY:

CYCLONE IDAI IN THE BUPUSA TRANSBOUNDARY BASINS OF MOZAMBIQUE AND ZIMBABWE:

Impacts, mitigation, prevention, preparedness & community resilience

January 2021

Prepared by the Centre for Applied Research with Hatfield Consultants Africa

for Resilient Waters Program

CENTRE FOR APPLIED RESEARCH

Hatfield

Contents

NOTE:

This executive summary is based on the final project report: Centre for Applied Research and Hatfield Consultant Africa (CAR & HCA, 2020).

1 Idai

Cyclone Idai struck Mozambique, Zimbabwe, and Malawi in March 2019, and caused significant loss of life and livelihoods, injuries as well as extensive damage and destruction of infrastructure, houses, etc. The 'USAID Resilient Waters Program' commissioned the Centre of Applied Research (CAR) and Hatfield Africa Consultants (HCA) to assess the impacts of Cyclone Idai on communities in Mozambique and Zimbabwe, and to identify lessons, tools, and strategies for the strengthening of communities' resilience towards cyclones. The specific project objectives were to:

a. Assess the impacts of Cyclone Idai at community level in Mozambique and Zimbabwe; and
b. Identify lessons for strengthening of community resilience against cyclones.

Soon after Idai struck, needs assessments were conducted in Mozambique (Post Disaster Needs Assessment or PDNA; GoM, 2019)) and Zimbabwe (Rapid Integrated Needs Assessment or RINA; GoZ *et.al.,* 2019), establishing the main impacts and required relief, recovery, and reconstruction efforts. The assessments showed that substantial relief efforts were needed together with investments in reconstruction and planning to improve the resilience of the impacted sectors and communities.

While the project covered Mozambique and Zimbabwe, it focused on the three shared river basins of the Buzi, Pungwe and Save River Basins (BuPuSa). The assessment was done through a geospatial analysis (BuPuSa), a desk top socio-economic analysis (countries and BuPuSa) and consultations through virtual workshops/ meetings, interviews with key stakeholders and a questionnaire survey.

2 The countries and the Buzi, Pungwe and Save (BuPuSa) basins

An estimated 5.7 million people live in the BuPuSa basins, which together cover 166,400 km^2. All rivers originate in Zimbabwe and flow into the Indian Ocean in Mozambique. Mozambique and Zimbabwe have joint agreements for the Buzi and Pungwe river basins and are currently working on a three-basin agreement for the three basins. Currently, ARA-Centro and ZINWA are the key institutions for the joint management of the shared BuPuSa river basins.

Key characteristics of each river basin:

- ✓ Buzi:
  - Mostly in Mozambique;
  - Flood prone, particularly near Beira where the Buzi estuary joins the Pungwe flood plains;
  - Agreed annual abstraction ceiling is 767 Mm^3, shared almost equally between the two countries. Most water is allocated for irrigation (615 Mm^3); and
  - Current water use is not monitored.
- ✓ Pungwe:
  - Mostly in Mozambique;
  - One large dam development in Zimbabwe; smaller dams in Mozambique;
  - Potential for further development in Mozambique;
  - Agreed annual abstraction ceiling is 810 Mm^3; 71% for Mozambique and 29% for Zimbabwe. Most water is allocated for irrigation (541 Mm^3); and

- Current water use is not monitored.

✓ Save:

- Mostly located in Zimbabwe;
- Heavy upstream development in Zimbabwe has led to frequent drying up of the downstream parts in Mozambique;
- Many dams, mostly for irrigation, and limited additional dam development potential;
- No formal annual water abstraction ceilings; and
- Current water use is not monitored.

The INGC and DCP are the lead institutions for disaster risk management (DRM) in Mozambique and Zimbabwe, respectively. Both institutions are decentralized with regional centers in Mozambique (CENOE) and provincial/district Civil Protection Units (CPU) in Zimbabwe. Both countries have established a national DRM Fund, fed by the national budgets. Mozambique has local DRM Committees (DRMC). In Mozambique, INAM is responsible for weather forecasts and an early warning system (EWS). The Directorate of Water Resources Management (DNDRH) has regional offices (Ara Centros) and has a Department of International Rivers responsible for transboundary water resource management. The Ara Centro in Beira is responsible for the BuPuSa basins. Zimbabwe does not have local DRMCs. The National Civil Protection Platform has stakeholders from government and outside government (including NGOs, donors, and the private sector). One percent of the national government budget is meant to be available for DRR activities through the national DRM Fund. ZINWA and the Department of Water Resources and catchment councils are responsible for transboundary water resource management.

3 The impacts of Cyclone Idai

The impacts of Cyclone Idai has been huge and diverse. The cyclone hit the BuPuSa area hard, but its impacts went well beyond BuPuSa:

- ✓ Total affected area is estimated to be around 380,000 km^2 of land area; some 290,000 km^2 in Mozambique and around 90,000 km^2 in Zimbabwe.
- ✓ The total affected area in BuPuSa is around 166,000 km^2 ; around 104,000 km^2 in Mozmabique and 62,000 km^2 in Zimbabwe;
- ✓ Heavy rain affected almost 38,000 km of the BuPuSa area. Over 23,000 km^2 received more than 200 mm of rainfall, 47% in Mozambique and 53% in Zimbabwe. Mozambique had the heaviest rainfall: 87% of the affected area received over 400 mm of rain, concentrated in Manica and Sofala Provinces. In Zimbabwe, Chimanimani and Chipinge Districts were most affected.

3.1 Geo spatial analysis

The geospatial analysis focused primary on providing an assessment of the BuPuSa area (using medium resolution imagery) and two focus areas (Beira and Chimanimani using high resolution imagery), through the provision of detailed topographic maps. The analysis went on the provide the following analytical outputs: detailed community-level damage assessments (Chimanimani and Beira), flood and landslide analysis (Chimanimani and Beira), basin tree loss analysis, and basin-scale landcover change analysis.

Damage assessment

The damage assessment utilized high-resolution imagery from before and after the event for the two focus areas. The analysis showed the damaged caused by Cyclone Idai in both communities. The categorization of damaged houses enabled the development of damage heat maps (Figure 1), which revealed differing damage patterns in each location.

Chimanimani suffered damage to residential buildings located in lower lying areas close to streams and riverbeds. There was visible destruction of bridges and motorways due to landslides and massive slope failures. In contrast, in Beira damage was concentrated to public/civic buildings, with no damage observed to motorways. There was visibly more damage observed in Beira with a higher number of affected structures observed.

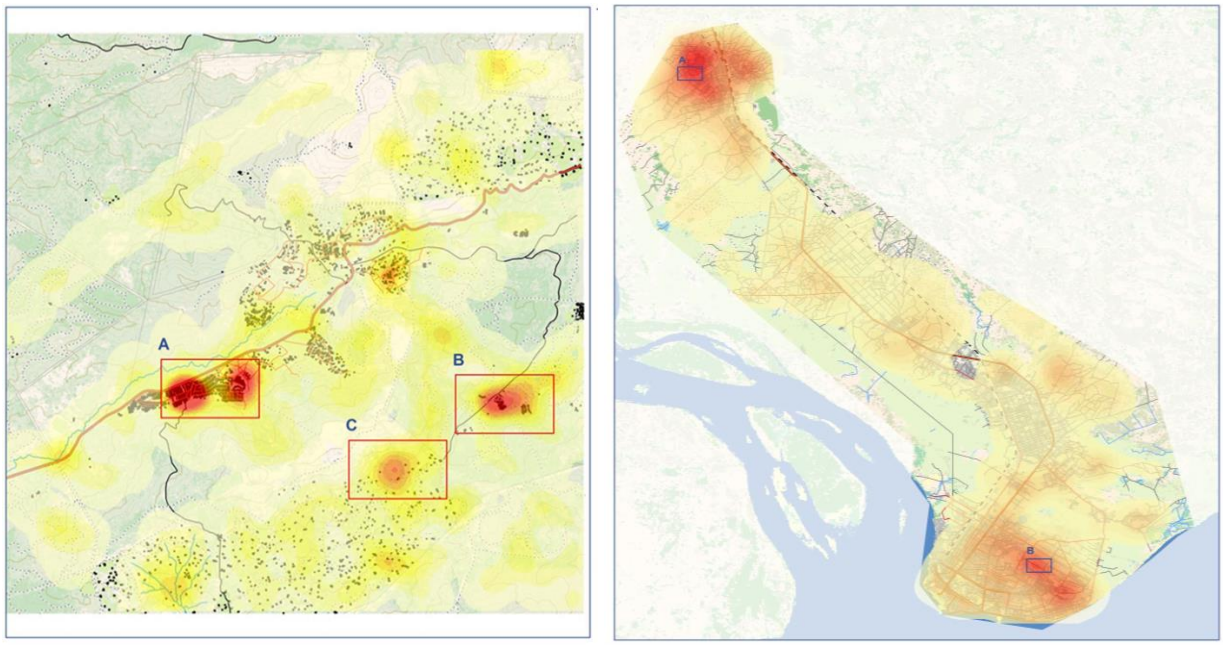


Figure 1: Heat map showing distribution of damage in Chimanimani (left) and Beira (right).

The damage patterns of the two locations were substantially different, with Chimanimani recording more localized damage around landslides and flooding while Beira experienced more widespread damage caused by high velocity winds. While limited in scope and size, this analysis provided an insight into how high-resolution imagery could be utilized to augment or replace field work to assess community level damage.

Flood and landslide analysis

This analysis of the two focus areas identified the flooded areas and bare earth, including landslides in Chimanimani, which were integrated into the flood analysis map. The damage in Chimanimani and Beira was characterized. While flooding was extensive in both areas, the settlements in Beira were largely spared mass flooding, and Chimanimani was more significantly impacted by landslides, with severe damage concentrated around the landslide paths which cut right through several densely populated parts of the village, devastating housing, and roads. Furthermore, damage patterns in Beira were varied and

seemed to be driven more by selected building materials used, and level of exposure (lack of shelter from wind caused by removal of trees) than flooding *per se*.

Basin-scale tree loss analysis

Google Earth Engine (GEE) was used to conduct a rapid tree loss analysis by comparing tree cover in the basin before and after the cyclone event. Most of the tree cover loss was observed in Sofala and Manica provinces. Closer inspection using high-resolution imagery suggested that some of the tree loss could have been due to an increase in the need for firewood while power supply was interrupted and possibly to build temporary shelter. In the Eastern highlands of Zimbabwe, the landslides also contributed to tree loss especially in areas where deforestation was observed prior to the cyclone event.

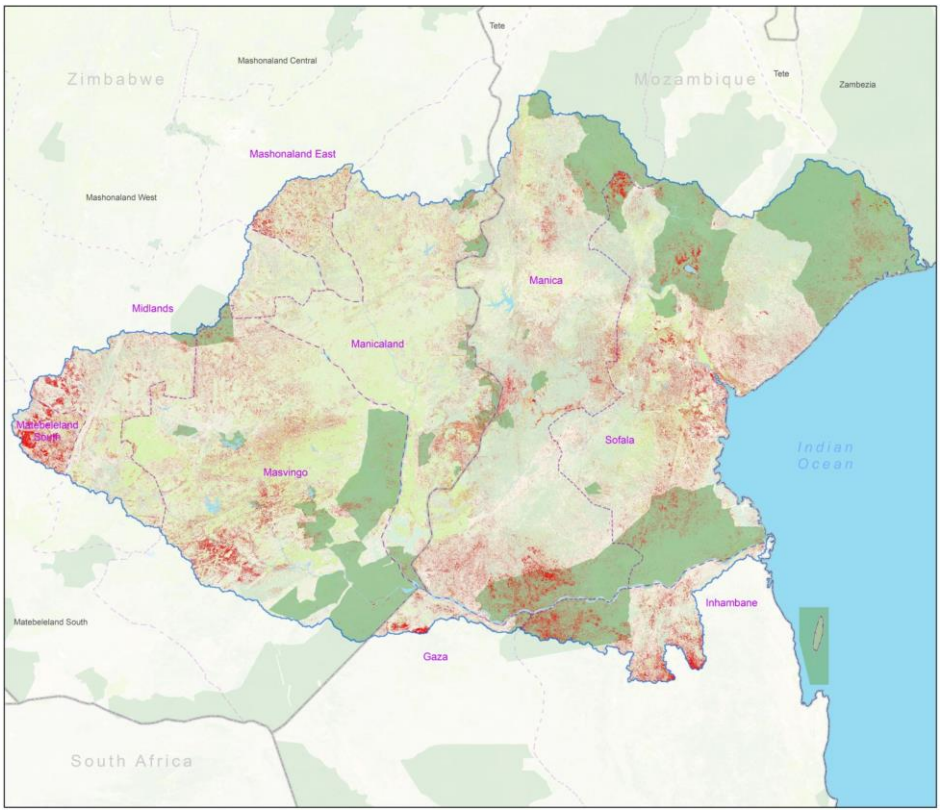


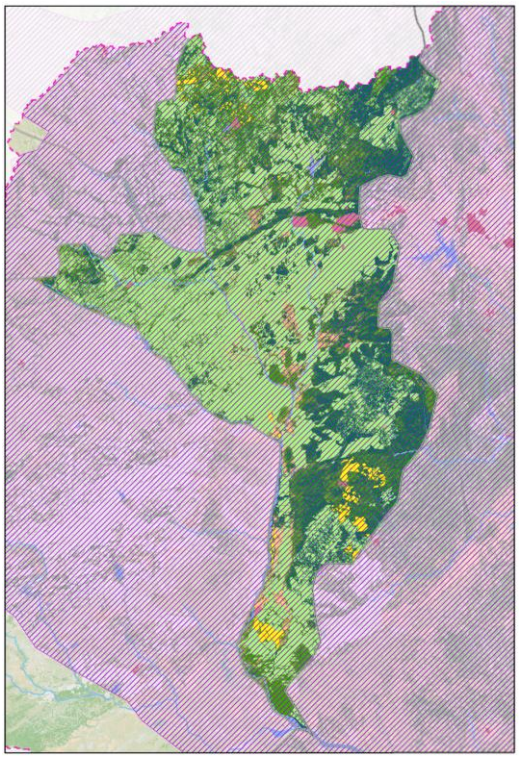
Figure 2: Tree loss analysis results across the BuPuSa basin.

While some of these observations resulted from this analysis, all observations were made against the background of seasonal regrowth and regeneration associated with increased availability of water at the end of the dry season.

Basin-scale landcover change analysis

Sentinel-2 medium-resolution (10-meter) multispectral imagery was used to identify land cover changes (before and after Cyclone Idai. The landcover classes obtained were sparse vegetation, grassland/pasture, dense vegetation, cultivated (dryland and irrigated) agriculture, water, and urban areas. The classification results revealed that in both Zimbabwe and Mozambique there is a lot more agricultural activity than what is recorded in any national database, and supporting the fact that agriculture is the dominant rural livelihood source. Many families, especially Zimbabwe utilize land for subsistence farming. The landcover

classification results were further analyzed to illustrate provincial-level change in landcover, exposure to the cyclone and intensity of impact. This phase of the geo spatial analysis revealed key insights in the communities that were most substantially affected by the heavy rains during and in the weeks after the cyclone event. Of interest were the number of small farm holdings that were affected as well as large scale farming operations that provide jobs to hundreds of people in their surrounding communities. The land cover category 'water" increased substantially, mostly in Sofala Province. In addition, Figure 3 below shows that 100% of ~ 13,000 km^2 of agricultural land in Manicaland province of Zimbabwe fell in the cyclone impact zone.



Analysis result of cultivated land that were directly affected by the cyclone

	Total area	Affected by Cyclone	% Affected
Irrigated	46,298	46,298	100.0
Rainfed	1,252,445	1,252,445	100.0

* Areas are in Ha

Figure 3: Analysis of directly affected agricultural land

The geospatial analysis also provided data (e.g., land areas) to support the socio-economic assessment, showing the benefits of a combined geospatial and socio-economic analysis. A repository with all imagery and analysis has been prepared for Resilient Waters.

3.2 Socio-economic analysis

The analysis comprised a desk top review, integrating available literature and data, and brief consultations of key stakeholders.

Overall economic costs:

The total damages and losses in the two countries are estimated at US$3.4 billion (GoM, 2019 and GoZ, *et.al.,* 2019). The damages and losses are highest in Mozambique:

a. Mozambique: US$2.8 billion or 18.9 % of the gross domestic product (GDP); and
b. Zimbabwe: US$0.6 billion or 3.6 % of GDP.

The estimated recovery costs are similar to the costs of damages and losses (GoM, 2019; GoZ *et.al*., 2019): US$3 billion for Mozambique and US$0.5 billion for Zimbabwe.

Consultations indicated the high opportunity costs of Idai relief efforts. Financial and human resources as well as institutional capacities were diverted towards Idai relief, reducing the support for other development areas.

People's lives and livelihoods

People's lives were seriously affected in multiple ways. Lives were lost and people injured or displaced. Moreover, people's health was affected as well as their access to water and sanitary facilities:

- ✓ A total of 1.8 million people were directly affected. This involved around 354,000 households (GoM, 2019: GoZ *et.al*., 2019). In Mozambique, over 1.5 million people were affected (around 300,000 households); in Zimbabwe 270,000 people were affected (54,000 households);
- ✓ Almost 140,000 people were displaced, 3,200 injured and around 1,000 people lost their lives;
- ✓ Some displaced persons were housed in temporary camps, but most stayed with other families;
- ✓ Small outbreaks of cholera and malaria occurred in Mozambique. In Zimbabwe, some cases of malaria, dysentery and diarrhea were reported by the end of April 2019;
- ✓ 74 % of the population in the BuPuSa region lived in areas that received more than 200 mm of rainfall. Roughly a quarter of the population lived in areas that received up to 200 mm and 201—400 mm each; 47 % received more than 400 mm (of which 6 % over 600 mm).
- ✓ 31 settlements received more than 400 mm of rainfall: two in Zimbabwe (Chimanimani and Chipinge); three settlements in Mozambique received more than 600 mm (Tica, Inchope and Nhamatanda).

The livelihood impacts of Idai have been dramatic through the loss of income, harvest, and assets. These impacts were aggravated by the agricultural dependency of most (rural) households, lack of economic diversification, poverty and pre Idai livelihood stress. In Zimbabwe for example, most rural households already sold animals, reduced their cereal stock, and became dependent on external support from government, relatives/remittances, NGOs, UN, and churches.

Rough estimates were made of the impact on average household and per capita (p.c.) income:

- ✓ Zimbabwe:
  - Using RINA figures and with some assumptions, the Idai impacts could amount to a loss of US$4,592 per household. This exceeds the average annual household income in 2017 and is more than double the average rural household income in 2017. Clearly, livelihood losses have been huge and livelihood insecurity has dramatically increased;
  - Using RINA figures and some assumptions, the per capita costs would be US$ 1,275, 33 % higher than the average p.c. annual income (US$ 860).
- ✓ Mozambique: Based on the PDNA, per capita damage and losses are estimated to be at least around US$ 840[1], 42 % higher than the average p.c. income of US$ 590.

[1] This excludes the private costs and dame to the commerce and industry sector.

Private assets

- ✓ Houses: the estimates of damaged/ destroyed houses vary. Roughly 250,000 to 300,000 houses were destroyed or damaged affecting 1.3 to 1.5 million people:
  - In Mozambique, 110,000 houses were destroyed; 130,000 houses were partly destroyed (GoM, 2019); 60 % of these were in urban areas and in low-lying areas close to rivers;
  - In Zimbabwe, at least 10,000 houses were destroyed and 17,715 were damaged, mostly in Chimanimani and Chipinge Districts (GoZ *et.al.*, 2019). A remote sensing (RS) assessment for RINA puts the figure lower at 10,730, two-thirds of which are in Chimanimani; and
  - It should be noted that small/informal back yard businesses were negatively affected by the destruction or damage to houses.
- ✓ Business buildings:
  - In Zimbabwe, Cyclone Idai damaged irrigation infrastructure, plantations of tea, sugar cane, fruit trees and forest plantations;
  - In Mozambique, Idai affected over 400 private enterprises with over 15,000 jobs[2]. The estimated damage was US$119.3 million (e.g., damaged warehouses and production interruptions[3]). In terms of numbers, the service & commerce sector was most affected; in terms of losses, industry and agribusiness suffered the highest losses, mostly large businesses with more than 100 employees (GoM, 2019).
- ✓ The private sector also incurred damage to private educational and health facilities. Details are not known.

Impacts on agriculture

The agricultural sector has been heavily affected through lost harvest, income, and damage to infrastructure. The cyclone's impact on crop production has been most serious. Livestock production, fisheries and forestry were affected to a smaller extent. Based on the geospatial assessment, 61 % of the cultivated land in the BuPuSa region received 200+ mm of rainfall; this is around 38,000 km^2. The heaviest rainfall was in Mozambique. Manica and Sofala in Mozambique received over 600 mm of rainfall.

- ✓ Dryland crop production: Cyclone Idai led to significant flooding of drylands:
  - In Mozambique (GoM, 2019), an estimated 715,378 ha of cultivated land were flooded, affecting over 433,000 households. Production losses were estimated at 2.2 million MT. Assuming all households cultivate corn and cassava, each household lost 2,472 kg of corn and cassava. Losses of fruits, vegetables and rice were also high. In addition to production losses, support infrastructure was damaged and or destroyed;
  - In Zimbabwe, over 600,000 ha of dryland farming land had possible flooding damage (GoZ *et.al.,* 2019, p.19). Maize and millet were the most affected food crops; both are staple crops for rural livelihoods, with production losses estimated around 580,000 MT. Considerable losses of fruit trees also occurred; and
  - The geospatial assessment suggest that 1.3 million ha of dryland cultivation were affected (Figure 3).
- ✓ The impact on the irrigation sector has been smaller than that on dryland farming:

[2] Excluding backyard informal businesses. Assuming each employee was a breadwinner, around 100,000 households may be affected.

[3] Six days in Sofala Province.

- In Mozambique, over 4,300 ha of irrigated land and associated infrastructure were damaged or destroyed, mostly small and medium farms (almost 3,400 farms in total). The production losses are not known;
- In Zimbabwe, the impact on the irrigation sector has been larger but this is not well documented. Over 1,500 irrigation schemes may have washed away or were damaged (GoZ *et.al*., 2019). In Chimanimani and Chipinge 18 schemes were damaged affecting over 5,000 farmers; and
- The geospatial analysis shows that over 46,000 ha of irrigated land were affected (Figure 3).

✓ Livestock sector: livestock losses have been relatively low.
✓ Fisheries sector was hard hit in Mozambique, mostly in Sofala Province.

Impact on public infrastructure

✓ Health facilities:
- Between 200 and 300 health facilities were damaged by Cyclone Idai;
- In December 2019, 70 clinics in Zimbabwe were still damage; and
- Damage had adverse impact on access to health care and storage of drugs

✓ Educational facilities:
- Around 1,900 educational facilities were damaged by Idai: some 1,400 in Mozambique and 500 in Zimbabwe;
- In December 2019, 460 facilities were still damaged in Zimbabwe; and
- Damaged facilities affected students and teachers.

✓ Road infrastructure: damaged roads: in Zimbabwe mostly regional and local roads but in Mozambique also national roads.
✓ WASH: The water and sanitation infrastructure were damaged or unable to operate because of energy supply interruptions:
- Most households' water supply and access were affected; and
- Destruction of household sanitary facilities and increased open defecation with its associated health risks.

✓ Electricity network:
- In Mozambique: electricity infrastructure was seriously damaged (GoM, 2019); and
- In Zimbabwe: damage was confined to some transmission and distribution facilities (GoZ *et.al*., 2019).

Social impacts

No dedicated social impact assessment of the cyclone was carried out. It is known, however, that Cyclone Idai caused a wide range of social impacts, including:

✓ Disruption of community and family relationships;
✓ Displacement of persons and families and resettlements;
✓ Losses of breadwinners and jobs and increased hardships due to livelihood losses;
✓ Increased gender-based violence; and
✓ In the worst affected areas, people also suffered post-traumatic disorders.

Vulnerable groups were disproportionally affected as their adaptive capability is low: they live in high-risk areas, have poor houses and/or live in informal settlements with limited access to public services. Vulnerable group include children, the elderly, people with disabilities (PWD), people living with HIV, internally displaced persons (IDP) and women. Tensions may have arisen between IDPs and host communities, particularly where the recovery process was slow and IDPs received more humanitarian assistance than the local population.

Environmental impacts

No dedicated environmental impact assessment of Cyclone Idai has been conducted; however, the PDNA and RINA contain some qualitative environmental assessments.

The BuPuSa region is relatively rich in terrestrial and aquatic biodiversity. In Zimbabwe, it includes mountainous terrain stretching into Mozambique where it ends at the coast with estuaries and mangrove forests. Protected areas (PAs) accounted for around 5 % of the area affected by the cyclone.

- ✓ Protected Areas:
  - 81 % of the Protected Areas in the BuPuSa region received 200+ mm of rainfall; this is around 31,700 km^2. In Mozambique, 88 % of the PA land area received more than 200 mm of rainfall compared to 53 % in Zimbabwe.
  - The heaviest rainfall was in Mozambique: most very heavy rain (over 400 mm) fell in Manica and especially Sofala Provinces of Mozambique. Only Protected Areas in Sofala received over 600 mm of rainfall;
  - PAs are important for biodiversity protection, generate income and contribute to local livelihoods. For example, GNP is the largest non-government employer in Sofala province (GoM, 2019).
- ✓ Forests areas: considerable damage associated with the rainfall intensity;
- ✓ Mangrove forests: These forests were damaged, but the damage has not been quantified or costed:
  - Damage to important ecosystem services (e.g., for fish, coastal protection etc.); and
  - Adversely affected local livelihoods (e.g., lost timber, fuel, and food).
- ✓ Land/ soil erosion: landslides, soil erosion and serious land degradation:
  - Riverbeds were destroyed by boulders coming down from the mountains;
  - Some boulders remain unstable, risking more landslides; and.
  - Inadequate waste management and dumpsites contributed to landslides.

Hydrological monitoring stations in Zimbabwe along the rivers were also damaged.

4 Recovery, mitigation, and preparedness

The analysis of mitigation, prevention and preparedness measures was done taking into account the four DRM cycle stages (response & relief, recovery & rebuilding, mitigation & prevention and preparedness), the Sendai focus areas (understanding of disaster risks, strengthening of DRM, investing in DRM for resilience, and enhancing disaster preparedness; UN, 2015)) and the four resilience abilities of the draft SADC Resilience Strategic Framework (anticipatory, absorptive, adaptive and transformative abilities; SADC, 2019).

Response & relief

Response and relief efforts have been rapid starting with needs assessment and rapid interventions. Both countries lacked the capacity and financial means to offer the necessary relief. Fortunately, many ICPs supported the relief and response efforts with financial and technical means. Based on the UNCCD data base (www.fts.unocha.org) , an estimated US$ 500 extra humanitarian aid was sent to Mozambique and Zimbabwe. This is a significant amount, but it fell short of the identified immediate needs. As a result, relief and response efforts are not yet complete (per November 2020) while consultations revealed that international relief efforts are scaled down and Covid-19 interventions divert domestic financial and human resources away from Ida interventions.

Recovery and rebuilding

Government together with ICPs have launched several recovery and rebuilding projects. These include:

- ✓ Mozambique: repair and reconstruction of houses (targeted to vulnerable groups and building back better); repair and reconstruction of critical local infrastructure, private sector support and livelihood/ income and employment support;
- ✓ Zimbabwe: livelihood restoration (cash transfers and food aid to vulnerable groups), restoration of the agricultural sector, restoration of basic health services, combatting gender-based violence and child protection, repair of hydrological stations and rehabilitation of critical community infrastructure.

The common view during consultations was that many communities are not yet fully recovered, and that recovery may take up to ten years up may take, also depending on the macro-economic and general development challenges that the countries face.

Mitigation and prevention

Some mitigation and prevention efforts have been built in the countries' recovery programs:

- ✓ Mozambique: In Mozambique, building resilience are concentrated in the Beira area, and have two main components:
  - Repairing and significantly strengthening coastal protection; no details are given how this will be done but there is scope for nature-based solutions (Norton *et al*., 2020); and
  - Expanding the rehabilitated drainage system to reduce flooding in vulnerable parts of the city.
- Zimbabwe:
  - Support rehabilitation of critical community infrastructure; and
  - Support community level structural risk reduction and mitigation efforts.

Both countries intend to resettle affected population from high-risk to lower-risk areas. While the potential benefits of resettlement are recognized, resettlement is a sensitive and challenging issue; and the progress with resettlement is unclear. Some households decided to move back to their old homes, exposing them to the same risks as before; others are still in temporary accommodation. New settlements need to be identified, carefully planned, and have basic infrastructure as well as income generating opportunities to improve livelihoods. The local population needs to be actively involved and consulted.

Future mitigation and prevention also require the integration of DRM in land use and settlement planning, building of more resilient infrastructure, house building and WASH facilities as well as strengthening of EWS. These measures require additional financing but reduce damage and loss costs. "*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.

Preparedness

Disasters are recurrent and require preparedness: "*As we know, after the event is before the next event"* (Norton *et.al.*, 2020). In short, after each activity activities need to be undertaken to be better prepared for the next event. Generally, support efforts still emphasize relief and reconstruction and pay insufficient attention to long-term strengthening of prevention and preparedness.

Countries' preparedness has improved over time due to better meteorological and hydrological data and models, better DRM institutional structures and early warning systems. Existing food and WASH programs in both countries allowed rapid responses and, in a way, 'prepared' the countries.

The following areas emerged as critical for preparedness:

- ✓ Institutional structures and capacities:
  - Both countries have established DRM lead institutions (INGC and DCP) that work closely with other government (e.g., climate change, water resource management, environment, and meteorological services) and non-government institutions (ICPs, NGOs, private sector);
  - Capacity, funding, and equipment constraints occur, particularly at the district and local levels, hampering interventions. Consequently, both countries rely heavily on external financial and technical support. This poses coordination challenges and puts pressure on the countries' limited institutional capacities;
  - Mozambique benefited from the established local DRMCs; Zimbabwe does not yet have local DRM structures; and
  - Both countries have a DRM Fund, but these experience finance and capacity constraints.
- ✓ Community preparedness and support:
  - Local DRMCs in Mozambique contribute to local DRM efforts. They focused mostly on relief and response, and need to be more pro-active to strengthen local preparedness; and
  - Local DRMCs experience capacity constraints (e.g., equipment, financial and human resources).
- ✓ Policy environment:
  - The DRR Act in Zimbabwe is dated and the new one has not yet been adopted;
  - DRM and CCA are not yet fully integrated in land use and development planning; and
  - Idai interventions are undertaken within each country; there is no transboundary DRM strategy.
- ✓ EWS:
  - Meteorological and hydrological data & forecasting have improved and facilitated better early warning;

- Early warnings were sometimes delayed and insufficiently action oriented. Use of local languages and different communication means could have made early warnings more effective; and
- EWS require effective and rapid exchange of inputs and outputs between the local, provincial, and national levels.

Sendai focus areas

Two Sendai focus areas have been covered above (DRM strengthening and preparedness). The remaining two are summarized below:

- ✓ Understanding disaster risks:
  - The overall understanding of disasters has improved due to lessons learned and better data and models; and
  - Both countries face multiple types of disasters. Drought is the most common and frequent one; moreover, each disaster has some unique features. Cyclone Idai was 'unique' in its intensity and scale.
  - Disasters need to be understood and actioned at the transboundary level;
- ✓ Investing in DRR for resilience:
  - The national DRM Funds were under-resourced and inadequate to handle Idai impacts;
  - Most international DRM funding goes to short term relied; funding for medium- and longer-term resilience building is inadequate;
  - Sustained investment in critical national, provincial and local infrastructure ('engineering infrastructure' and 'green infrastructure) limits the impacts and contributes to better preparedness (e.g., sewerage rehabilitation in Beira, coastal protection, and mangrove rehabilitation); and
  - Integration of DRM and CCA in development planning could strengthen the case for investments in DRR resilience.

SADC ability capacities:

- ✓ Anticipatory ability:
  - Better meteorological data, forecasting and EWS has improved the anticipatory ability;
  - Some community anticipation exists, mostly in Mozambique through the local DRMC and EWS. However, gaps existed in the appreciation and anticipation of the intensity of the disaster, action-orientation nature of the EWS, and conditions of local DRR relief facilities and equipment.
- ✓ Absorptive ability:
  - The absorptive ability of both governments was low due to multiple economic and development challenges; and
  - Communities' absorptive abilities were limited prior to Idai due to widespread poverty, food insecurity, dependency on subsistence agriculture and lack of economic diversification.
- ✓ Adaptive ability: 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 to several factors, including challenging macro-economic and development

conditions, financial and human resource constraints, limited baseline and monitoring data; and limited DRR capacities particularly at district level.

- ✓ Transformative ability:
  - The switch in balance from mostly focusing on short-term relief and response to a more balanced short and long-term approach of DRR has hardly materialized. This applies to governments and ICPs;
  - Empowerment and greater DRM participation of communities is on-going in Mozambique but needs to progress further and be established in Zimbabwe,
  - Countries do not yet fully integrate DRR and CCA in development and land use planning;
  - DRM has not yet been systematically upscaled to the transboundary level; and
  - Collaboration between government, communities, and the private sector. Idai relief and recovery have seen good examples of partnerships.

5 Recommendations

Given the countries' situation, it is not realistic to address all challenges and areas for improvement immediately. It is important that governments together with non-state actors (e.g., private sector, communities, and NGOs), identify priorities and interventions that can be implemented with the available capacities and abilities. In due course, scope of interventions can be expanded when means and capacities increase.

It is recommended that the countries and BuPuSa adopt a **focused, prioritized**, **do-able** and **incremental** approach led by the lead DRM institutions (INGC and DCP) with active participation of all stakeholders and focused on **strengthening community resilience**.

Below, we make suggestions as to which institutions could follow up the recommendations that are made. It should be stressed that the decisions regarding the recommendations and the institutions responsible for their implementation must be made by the countries themselves, BuPuSa and where relevant the collaborating ICPs. Given their mandates, the INGC and DCP will be 'lead' institutions and we suggest that they work closely with the Department of International Rivers (DNGRH) in Mozambique and the Department of Water Resource Planning and Management, Ministry of Lands, Agriculture, Water and Rural Resettlement in Zimbabwe, and liaise with other ministries or departments such as Environment, Meteorology , development planning, agriculture, and rural development.

5.1 BuPuSa and member states

The recommendations are structured under ten key issues discussed below:

1 Strengthening the national DRM capacity

The countries and BuPuSa face different types of disasters, the most common one being droughts followed by floods and cyclones (in Mozambique). Therefore, the DRM institutions need to be prepared for droughts as well as floods and cyclones. Countries' DRM capacity is determined by the institutional structures involved as well as their technical and financial capabilities.

Both countries have strong DRM lead institutions. Zimbabwe has the DCP and a national multi-stakeholder National Civil Protection Committee (NCPC), but decentralization of DRM resources is needed, and the draft DRM Act needs to be finalized and approved (NCPC and DCP to consider for action). The NCPC and DCP Effectively linked DRM institutions at the national-provincial and local level are essential (INGCC and NCPC/ DCP to consider for action). Consultations showed that there is need to build more capacity particularly at the local and provincial levels.

Both countries have a DRM Fund, but the funds need to be increased and ringfenced, i.e., exclusively used for DRM (Ministries of Finance, DCP and INGC to consider for action). These funds should exceed immediate relief efforts. If the DRM Fund would also cover mitigation, prevention, and preparedness, ICPs could contribute to the national DRM Funds (ICPs to consider for action). The feasibility of a SADC DRM Fund, particularly for transboundary resource management initiatives, needs to be assessed as a supplement to national funds (SADC Secretariat and member states to consider for action).

It is important that local DRM structures are established and where they exist -as in many Mozambican villages- strengthened. It is recommended that Zimbabwe reviews the best way to establish local DRM structures (DCP and CPUs to consider for action). DRM capacities can also be strengthened at the SADC level, e.g., through the establishment of a rapid SADC DRM 'force' to support disaster struck SADC countries (SADC Secretariat and member states to consider for action). RBOs need to include DRM in their strategic development plans for their basins (SADC RBOs to consider for action).

2 Integration of DRR and CCA in development planning

Disasters are recurrent and climate change generally increases the frequency and intensity of disasters. Disasters and climate change are both 'facts of life' that need to be recognized and considered in development planning. Given the links between DRM and CCA and the limited institutional capacities, it is important to fully harmonize DRM and CCA, and incorporate both in national and provincial development and land use plans. To facilitate this process, the risks and costs of disasters and the benefit from mitigation, prevention and preparedness need to be shown to development planners. Disasters and climate change also need to be fully integrated in environmental assessments. This also applies to transboundary water resource management (TWM). These actions need to be considered by DCP, INGC and the Ministries responsible for climate change adaptations and targeted to the Ministries of Development Planning and responsible for environmental assessments.

3 Identification, (re-)building and maintenance of critical infrastructure

Critical infrastructure may refer to infrastructure from the public sector, communities, and the private sector. The project showed that different types of infrastructure are interlinked and, failure of one component can lead to failure or disruption of others (e.g., energy and communication/WASH, road closure and delivery of relief material and medical supplies). The PERC report (Norton *et.al.,* 2020) identifies roads, communication, rescue equipment, hospitals/ clinics, and energy networks as critical infrastructure. Gaps and weaknesses of critical infrastructure need to be identified to increase the resilience and performance of the package of critical infrastructure, which then leads to building back better (for rehabilitation) and building better (for new infrastructure).

The following is recommended (to be considered for action by the responsible ministries with the INGC and DCP as catalysts):

a. Avoid rebuilding and building of critical infrastructure in high-risk areas (where possible);
b. Rebuild climate smart and resilient agricultural infrastructure (e.g., irrigation schemes);
c. Rebuild and build climate smart and resilient water sector infrastructure, including hydrological and meteorological infrastructure. Better dam design & re-assessment of safety and resilience of existing dams in view of DRM and CCA;
d. Harmonize of dam operating guidelines to ensure sufficient environmental flows, optimal development benefits and flood avoidance;
e. Review the options for nature-based adaptations and their feasibility; and
f. Prioritize maintenance of critical infrastructure. Ideally, all infrastructure needs to be adequately maintained. When maintenance funds are inadequate, critical infrastructure should be prioritized.

4 Building community resilience through DRM structures and livelihood diversification

Community resilience can be strengthened by the establishment of local DRM structures, by strengthening and diversifying livelihoods and by special attention for vulnerable groups. Local DRMCs have benefited DRM in Mozambique. This system can be expanded to more settlements in disaster prone areas in Mozambique and to Zimbabwe. Existing local DRMCs need strengthening to:

a. Become more pro-active and mitigate, prevent, and be prepared for future disasters. DRM should be a continuous effort and become pro-active. This change would be facilitated by the development of simple local DRM strategies covering the DRM cycle stages. The Flood Resilience Measurement tool (Keaton *et.al*., 2017) could be tested and adapted to the local conditions to raise awareness and preparedness. Community involvement in meteorological and hydrological monitoring, and local risk mapping and monitoring would assist community understanding and preparedness when combined with action-oriented early warnings;
b. Acquire and maintain community-based DRM facilities and equipment, including shelters, boats and other means of transport, radios, mobile phones, water purification & storage equipment, storage facilities for food, basic medicines, and water purification. Standardization of equipment is essential to enhance the effectiveness of support; and
c. Raise awareness about disasters and 'best responses' (short and longer term).

The DCP, INGC as well as NGOs such as the national Red Cross organizations and ICPs could spearhead these efforts. They could also support the involvement of local DRMCs in EWS, including providing feedback about the early warnings after each event to improve EWS effectiveness.

Improved and diversified livelihoods will make households more resilient. DRM should be linked to rural development planning and poverty reduction. Reduction of agricultural dependency, agricultural diversification and economic diversification are essential to realize more secure livelihoods. DRM efforts need to pay special attention to vulnerable groups to ensure that these groups are better prepared for disasters and are fully covered by relief and resilience building efforts. Development ministries, ICPs and NGOs should support economic and livelihood diversification and protection of the vulnerable groups.

5 Development of TWM DRM strategies

The project showed that a basin-wide DRM strategy is needed, either separately as a DRM strategy or through DRM and CCA integration in basin development, investment and land use plans as well as EIA/SEA requirements. The following interventions should be considered:

i. (Re)Building of meteorological, hydrological and livelihood monitoring networks in the basins;
ii. Modelling and forecasting of hydrological conditions and floods and translation of the main results in regular result briefs and coordinated EWS and early warnings;
iii. Development of an integrated flood risk management framework;
iv. Mapping of high-risk areas in terms of rainfall, cyclone frequency and flooding;
v. Establishment of effective flood resilient basin-wide communication networks; and
vi. Basin-wide water infrastructure and ecosystem-based interventions to manage water resources for economic development and flood damage avoidance.

Cyclone Idai clearly showed that the scale of disasters exceeds national boundaries and capacities. While ICPs are instrumental in providing financial and technical assistance, it is important that SADC as a regional organization gets involved in DRR and DRM by pooling technical and financial resources. Possible SADC interventions would be:

- ✓ Establishment of a SADC DRM Fund;
- ✓ Establishment of a Rapid Disaster Relief and Rebuilding team;
- ✓ Regional high-risk areas and flood mapping exercises to assist RBOs and SADC countries; and
- ✓ Establishment of a SADC RBO DRM lessons and best practice data base covering the four DRM cycle phases.

It is important that SADC DRM efforts are not confined to relief but also aim at improving preparedness and resilience.

6 Effective DRM partnerships

The Idai experience has shown that partnerships are essential. DRM is not just a matter of governments or the directly affected households. A host of non-state actors, communities and the private sector have contributed to Idai relief and reconstruction. Zimbabwe has a Civil Protection Platform with representatives from all relevant institutions inside and outside government. Mozambique may establish a similar platform (INGC & CCGC to consider for action).

The current UN-cluster approach is useful in coordinating relief efforts of different partners. It is recommended that the cluster approach is extended beyond the existing clusters and new clusters be established for disaster mitigation, prevention, and preparedness. This will coordinate efforts to build longer term resilience. The UN and other multilateral and bilateral agencies together with national governments (led by the INGC and DCP) should consider this for action.

ICPs offer indispensable technical and financial support. It is recommended that ICPs match short-term relief and response funding with longer term DRM support aimed at resilience building. Moreover, where possible local equipment, material and expertise should be used to support economic recovery and livelihoods. It is important to -where possible- standardize support equipment and select the most effective type of equipment, and to limit the number of different brands to facilitate efficient maintenance.

7 Better balancing short- and long-term DRM interventions

With the expected increase in disasters and greater intensity of the disasters, DRM will require more human and financial resources. It is important to minimize human tragedies and as prevention is cheaper than relief and responses, more interventions and resources are needed to prevent and/or prepared for negative impacts. This requires resilience building at the national and household levels. Global assistance for human relief needs to continue but greater contributions are needed for mitigation, prevention, and preparedness. The ICPs should consider this for action. This can be promoted through the recommended establishment of additional DRM resilience clusters (see above) and by channeling (some) international DRM resilience funding through the national DRM Funds.

8 Rapid needs assessments and follow ups

Rapid needs assessments are essential to quickly assess the damage and relief and reconstruction needs. National governments need to lead this process, where necessary assisted by ICPs. PDNAs are useful templates but it is recommended that:

- ✓ The private sector and people's livelihoods are assessed in greater detail than done in the Mozambique and Zimbabwe;
- ✓ Stakeholders and the directly affected population are consulted.

The rapid assessments should contribute to the development of medium to long-term plans, and include specific activities on mitigation, prevention, and preparedness. It is recommended that Post Event Response Capability (PERC) studies are carried out at least twice (after 1 year, 3 years, …) to learn lessons from the relief and recovery and to assess the progress with resilience building. The project clearly showed that relief and rebuilding take time and need to continue for a considerable period (e.g., 5-10 years). National governments (with INGC and DCP as catalysts) together with ICPs need to support the incorporation of these aspects in rapid assessments, DRM, CCA and development planning.

9 Info/data & info/data base, forecasting and info/data (base) access

DRM and EWS require adequate data and monitoring networks, covering meteorology, hydrology, social, livelihoods/ development and environmental data. Moreover, regular mapping of high-risk areas, floods, rainfall, settlements, livelihood zones, land use etc. is essential. Data should be integrated into a Data & Info System that should be easily accessible to stimulate more research (e.g., open access data sharing platform), and further improve the understanding of the risks of cyclones and droughts. Easy and quick info/data availability is essential to improve community resilience. It is equally important that the info/data inform development and land use planning, for example to identify high risk areas and avoid further developments in such areas.

It is also important to initiate a data base for cyclone DRM experiences with details about the nature of the cyclone, the impacts and damage caused, and the DRM efforts as per DRM cycle stage in terms of nature of the interventions, institutions involved, level of efforts (human and financial resources) as well as lessons learned (INGC and DCP to consider for action with support of multilateral ICPs).

Member states may have their 'own' data collection systems and data base. It is recommended that data collection systems and national data base are standardized as much as possible to facilitate upscaling to the basin level (INGC, DCP and RBO member states to consider for action).

10 Environment

Idai has shown that cyclones cause significant environmental damage and risks that environmental rehabilitation and nature-based solutions may increase future resilience. There is need for slope stabilization to prevent future landslides, restoration of riverbeds damaged by gold mining, and rehabilitation of mangrove forests to maintain their essential functions. There is also need for land rehabilitation and re-afforestation in the worst affected forests and PAs.

Nature-based solutions (NBS) that improve resilience need to be identified and their feasibility assessed. These include development of green areas in settlements and coastal revegetation. Another NBS is to create more space to rivers by reducing encroachment into the river plains. This would also reduce people and human activities to flood risks. Creation of more space for river would be linked to the resettlement program. The above should be considered for action as part of the Beira rehabilitation plans (e.g., for Beira by the Beira Municipality under the Beira Recovery and Resilience Plan and the World Bank and Dutch development assistance under the CERPP project).

5.2 LIMCOM & OKACOM

LIMCOM

LIMCOM has a final draft DRM Action Plan (GWP-SA, 2016). The plan is comprehensive and forms a good foundation for DRM and DRR in the Limpopo Basin. The intervention areas covered are consistent with the ones that emerged from the Idai project and need to be pursued. An additional recommendation from the Idai project is to establish effective local DRMCs with adequate means and tools and adequately trained. The plan still appears to be a draft and needs to be finalized and adopted by the member states. Moreover, the institutional structures to implement the plan need to be established and mobilized. Resilient Waters should support the finalization of the plan, and its implementation, particularly at the community level. Finally, it would be useful to connect LIMCOM DRM interventions and experiences with SADC-wide DRM efforts to benefit from technical and final capacity in the region as well as share lessons and experiences with other RBOs (e.g., in a SADC data platform).

OKACOM

The OKACOM has developed several strategic documents such as the basin's Vision, the Transboundary Diagnostic Analysis (TDA, 2011), the Strategic Action Plan (SAP, 2011), a MultiSectoral Investment Opportunity Assessment (MSIOA) and OKACOM is currently developing a Decision-Support System (DSS). However, there is no specific DRM strategy. The SAP does not have DRM as a thematic area but recognizes that floods and droughts are likely to increase and need to be managed. The main factors behind increased disaster risk exposure are climate change and land use changes. Climate change is currently expected to lead to higher temperatures, increased rainfall, particularly upstream, and increased variability of the river flow. Floods may become more likely. Population and economic development can be expected to increase the pressure on the riverbanks and flood plains, i.e., high-risk areas. This would be enhanced by widespread poverty and expose particularly vulnerable groups. The following relevant DRM activities are envisaged in the TDA and the SAP:

a. Investments in meteorological and hydrological networks after reviewing the existing networks;
b. Upgrading the hydrological models for the basin;
c. Development of a DSS and information management system;

d. Review of climate change on water resources, including demand;
e. Development of drought management plans and flood forecasting models, flood preparedness plan and early warning systems (EWS), leading to reduced flood damage;
f. Resilient land use mapping; and
g. Economic diversification of livelihoods to increase resilience.

It is recommended that OKACOM develops a concise DRM plan for the basin (e.g., supported by Resilient Waters) that is fully integrated with development and land use plans for the basin and its member states as well as climate change adaptation strategies. Important components would be the assessment of the countries' DRM structures, harmonization of relevant DRM and CCA policies and upscaling to the basin level, establishment of local DRMCs, particularly in high-risk areas. There could be a window for CCA and DRM as part of the basin Fund that will be established. The strengthening of the meteo-hydro network and data sharing protocols and mechanisms is important, particularly for the flood forecasting. The CORB has the 'advantage' that it is currently under development and water resources are under-utilized. This advantage should be exploited by fully integrating DRM in environmental assessments and by the identification of high-risk areas and avoid their permanent development where possible. These suggestions also imply that DRM should be fully integrated in the DSS that is currently being developed.

6 Resilient Waters follow-up activities in BuPuSa and LIMCOM/OKACOM

Based on this project, the focus of Resilient Waters follow-up works in BuPuSa should be on increasing community preparedness and resilience to disasters such as Idai. This requires a medium to longer term commitment; in the case of Resilient Waters for the remainder of the project duration and possible extensions. Specially, Resilient Waters requested suggestions for the selection of villages-settlements to focus on.

<u>Settlement – community-based activities</u>

In our view, stakeholders in both countries and BuPuSa should make the final selection in 2021. We suggest considering the following criteria for the selection of villages:

a. Size of settlements, including urban & rural settlements;
b. Extent of damage;
c. Level of relief & reconstruction support;
d. Relocation – high/low risk areas;
e. With and without local DRMC (Mozambique);
f. BuPuSa and country priorities.

In terms of damage, the rainfall intensity map showed that the following settlements received more than 600 mm of rain:

- ✓ Mozambique:

- 400-600 mm: 23 settlements in Sofala (11) and Manica (12). Examples are Buzi & Dondo;
- Over 600 mm: Tica, Inchope and Nhamatanda.

✓ Zimbabwe:

- Chimanimani and Chipinge: 400 to 600 mm.

The damage was highest in Sofala Province in Mozambique and Chimanimani and Chipinge District in Zimbabwe. The rainfall intensity and cyclone frequency maps combined are indicative of high-risk areas. These maps should be complemented by a flood risk map to identify the high-risk areas more accurately. It is recommended that one village with and one without a local DRMC in Mozambique to analyze the impact of a local DRMC and to assist its further development.

The settlement-based activities may include the following:

a. Local assessment of Ida impacts and progress with rebuilding, mitigation, prevention, and preparedness for the next cyclone;
b. Livelihood assessment with the community and identification of diversification options;
c. Needs assessment: review of local DRM structures and processes, equipment, and facilities;
d. Establishment of a basic local DRM infrastructure (e.g., shelters, evacuation plan, storage of strategic stocks, essential transport means);
e. Training needs assessment and training activities;
f. Community participation in meteorological and hydrological monitoring as well as livelihood monitoring; testing & adjustment of "Flood Resilience Measurement Tool"
g. Community mapping of high-risk areas and inventory of IK regarding DRM (e.g., lessons learned) and climate change (adaptations);
h. Community EWS needs assessment and their active participation in EWS.

Local government and non-government institutions need to partner with the communities to increase their resilience and livelihoods. It is recommended that Resilient Waters collaborates with IFCRC and UNESCO on BuPuSa activities to benefit from their experience. Additional external support can be provided by the Centre for Applied Research (socioeconomic assessments) and Hatfield Consultants Africa (RS analysis for communities).

Other BuPuSa DRM activities could be:

a. Assist BuPuSa with development of a DRM strategy;
b. Assist BuPuSa with the restoration of the meteorological and hydrological monitoring stations and networks;
c. Assistance with implementation of resettlements from high to low-risk areas;
d. Development of dam operating guidelines (in conjunction with CRIDF?); and
e. Assess the potential of nature-based solutions (e.g., increasing the space of the rivers, revegetation as coastal protection and green spaces in settlements).

It is further recommended that Resilient Waters supports the recommended LIMCOM and OKACOM activities above to strengthen the basins' and their communities' resilience.

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