



Assessing Disaster Preparedness and Recovery from Tropical Cyclones in Zimbabwe: Insights from Cyclone Ana in Nyanga

Decide Mabumbo¹ · Nombulelo Kitsepile Ngulube²

Accepted: 14 August 2026
© The Author(s) 2026

Abstract

Tropical cyclones pose increasing risks in Southern Africa, with impacts shaped not only by hazard intensity but also by underlying vulnerabilities and disaster risk management (DRM) capacity. This study examines preparedness, response, and recovery following Cyclone Ana (2022) in Nyanga District, Zimbabwe, drawing on qualitative data from focus group discussions, key informant interviews, and field observations. Findings reveal persistent gaps in community preparedness, early warning communication, and institutional coordination, with DRM systems remaining largely reactive, centralized, and unevenly implemented. Although warning information was widely disseminated, its technical and generalized nature limited local interpretation and did not consistently prompt protective action. Recovery efforts were similarly constrained by short-term funding cycles and uneven targeting, resulting in variable outcomes across communities. At the same time, strong local capacity for collective action was evident, with communities mobilizing indigenous knowledge, social networks, and mutual support to address immediate needs. Building on these findings, the article positions Cyclone Ana as a baseline for assessing subsequent reforms, including the introduction of impact-based forecasting, anticipatory action frameworks, and strengthened contingency planning. While these developments represent important progress, significant challenges remain in operationalizing them at the local level. The study identifies a critical implementation gap between policy commitments and practice, underscoring the need to better align legislative reform, financing mechanisms, and institutional capacity with community-centered approaches. By linking empirical insights to broader debates on disaster risk governance, the article contributes to understanding how DRM systems can transition from reactive response toward more adaptive, inclusive, and resilience-oriented pathways.

Keywords Community-based disaster risk management · Disaster risk management · Early warning systems · Tropical cyclones · Zimbabwe

1 Introduction

Tropical cyclones are major weather hazards that generate significant risks, including flooding, infrastructure damage, livelihood disruption, and loss of life. Their impacts vary across regions and time due to differences in exposure, vulnerability, and risk management capacity (Shultz et al. 2005; WMO 2025). Beyond direct physical damage, cyclones create cascading risks through heavy rainfall, storm surges, and

high winds, contributing to landslides, disease outbreaks, food insecurity, and environmental degradation (Feehan et al. 2024). Consistent with disaster risk scholarship, these impacts are shaped not only by physical hazards but also by underlying vulnerabilities, inequalities, and weak institutional capacity, particularly in low- and middle-income countries (Gutiérrez et al. 2024; Kelman 2025). While global evidence does not show a clear increase in cyclone frequency, some regions are experiencing shifts in intensity, with rising losses driven largely by increased exposure of people and assets. Future projections suggest possible changes in cyclone intensity under climate change, although uncertainties remain and risks will continue to depend on development pathways and governance contexts (Collins et al. 2019; Knutson et al. 2019).

✉ Decide Mabumbo
dmabumbo@gmail.com

¹ International Water Management Institute,
Hatfield, Pretoria 0083, South Africa

² Disaster Prevention Research Institute (DPRI), Kyoto
University, Uji, Kyoto 611-0011, Japan

The southwestern Indian Ocean is frequently affected by tropical cyclones, although risk varies across space and time (Ramos-Scharrón et al. 2022). Countries such as Madagascar, Mozambique, and Malawi are regularly impacted, with effects extending inland. Although landlocked, Zimbabwe experiences cyclone-related flooding and landslides in its eastern districts due to storms originating in the Mozambique Channel (Rangarirai et al. 2023). Major events over the past two decades include Cyclones Eline (2000), Dineo (2017), Idai (2019), Chalane (2020), Eloise (2021), and Ana (2022) (Mukwenha et al. 2021). More recently, eastern Zimbabwe has been affected by the remnants or direct impacts of Cyclone Batsirai (2022), Cyclone Freddy (2023), Tropical Storm Filipo (2024), and Tropical Cyclone Chido (2024) Hungwe et al. (2024).

Cyclone Idai in March 2019 affected nearly three million people across Mozambique, Malawi, and Zimbabwe, making it one of the largest transboundary disasters in Southern Africa. In Zimbabwe, 347 people died, more than 17,600 were displaced, and losses exceeded USD 1 billion (Shahi 2022; Rangarirai et al. 2023). The event exposed major gaps in preparedness and institutional coordination (Chanza et al. 2020; Munsaka et al. 2021). Three years later, Cyclone Ana again tested Zimbabwe's disaster risk management system. Although less severe, Ana caused substantial damage in Manicaland Province, destroying homes, schools, and roads, and disrupting livelihoods and services in districts such as Nyanga (GoZ 2022a).

Despite these impacts, Cyclone Ana has received limited scholarly attention compared to Idai. Yet disaster risk research shows that smaller, recurrent events generate significant cumulative losses while often being under-prioritized in policy and humanitarian responses (Wisner and Gaillard 2009; UNDRR 2019). Examining Ana therefore provides an opportunity to analyze how communities and institutions prepared for, responded to, and began recovering from recurrent cyclone risks.

This study focuses on Nyanga District, which was significantly affected by Cyclone Ana, and pursues three objectives: (1) assess impacts on livelihoods and infrastructure; (2) examine preparedness, response, and recovery strategies across actors; and (3) identify opportunities for strengthening disaster risk management and resilience in Zimbabwe's cyclone-prone regions.

The article proceeds with a description of the study area and methodology. Findings are presented across five sections: impacts (Sect. 4.1); preparedness measures excluding early warning and protective actions (Sect. 4.2); early warning systems and protective actions (Sect. 4.3); response and relief (Sect. 4.4); and recovery (Sect. 4.5). Early warning and protective actions are treated separately due to their distinct operational role in shaping immediate

risk reduction behavior during cyclone events. The article concludes with key implications for disaster risk reduction policy and practice.

2 Description of the Study Area

This study was conducted in Nyanga District, one of the seven districts in Manicaland Province, Zimbabwe. The district is located approximately 106 km northeast of the provincial capital, Mutare, and shares borders with Mozambique to the east, Mudzi and Mutoko Districts to the north, Makoni to the west, and Mutasa to the south (Fig. 1). Administratively, Nyanga operates under Zimbabwe's Ministry of Local Government framework, with a District Development Coordinator (DDC) serving as the primary authority, alongside traditional leaders who continue to play an important role in community governance.

Geographically, Nyanga comprises five agro-ecological zones with distinct environmental and livelihood characteristics. The southern zones (I–III) support forestry, horticulture, maize, tobacco, and dairy farming, as well as wildlife conservation in Nyanga National Park. The northern zones (IV–V) are semiarid and are more suitable for small grains, livestock production, and artisanal mining. The district also contains notable agricultural infrastructure, including two major irrigation schemes—Nyamaropa and Nyakomba—and six smaller schemes, contributing to its role in potato seed production (GoZ 2018).

Although Nyanga has considerable agricultural potential, it faces persistent development challenges. Road networks linking rural service centers remain in poor condition, while urbanization pressures have contributed to settlement expansion onto steep slopes and floodplains, increasing exposure to landslides and flash floods during the rainy season.

The district's location near Mozambique and within the broader southwestern Indian Ocean cyclone-influenced region contributes to recurrent weather-related impacts, which interact with local patterns of vulnerability and land use. Nyanga has experienced several severe events, including Cyclone Idai in 2019, which brought intense rainfall, landslides, and flash floods that damaged infrastructure, displaced communities, and resulted in fatalities (Hungwe et al. 2024). Earlier cyclones, such as Japhet (2003) and Dineo (2017), further illustrate the persistence of these risks and associated governance challenges.

This study examined three purposively selected wards in Nyanga District: Tangwena (Ward 21), Samanyika (Ward 13), and Kute (Ward 14). These wards were selected based on their documented exposure to Cyclone Ana in January 2022, established vulnerability profiles, and the localized

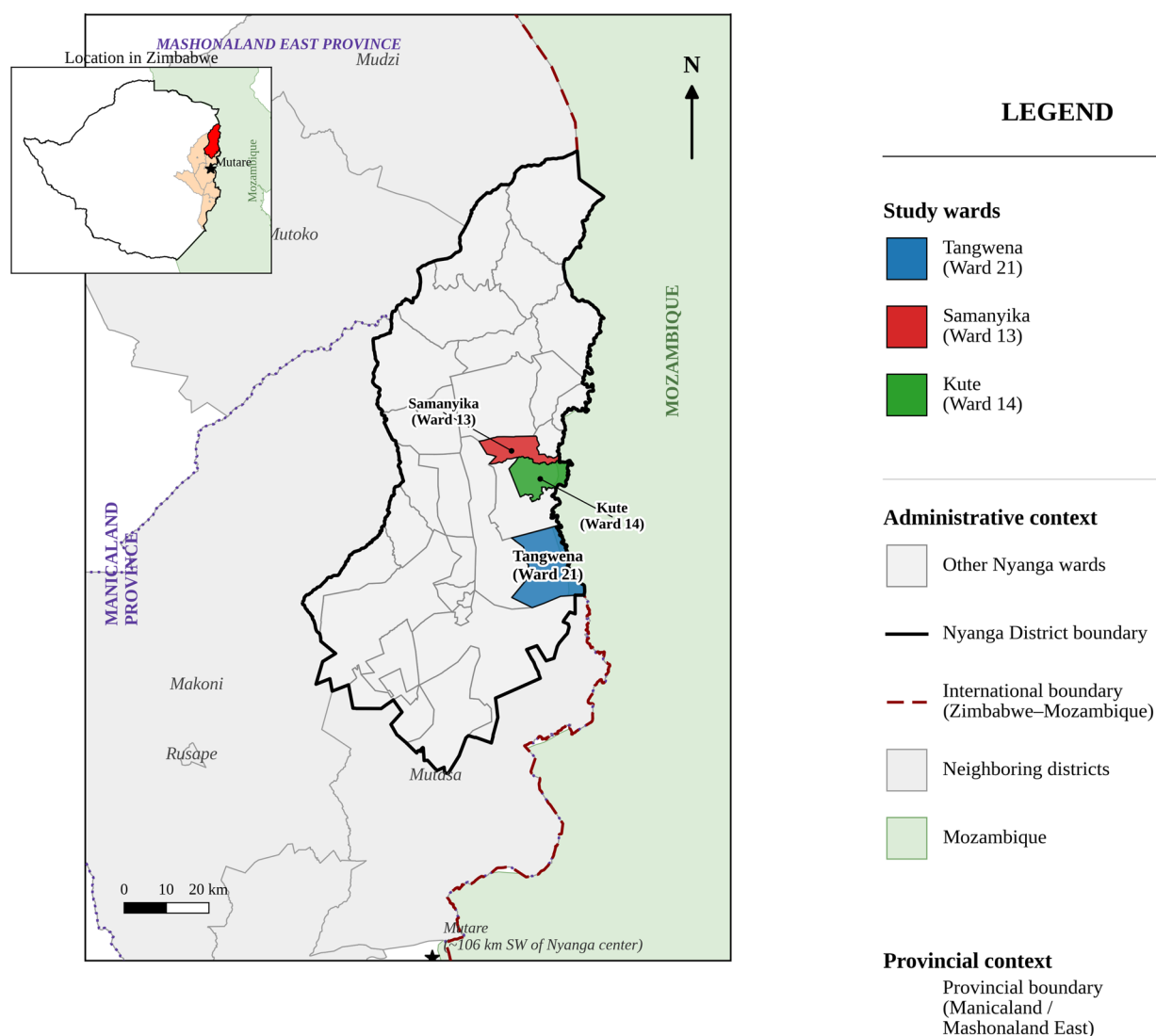


Fig. 1 Map of Nyanga District

impacts reported. According to records from the Nyanga District Office, these areas experienced substantial damage to infrastructure, croplands, and housing.

3 Methodology and Data Collection

This study employed a qualitative research design to examine the lived experiences, perceptions, and coping strategies of communities affected by Cyclone Ana. Although quantitative approaches are widely used in disaster research for rapid assessments and resource allocation (Bamberger 2000; IMF 2020), they are less suited to capturing the social, cultural, and institutional dynamics that shape vulnerability, resilience, and recovery. Qualitative methods therefore offer particular value in disaster risk management research,

enabling in-depth exploration of local knowledge systems, social relationships, and institutional practices (Barua and Rahman 2018; Chanza et al. 2020), as well as documenting indigenous coping mechanisms and structural factors not easily represented in quantitative datasets (Ashraf 2024).

Data were drawn from both secondary and primary sources to support triangulation. Secondary materials included peer-reviewed literature, government reports, nongovernmental organization (NGO) publications, and local administrative documents from the Nyanga District Office, such as disaster management plans, meeting minutes, and post-cyclone assessments. Additional insights were obtained from two government-UNDP (United Nations Development Programme) workshops attended by 42 members of the District Civil Protection Committee,

representing 20 government departments, development partners, business associations, and traditional leaders.

Primary data collection comprised focus group discussions (FGDs), in-depth interviews, and participant observation. Eight FGDs were conducted across three study sites with disaster-affected households and ward-level disaster risk management committees. Discussions and interviews were held primarily in Shona, with English used where appropriate. The researcher's fluency in both languages removed the need for interpreters. Sampling prioritized inclusivity to ensure participation of women, older adults, and youth.

The group format of FGDs facilitated interactive dialogue and the emergence of shared perspectives that may not surface in individual interviews (Kitzinger 1995). In total, 27 interviews were conducted: 22 with purposively selected households substantially affected by the cyclone and five key informant interviews with representatives from the Department of Civil Protection, UNDP, the Zimbabwe Red Cross Society, the Meteorological Services Department, and a local NGO. Some interviews included multiple district-level officials from the District Development Committee and the Rural District Council. Observational data, including field notes and photographs, further enriched the dataset by documenting cyclone impacts, recovery activities, and community preparedness measures.

Data analysis followed an iterative, inductive process combining qualitative content and thematic analysis. All transcripts and field notes were coded and categorized using NVivo to support systematic data management and comparison.

Coding involved three stages: initial categorization, code refinement, and theme development. This process facilitated the identification of recurring patterns while preserving contextual depth and interpretive nuance.

Formal permissions were obtained from national, provincial, and district authorities, security officials, and local village heads. In the absence of a formal institutional ethics review board, the study adhered to internationally recognized ethical standards, including informed consent, confidentiality, anonymity, and voluntary participation. Research objectives were clearly explained, oral consent was obtained, and participants were assured of their right to decline or withdraw at any stage without consequence.

4 Results and Discussion

This section presents the findings from the analysis of data collected in Nyanga District following Cyclone Ana. The findings are organized into five thematic areas: the impacts of Cyclone Ana, community involvement in preparedness, warning systems and protective action, response and relief,

and recovery. Relevant literature is used to contextualize the findings and their implications for disaster risk management.

4.1 Cyclone Ana-Induced Impacts in Nyanga District

Cyclone Ana affected Nyanga District in January 2022, generating substantial impacts across multiple sectors. Prolonged rainfall and associated flooding caused damage to housing, public infrastructure, environmental conditions, and livelihood systems. Evidence from interviews with community members and focus group discussions with disaster risk reduction practitioners indicated extensive material losses and disruptions to everyday activities. Table 1 summarizes the main sectoral impacts of Cyclone Ana in the study area.

One of the most immediate impacts was damage to residential housing. Field assessments documented 126 affected houses, of which 70 were rendered uninhabitable (GoZ 2022a). As a result, several households were displaced and accommodated in temporary shelters or overcrowded public facilities. Loss of shelter disrupted household routines and increased exposure to health, safety, and protection risks, particularly among children, older adults, and persons with disabilities.

Comparable housing impacts have been reported in other cyclone-affected contexts. For example, research from Tamil Nadu, India, following Cyclone Gaja documented extensive housing destruction in highly exposed rural settlements (George et al. 2021). Similarly, studies from Bangladesh following Cyclone Aila indicate that poorer households faced greater difficulties in reconstruction due to limited financial and institutional support (Ahmed et al. 2023). These cases highlight how housing losses are shaped not only by hazard intensity but also by pre-existing socioeconomic conditions and recovery capacities.

Cyclone Ana disrupted water and sanitation systems across Nyanga District, damaging boreholes, destroying latrines, and inundating sanitation facilities in schools and clinics. These impacts were particularly evident in Nyafaru Village (Ward 21) and Samanyika Village (Ward 13), where water points were submerged or damaged, thereby limiting access to protected water sources. As a result, some households traveled longer distances to obtain safe water, while others relied on untreated supplies, increasing exposure to waterborne health risks.

Disruptions were also observed in educational and health-care facilities. At Dazi Primary School, the absence of a reliable water supply affected routine teaching and learning, while a nearby health post temporarily suspended operations due to inadequate sanitation. According to the district environmental health officer: "Toilets were destroyed, forcing communities to resort to open defecation. The remaining pit

Table 1 Sectoral impacts of cyclone Ana in Nyanga district

Sector	Impact	Consequences
Shelter and Household Assets	126 homes damaged 70 uninhabitable 56 partially destroyed Loss of household property	Displacement and overcrowding Reconstruction costs Use of unsafe materials Emotional distress and protection risks, especially for women and children
Water and Sanitation	Boreholes, wells, and latrines destroyed or contaminated School and clinic sanitation failed	Open defecation Higher risk of cholera and typhoid Clinics closed due to water shortages Women and girls travel long distances for water
Public Infrastructure	Primary roads and footbridges washed away School roofs and clinic structures damaged	Communities cut off Delayed humanitarian access Disrupted education and health services Increased transport costs and accident risk
Agriculture, Environment, and Livelihoods	Crops destroyed near harvest; irrigation systems and cattle dip tanks ruined Dams severely damaged Soil erosion, deforestation, and siltation increased	Immediate food shortages Reduced household income Higher livestock disease risk Lower productivity and slower recovery Damaged farmland and blocked waterways
Social Systems and Well-being	Weakened community structures School disruptions Trauma and mental health needs Burden on women and caregivers	Deepened inequalities Higher school dropout rates Mental health strain Resilience weakened by lack of social safety nets

Source Authors' construction from field data.

latrines were unsafe and could collapse at any time. Women, children, and the elderly were particularly at risk of severe illness.”

These impacts were experienced unevenly across social groups. For example, an in-depth interview with a female-headed household in Ward 21 indicated that daily travel for water increased by approximately 3.5 km, adding around two hours to caregiving responsibilities and reducing time available for income-generating and domestic activities.

Existing research suggests that disruptions to water and sanitation systems following tropical cyclones are frequently associated with increased risks of infectious disease transmission. Studies from cyclone-affected provinces in China have documented elevated incidence of bacillary dysentery and typhoid fever following flooding events (Zheng et al. 2017). Similar patterns were reported after Cyclone Aila in Bangladesh (Yeasmin et al. 2022) and Cyclone Idai in Zimbabwe, where damaged water infrastructure contributed to heightened cholera vulnerability (Mukwenha et al. 2021).

The Nyanga case illustrates how damage to rural water infrastructure reflects underlying design limitations, maintenance constraints, and resource shortages, which reduce system resilience under extreme rainfall and flooding conditions. Many facilities were designed to operate under average climatic conditions and lacked protective measures against extreme weather events, thereby increasing their susceptibility to failure.

Cyclone Ana also affected public infrastructure, including roads, bridges, schools, and clinics. In Ward 13, near Regina Village, sections of the Troutbeck-Nyafaru route were rendered impassable, restricting mobility and delaying emergency assistance. Flooded rivers damaged bridges, while stormwater infiltration affected school and health facility buildings, disrupting service delivery. In several wards, classrooms were rendered unusable due to roof damage and prolonged waterlogging. Figure 2 presents damage to the



Fig. 2 Damage to Murozi Footbridge caused by Cyclone Ana in Ward 13, Nyanga District. Photograph by Vuyisile Ndlovu, Christian Aid

Murozi footbridge, which provides access to nine villages and serves approximately 135 schoolchildren in Ward 13.

These patterns of infrastructure disruption are consistent with observations from other cyclone-affected contexts. For example, Cyclone Sidr in Bangladesh damaged roads and embankments, restricting access to affected regions (Hossain et al. 2008), while Cyclone Debbie in Australia exposed structural weaknesses in coastal infrastructure systems (Berman and Kuleshov 2023). Such cases suggest that infrastructure impacts are shaped not only by hazard intensity but also by planning practices, maintenance regimes, and institutional capacities.

Cyclone Ana also affected livelihoods and food production, particularly because it struck shortly before the main harvest. Heavy rainfall and flash flooding damaged maize, bean, and vegetable fields, especially in Wards 21 and 14, while contributing to soil erosion, siltation, and blocked waterways. Irrigation schemes and dip tanks were inundated or destroyed, and small livestock were lost during evacuations. These impacts reduced household food availability and income, heightening food insecurity among subsistence farmers. A female farmer from Ward 21 explained: “We heard the wind getting stronger around 2 a.m., but our traditional warning signs—the way the birds were flying and the color of the evening sky—had already told us something big was coming... We moved our goats to higher ground, but we could not save our maize crop... Now my three children have dropped out of school because we need them to help rebuild and find work.”

This account illustrates how local knowledge informs anticipatory action while also revealing its limits under extreme conditions. Although early warning signs prompted precautionary measures, constraints related to land use, asset protection, and livelihood dependence reduced households’ ability to prevent major losses. Crop failure triggered cascading effects, including food insecurity, school interruptions, mental health strain, and increased care and livelihood burdens, particularly for women and low-income households.

Beyond immediate impacts, the findings show broader, interconnected livelihood effects that persist well after the disaster. Crop losses and damaged farmland likely undermined productivity in subsequent seasons, especially where soil degradation, disrupted irrigation, and limited market access continued. Increased livestock disease risk suggests ongoing strain on animal husbandry, including reduced access to veterinary care, feed, and essential supplies. Transport disruptions further constrained local trade and small businesses, compounding income losses beyond agriculture. While these dynamics varied across households, they demonstrate how initial shocks ripple through multiple sectors. Emerging adaptive strategies, such as shifts in livelihood practices were evident but

uneven and highly context-dependent. Collectively, these patterns underscore the need for longitudinal, systems-based analyses to better understand recovery and adaptation over time.

4.2 Community Involvement in Preparedness

Nyanga District has experienced repeated hydrometeorological hazards, including major cyclones. Despite this exposure, substantial gaps in community-level preparedness for Cyclone Ana indicate persistent limitations in local disaster risk management (DRM) systems. Analysis of focus group discussions and interviews showed that 76% of participants were unaware of any formal emergency preparedness plans, reflecting weak links between institutional DRM arrangements and everyday community practices and contributing to heightened vulnerability.

At the institutional level, shortcomings were evident in planning processes and documentation. Ward-level DRM plans developed in 2018 with external support were intended to guide disaster management until 2024. However, document analysis shows that these plans remained heavily response-oriented: only 18% focused on preparedness, compared to 65% on response, with the remaining 17% covering risk assessment, mitigation, and recovery. This imbalance reflects a persistent bias toward reactive rather than preventive disaster management.

Community participation in planning was similarly uneven. Approximately 64% of participants reported never being consulted during risk assessments or DRM plan development, indicating engagement was limited to a small subset of community members. While some representation existed, it did not translate into broader involvement. As one resident noted, “We only see officials after disasters strike, never before, when we could plan together.” Limited participation reduced ownership and constrained integration of local knowledge into formal planning.

The predominance of reactive approaches reflects both institutional incentives and the realities of governing in resource-constrained settings. Authorities prioritize visible infrastructure and service delivery over long-term preparedness. As one official explained, “When the MP visits, communities ask about the new borehole or clinic construction. No one asks about disaster preparedness until after the cyclone hits.” This aligns with literature on everyday versus extreme risk, where immediate needs overshadow investment in less frequent hazards (UNISDR 2009).

These dynamics are reinforced by donor funding cycles that mobilize resources after disasters rather than for sustained risk reduction. Disaster risk management plans developed post-Cyclone Idai benefited from such funding, but

responsibility later shifted to under-resourced local institutions, limiting long-term effectiveness.

Although community-based disaster risk management (CBDRM) principles have gained prominence in policy discourse, they were not strongly embedded in legislation at the time of Cyclone Ana, and implementation varied widely across wards. Only 8 DRM committees (24%) met regularly, 15 (44%) convened mainly during emergencies, and 11 (32%) were largely inactive. Where functional, activities focused on relief distribution rather than preparedness, with members often describing their role as “helping distribute aid.”

Participation was further shaped by social hierarchies. Committees often reflected dominant local power structures rather than inclusive representation. In one ward, membership consisted mainly of male household heads despite women’s central roles in water collection and household risk management. Limited involvement of women constrained the effectiveness of CBDRM initiatives, particularly in relation to water and health risks.

Capacity limitations further undermined preparedness. Assessments of 45 committee members revealed major gaps (Fig. 3): 15 had not received training in hazard mapping, 7 had never participated in vulnerability assessments, 35 lacked contingency planning experience, 40 had not been trained in post-disaster needs assessment, 35 reported limited knowledge of early warning systems, and 36 had minimal

training in emergency coordination. These gaps restricted committees’ ability to translate policy into practice.

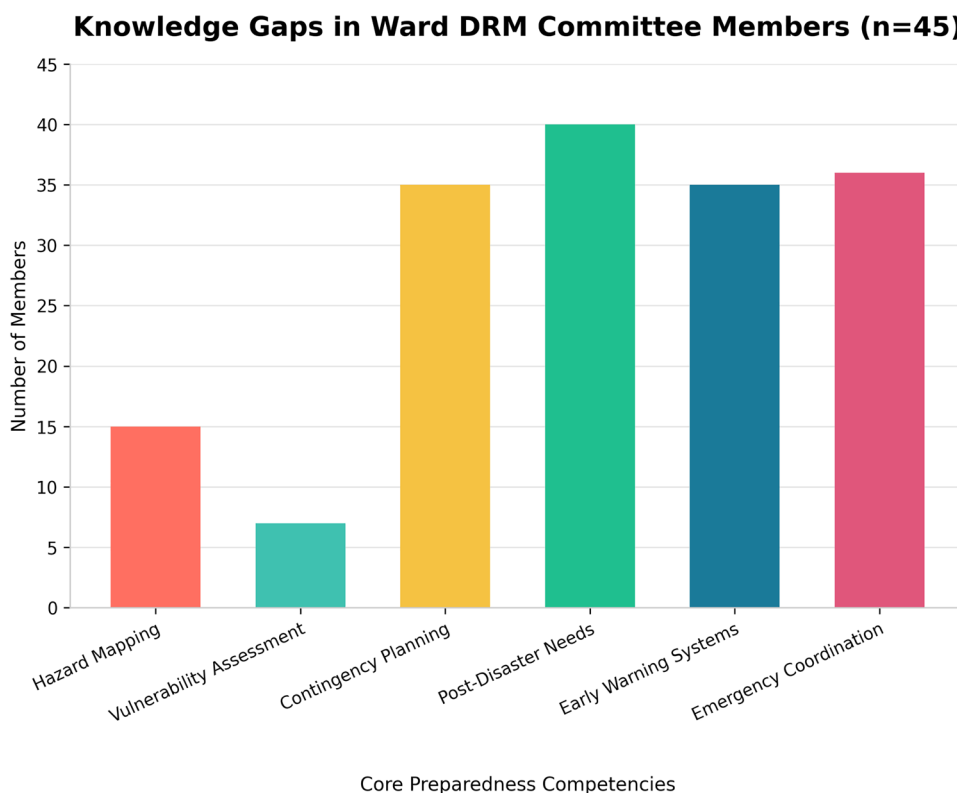
These deficiencies reflect limited opportunities for capacity development. Around 70% of members reported no refresher training in the previous three years, alongside limited technical support and practical engagement, constraining their ability to lead preparedness efforts.

More broadly, these challenges reflect governance constraints. Despite decentralization efforts, a gap persists between national policy and local implementation. Budgeting processes were often unclear, with resources prioritized for response rather than preparedness due to fiscal constraints.

This implementation gap is reinforced by Zimbabwe’s Civil Protection Act (Chapter 10:06) of 1989, which remained the primary framework at the time of Cyclone Ana. The Act reflects a hazard-focused, response-oriented approach with limited emphasis on prevention and preparedness (Manyena et al. 2013; Mavhura 2016). Key mechanisms such as contingency planning are insufficiently specified, limiting translation of policy into practice and reinforcing reactive risk management.

The experience of Cyclone Ana illustrates the limitations of static DRM plans lacking operational contingency mechanisms. In Nyanga, the absence of scenario-based planning, resource pre-positioning, and clear activation procedures constrained timely and coordinated response.

Fig. 3 Results on capacity assessments with disaster risk management (DRM) committee members



Comparative evidence highlights the benefits of such approaches. Following the 2010 Merapi eruption, community-based contingency systems in Indonesia improved coordination (Koenti 2022). In Zimbabwe's Chimanimani District, local preparedness initiatives enhanced readiness and coordination (Rangarirai et al. 2023). In Mozambique, anticipatory action and early warning systems during Cyclone Freddy (2023) enabled pre-emptive evacuation and reduced losses (UNDRR 2023). These contrasts highlight uneven implementation across contexts.

Strengthening preparedness in Nyanga therefore requires adaptive contingency planning, regular community-based risk assessments, simulation exercises, pre-positioned supplies, and clearer links between early warning and action, alongside integration of indigenous and technical knowledge.

Since Cyclone Ana, Zimbabwe has introduced reforms, including the Disaster Risk Management and Civil Protection Bill (GoZ 2022b), alongside growing emphasis on CBDRM, impact-based forecasting, and anticipatory action. While these represent important shifts, evidence from Nyanga indicates persistent gaps between policy and practice, particularly in capacity, coordination, and inclusive participation. Effective preparedness depends not only on formal plans but on sustained capacity development, institutional support, adequate financing, and meaningful community engagement, reinforcing the need to bridge policy commitments and everyday practice (Munsaka et al. 2021).

4.3 Warning Systems and Protective Action

The evaluation of warning and response processes during Cyclone Ana revealed mixed outcomes in Zimbabwe's disaster management system. Although the event was forecast to affect northern and northeastern regions, including Manicaland, Mashonaland, and parts of Masvingo (International Federation of Red Cross and Red Crescent Societies 2022), the translation of forecasts into locally meaningful and timely action remained uneven. The Zimbabwe Meteorological Services Department (MSD) issued regular bulletins through print, broadcast, and social media in coordination with the Department of Civil Protection (DCP) and local structures.

However, significant challenges emerged in both warning dissemination and response implementation within Nyanga District. Approximately 30% of participants reported not receiving any warning prior to the cyclone, largely due to infrastructure and access constraints, including unstable mobile networks, limited radio and television reception in mountainous areas, restricted access to communication technologies among vulnerable groups, and damaged

transport infrastructure. These barriers were particularly pronounced in remote settlements such as Ward 21, where topography disrupted radio signals and cellular coverage. Traditional communication mechanisms, including community meetings and door-to-door visits, were also constrained by poor road conditions and safety concerns as the storm approached.

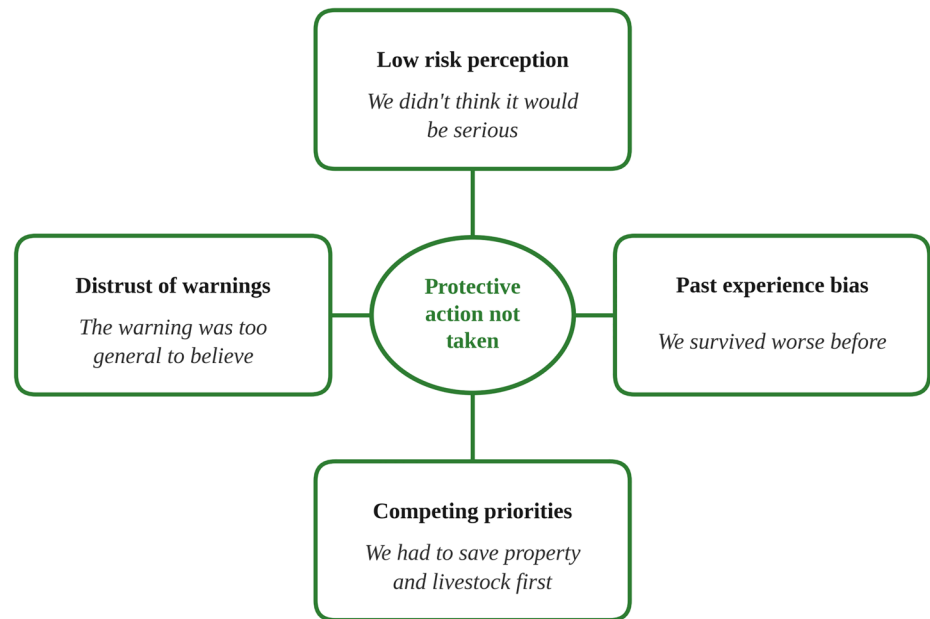
Although around 70% of participants reported receiving warnings through television, radio, social media, local officials, or informal networks, these messages did not consistently translate into protective action. The technical and generalized nature of MSD bulletins limited their usefulness for local decision making. For instance, bulletins issued on 23–24 January 2022 referred broadly to “thunderly showers,” “downpours,” and “strong winds” across several provinces (MSD 2022), without specifying local risks or recommended actions. Many residents were therefore uncertain about how the warnings applied to their own safety and livelihoods.

Focus group discussions further showed that warnings lacked spatial specificity and actionable guidance. Technical terms such as “tropical depression,” “moderate tropical storm,” and “overland depression” were poorly understood, particularly among older residents and those with limited formal education. While some participants recognized rainfall measurements, few could interpret storm classifications in relation to likely impacts, reducing both perceived urgency and trust in official information.

Warnings also rarely included impact-based information on secondary hazards such as flooding, landslides, or infrastructure failure. Residents in flood-prone riverine areas received similar advisories to those in elevated locations, despite markedly different exposure levels, limiting their ability to assess risk and make informed decisions. Although Zimbabwe has since begun introducing impact-based forecasting, the Nyanga case illustrates the baseline communication challenges that these reforms aim to address and suggests that gaps remain in translating forecasts into sufficiently localized, context-specific guidance.

The disconnect between information and action was further reflected in institutional and logistical arrangements. Despite designating 31 evacuation centers, district authorities lacked clear evacuation protocols, transport plans, pre-positioned supplies, and coordinated community response mechanisms. As a result, even when warnings were received, many households lacked viable options for protective action. Interviews with disaster risk reduction practitioners highlighted the absence of financing mechanisms and operational procedures linking forecasts to response, reinforcing an implementation gap. Similar warning-action disconnects have been documented in other disaster-prone contexts (Taylor 2023; Kanani 2024; Mabumbo et al. 2024). Although national frameworks

Fig. 4 Social and cognitive barriers preventing protective action despite early warning receipt



introduced after Cyclone Ana increasingly emphasize anticipatory action and contingency planning, these findings indicate persistent challenges in operationalizing such approaches at the local level, particularly in coordination, resourcing, and first-mile delivery.

Social and cognitive factors also shaped warning responses. Over half of the participants believed that the storm would not directly affect them, often drawing on past experiences of forecasts perceived as exaggerated. Others prioritized livestock and crops over personal safety, while some expressed skepticism toward government-issued information. These patterns align with established models of protective behavior, including Protective Action Decision Theory and the Socio-Cognitive Model of Disaster Preparedness, which highlight constraints related to risk perception, trust, outcome expectancy, and perceived response efficacy (Maloney et al. 2011; Terpstra 2011; Kanakis and McShane 2016).

As Bongo et al. (2013) noted, local knowledge and lived experience strongly influence how hazard information is interpreted. In Nyanga, residents filtered Cyclone Ana warnings through prior experiences, reinforcing “disaster scripts” that normalized risk and reduced incentives for evacuation or preparedness. These dynamics correspond to the behavioral constraints illustrated in Fig. 4, where multiple social and cognitive factors limited protective action despite receipt of warnings.

Taken together, these findings reinforce evidence from Zimbabwe and comparable settings that challenges in warning effectiveness are rooted in weak dissemination channels, limited community engagement, and low institutional trust (Gwimbi 2007; Mavhura 2020; Khoza

and Nhamo 2021). They also align with critiques that early warning is often treated as a technical solution, despite its dependence on political, institutional, and logistical conditions (Matveeva 2006).

Since Cyclone Ana, Zimbabwe has taken steps toward more people-centered warning systems through impact-based forecasting, strengthened early warning systems, and increased emphasis on anticipatory action. However, the Nyanga case highlights persistent gaps in applying these advances at community level, particularly in geographic specificity, clear response protocols, financing, and first-mile communication. Strengthening coordination among meteorological services, civil protection authorities, and local institutions alongside deeper community engagement in co-producing warning and response strategies remains essential for improving forecast usability and enabling timely protective action.

4.4 Response and Relief

Following Cyclone Ana, Nyanga District experienced extensive infrastructure damage, including blocked roads, damaged housing, and disrupted water systems, which constrained access to food, clean water, and temporary shelter. Although authorities attempted to restore services quickly, relief and recovery support were uneven. Initial impact reports were received soon after landfall, but detailed assessments in the most affected villages took nearly two weeks and relied heavily on humanitarian partners. Interviews and document analysis linked these delays to impassable roads, limited vehicle availability, fuel shortages, and broader resource constraints.

These challenges reflect both capacity limitations within the DRM system and wider structural constraints associated with resource scarcity and competing development priorities. In 2022, of the USD 7.3 million allocated nationally for DRM, approximately 28% supported operational logistics such as vehicles, equipment, and response costs, with most funding directed toward longer-term investments (GoZ 2021). While such investments are essential for reducing underlying vulnerabilities, they can limit short-term flexibility during rapidly evolving hazard events. In this context, delays in relief delivery underscore the need to balance long-term risk reduction with cost-effective, context-appropriate mechanisms for timely response, including improved resource mobilization, streamlined funding procedures, and strengthened local-level capacities.

Challenges in data and information management further constrained response effectiveness. Focus group discussions revealed that residents were repeatedly surveyed by different agencies yet received limited assistance, generating frustration with assessment processes that did not translate into timely support. Coordination among humanitarian actors was limited, resulting in incomplete and fragmented datasets, particularly regarding social and economic vulnerabilities. For example, the official March 2022 assessment report included few vulnerability indicators and was disaggregated only by age (GoZ 2022a), limiting its usefulness for targeted planning.

In this context, grassroots responses emerged as a central component of local disaster management rather than merely compensating for delayed institutional support. Community volunteers cleared debris, provided temporary shelter, and distributed essential supplies. These efforts were particularly important given that some ward-level extension workers responsible for coordination had evacuated, creating gaps in local service provision. As one community leader explained: “We couldn’t wait for official help. The river had blocked the main road, and the footbridges were badly damaged, so we took matters into our own hands. The youth cleared paths, the church provided food, and families whose homes were not severely affected sheltered those who had lost everything. We knew that we had to rely on our own resources first.”

This account illustrates how collective action and social networks functioned as core elements of community-based disaster risk management (CBDRM). While institutional limitations shaped the context, the Nyanga response demonstrates the capacity of local actors to organize, mobilize resources, and provide immediate support. These dynamics underscore the importance of strengthening and formalizing community-led mechanisms, with institutional systems playing a complementary role in supporting, resourcing, and scaling locally driven responses.

However, misalignments between relief provision and household needs were also evident. Of the 126 affected households, only 20 received government-prefabricated shelters (GoZ 2022a), and allocation processes did not consistently reflect household size or dependency ratios. In one case, a household with more than 20 members received a single shelter. A resident described this situation as follows: “Despite losing everything, I received inadequate support and no assistance for food, education, or rebuilding livelihoods. The shelter is not large enough for even half of my family.” Such cases highlight limitations in needs assessment and targeting mechanisms, with implications for recovery outcomes.

Although national policy frameworks promote CBDRM, evidence from Nyanga indicates uneven implementation. Planning and response remained centralized and technically driven, with limited sustained community engagement, despite residents’ detailed knowledge of local hazards and priorities. At the same time, the response to Cyclone Ana revealed strong local capacity for collective action. Community members organized mutual support, shared resources, and coordinated assistance; practices reflecting core CBDRM principles but insufficiently recognized and institutionalized. The Nyanga case therefore underscores the need to align formal disaster risk management structures with existing community capacities, positioning local actors at the center of preparedness and response, supported by institutional coordination, technical expertise, and resources.

Comparative evidence highlights opportunities to strengthen such capacities. In Bangladesh, community-based disaster committees are integrated into national governance systems and supported through training and resource provision (Serrao-Neumann et al. 2018). In Vanuatu, traditional governance institutions collaborate with state agencies to develop culturally appropriate preparedness and response strategies (Bubb and Le Dé 2022). These examples illustrate how formal recognition and institutional support can enhance the effectiveness of community-led initiatives.

In Zimbabwe, strengthening response capacity will require greater investment in ward-level DRM committees, regular training programs, and standardized contingency and rapid response protocols. More fundamentally, bridging the gap between policy commitments and practice depends on institutionalizing meaningful community participation through operational procedures and sustained budgetary support. The experience of Cyclone Ana thus reflects both persistent systemic constraints and the important, although still underutilized, role of community-led collective action in addressing immediate humanitarian needs.

Fig. 5 Destroyed house (left) and the reconstructed house (right) in Dazi Village, Ward 21, Nyanga District, after Cyclone Ana. Photograph by Vuyisile Ndlovu, Christian Aid



4.5 Recovery

Recovery is increasingly understood not as a return to pre-disaster conditions but as a long-term, development-linked process with the potential to “build back better” by addressing underlying vulnerabilities (Norton et al. 2023). Its effectiveness depends on how well social, economic, and institutional dimensions, such as equity, participation, and local capacity are integrated into recovery efforts.

In Nyanga District, post-Ana recovery was supported by a crisis modifier under the Zimbabwe Resilience Building Fund, which enabled rapid adaptation of ongoing development programs and strengthened coordination between humanitarian assistance and longer-term initiatives, with technical backing from UNDP (2022).

Initial recovery efforts prioritized housing reconstruction for the most affected households. Through collaboration among local authorities, Community Technology Development Organisation (CTDO), and other humanitarian actors, 40 houses received support, including 20 full reconstructions and 20 rehabilitations. The Department of Public Works provided technical oversight, drawing on “Build Back Better” (BBB) principles as articulated in the Sendai Framework. However, as Maly (2017) noted, BBB is often applied as a broad and ambiguous concept that prioritizes structural

safety over social and livelihood recovery, while limiting meaningful community participation. In Nyanga, resource constraints and limited local involvement restricted the translation of these principles into practice (Fig. 5).

Many households received limited or no housing assistance, resulting in reliance on temporary materials such as grass, plastic sheeting, and salvaged debris. These practices reflect a persistent constraint in post-disaster recovery: the limited scale and duration of reconstruction support. Without adequate materials and technical assistance, housing recovery remained incomplete for many families. As one resident explained: “Six months after the storm, we are still using plastic sheets for our roof. Without proper materials, the next storm could destroy everything again. It feels like we are preparing to lose our home all over again.” This account illustrates how partial reconstruction can perpetuate long-term vulnerability and undermine recovery trajectories.

In parallel, recovery efforts prioritized the restoration of public infrastructure. Repairs to Nyafaru Secondary School, which serves as an evacuation center, supported the resumption of educational activities and strengthened local preparedness capacity. Rehabilitation of roads and footbridges along the Troutbeck-Dazi-Nyafaru corridor improved

Fig. 6 Road and footbridge rehabilitated in Ward 21, Nyanga District. Photograph by Sheron Kubalela, Community Technology Development Organisation



mobility and access for remote communities, facilitating service delivery and livelihood activities (Fig. 6).

Table 2 provides a comprehensive summary of the key infrastructure rehabilitated after Cyclone Ana. It highlights the number of units restored, the direct beneficiaries reached, and the secondary benefits realized by affected communities.

Health system recovery included the installation of a piped water supply at Dazi School and Clinic, enabling services to resume after prolonged closure due to water shortages. Managed by sub-catchment authorities and government engineers, this intervention reflects a “recovery surplus,” whereby post-disaster investments improve service provision beyond pre-disaster conditions (Dube 2020). However, such gains were localized and dependent on targeted external support. Additional improvements were observed through hygiene promotion and sanitation initiatives implemented using participatory approaches, including the Community Action Cycle, with reported reductions in waterborne diseases.

Livelihood restoration also formed an important component of recovery. Rehabilitation of dip tanks and weir infrastructure at Nyamarimbira Farming Scheme improved livestock management and agricultural productivity. In addition, approximately 600 farmers received short-cycle seed and vegetable inputs, supporting short-term food availability and dietary diversity.

However, as with housing assistance, livelihood support was unevenly distributed. Eligibility criteria excluded some affected households, limiting program reach and constraining longer-term livelihood stabilization. As one extension officer noted: “While seed distribution aided some farmers’ recovery, those ineligible struggled through the next season. A graduated support approach was needed for all affected households.”

These outcomes do not reflect inherent limitations of BBB principles, which aim to reduce vulnerability and strengthen resilience, but rather challenges in their implementation. Where support is time-limited or narrowly targeted, recovery interventions may reinforce existing inequalities and leave some households behind. Similar concerns are highlighted in the literature, which emphasizes the importance of inclusive targeting, sustained support, and

locally grounded approaches for equitable recovery (Hallegatte et al., 2018; Norton et al. 2023).

Recovery initiatives also contributed to institutional capacity development. As introduced in Sect. 4.2, community managed disaster risk reduction training was provided to 126 local leaders and government officials, supporting revisions of DRM plans, clarification of roles, and improved coordination. In the recovery context, these efforts strengthened local response and recovery capacities.

Focus group discussions further highlighted the importance of community-led recovery practices. Churches provided psychosocial support, while traditional leaders coordinated food assistance and household visits. These activities reinforce recovery as a multidimensional process encompassing social, emotional, and relational dimensions alongside material reconstruction.

Despite these advances, structural constraints limited the scale and sustainability of recovery following Cyclone Ana. Persistent resource shortages, reliance on short-term donor funding, and the absence—at the time—of integrated recovery frameworks linking assessment, financing, and implementation contributed to uneven outcomes. Since Ana, national efforts have sought to address these gaps through strengthened contingency planning, anticipatory action frameworks, and more coordinated financing systems. However, the Nyanga case highlights ongoing challenges in operationalizing these approaches at scale, particularly in securing predictable financing, integrating data systems, and improving coordination across sectors and governance levels.

Strengthening future recovery therefore requires not only expanding these reforms but improving their accessibility and effectiveness at the local level. Priorities include strengthening post-disaster assessment systems through integrated data platforms, institutionalizing pre-arranged financing mechanisms, and enhancing cross-sector coordination within national governance structures. Formal recognition and integration of community- and faith-based organizations within DRM frameworks would further support psychosocial recovery, local resource mobilization, and inclusive governance.

Table 2 Public infrastructure recovery outcomes

Infrastructure Type	Units Rehabilitated	Direct Beneficiaries	Secondary Benefits
Schools	2	465 students	Restored evacuation centers
Health facilities	1	1,500 residents	Resumed clinical services
Roads	18 km	9 communities	Improved market access
Footbridges	3	5 communities	Enhanced mobility during wet season
Water systems	2	2,200 residents	Reduced waterborne disease risk
Dip tank	1	200 residents	Reduced livestock disease risk

5 Conclusion

The case of Cyclone Ana in Nyanga District reveals persistent structural weaknesses alongside emerging opportunities within Zimbabwe's disaster risk management (DRM) system. Despite policy commitments to decentralized and participatory approaches, implementation across preparedness, warning, response, and recovery remains uneven, constrained by legal, financial, and institutional factors that limit community participation and local ownership.

Reforms introduced since 2022, such as impact-based forecasting, anticipatory action, and strengthened contingency planning, represent important progress, building on the baseline conditions observed during Cyclone Ana. However, the Nyanga experience shows that gaps in interpretation, coordination, financing, and operational capacity continue to undermine their effectiveness. Recovery efforts were similarly shaped by short-term funding cycles and fragmented systems, resulting in uneven outcomes across communities.

At the same time, the Nyanga experience post-storm demonstrated strong local capacity for collective action, with residents mobilizing traditional knowledge and social networks to meet immediate needs. These practices highlight existing community strengths that remain under-recognized within formal DRM structures.

Taken together, the findings point to a persistent implementation gap: while policy reforms are advancing, their translation into consistent, locally grounded practice remains limited. Strengthening Zimbabwe's DRM system therefore requires closer integration of legislative reform, sustainable financing, and institutional capacity with inclusive, community-centered approaches that embed local knowledge and participation across all stages of risk governance. By situating preparedness, response, and recovery within broader political, institutional, and socioeconomic contexts, this study underscores that effective DRM depends not only on technical systems but also on sustained investments in institutions, participation, and locally rooted knowledge that support equitable and resilient development pathways.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright

holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

- Ahmed, K.J., S.M. Atiqul Haq, and M.B. Hyder. 2023. A comparison of migrant and non-migrant households' choices on migration and coping mechanisms in the aftermath of Cyclone Aila in Bangladesh. *Frontiers in Environmental Science* 11: Article 1160394.
- Ashraf, F. 2024. Bridging hazard risk perception: Enhancing knowledge in public health. In *Proceedings of the Nineteenth Midwest Association for Information Systems Conference*, 16–17 May 2024, Peoria, Illinois, USA.
- Bamberger, M., ed. 2000. In *Integrating quantitative and qualitative research in development projects. Directions in development*. Washington, DC: World Bank.
- Barua, P., and S. Rahman. 2018. The role of traditional ecological knowledge of southeastern island communities of Bangladesh in disaster risk management strategies. *IUP Journal of Knowledge Management* 16: 1–26.
- Berman, K., and Y. Kuleshov. 2023. Assessing tropical cyclone risk in Australia using community exposure-vulnerability indices. *Climate* 11(12): Article 235.
- Bongo, P.P., P. Chipangura, M. Sithole, and F. Moyo. 2013. Dynamics of configuring and interpreting the disaster risk script: Experiences from Zimbabwe. *Jamba Journal of Disaster Risk Studies* 5(2): 1–10.
- Bubb, J., and L. Le Dé. 2022. Participation as a requirement: Towards more inclusion or further exclusion? The community disaster and climate change committees in Vanuatu as a case study. *International Journal of Disaster Risk Reduction* 76: Article 102992.
- Chanza, N., P.Q. Siyongwana, L. Williams-Bruinders, V. Gundu-Jakarasi, C. Mudavanhu, V.B. Sithole, and A. Manyani. 2020. Closing the gaps in disaster management and response: Drawing on local experiences with Cyclone Idai in Chimanimani, Zimbabwe. *International Journal of Disaster Risk Science* 11(5): 655–666.
- Collins, M., M. Sutherland, L. Bouwer, S.M. Cheong, T. Frölicher, H.J.D. Combes, M.K. Roxy, and I. Losada et al. 2019. Extremes, abrupt changes and managing risks. In *Special report on the ocean and cryosphere in a changing climate*, eds. H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, and A. Alegria et al., 589–655. Geneva: Intergovernmental Panel on Climate Change.
- Dube, E. 2020. The build-back-better concept as a disaster risk reduction strategy for positive reconstruction and sustainable development in Zimbabwe: A literature study. *International Journal of Disaster Risk Reduction* 43: Article 101401.
- Feehan, C.J., K. Falbe-Dexter, M.S. Thomsen, T. Wernberg, and T. Miles. 2024. Ecosystem damage by increasing tropical cyclones. *Communications Earth & Environment* 5(1): Article 674.
- George, L., K. Balasubramani, S. Shekhar, A. Kumar, V. Elukapally, A. Grover, D. Mahata, and A. Kumar et al. 2021. A comprehensive study on preparedness, impacts, response and recovery from tropical severe cyclonic storm "GAJA": Lessons for the future. *Journal of Coastal Conservation* 25: Article 58.
- GoZ (Government of Zimbabwe). 2018. Nyanga District disaster risk management plan (2019–2024). Harare: GoZ.
- GoZ (Government of Zimbabwe). 2021. The 2022 national budget statement: Reinforcing sustainable economic recovery and resilience. Presented to the Parliament of Zimbabwe, 25 November 2021. <https://www.veritaszim.net/node/5386>. Accessed 17 Jul 2025.
- GoZ (Government of Zimbabwe). 2022a. Assessment report on Tropical Storm Ana: Nyanga District. Harare: GoZ.

- GoZ (Government of Zimbabwe). 2022b. Fifteenth post-Cabinet press briefing: 7 June 2022. Harare: GoZ. Accessed 17 Jul 2025.
- Gutiérrez, G., Z. Stalhandske, E. Mühlhofer, D.N. Bresch, and S. Brönnimann. 2024. Impact-based forecast for critical infrastructure during tropical cyclones. In *Proceedings of EGU General Assembly Conference 2024*, 14–19 April 2024, Vienna, Austria.
- Gwimbi, P. 2007. The effectiveness of early warning systems for the reduction of flood disasters: Some experiences from cyclone-induced floods in Zimbabwe. *Journal of Sustainable Development in Africa* 9(4): 152–169.
- Hallegatte, S., J. Rentschler, and B. Walsh. 2018. *Building back better: Achieving resilience through stronger, faster and more inclusive post-disaster reconstruction*. Washington, DC: World Bank.
- Hossain, M.Z., M.T. Islam, T. Sakai, and M. Ishida. 2008. Impact of tropical cyclones on rural infrastructures in Bangladesh. *Agricultural Engineering International: The CIGR Ejournal* X. <https://cigrjournal.org/index.php/Ejournal/article/view/1036>.
- Hungwe, M.-G., W. Gumindoga, O.M. Baez Villanueva, and D.T. Rwasoka. 2024. Comparative analysis of the variability and impacts of tropical cyclones in flood-prone areas of Zimbabwe. *Frontiers in Climate* 6(1): Article 1291751.
- IMF (International Monetary Fund). 2020. Updated common evaluation framework for IMF capacity development and guidance note. Washington, DC: IMF. <https://www.imf.org/-/media/Files/Publications/PP/2020/English/PPEA2020040.ashx>. Accessed 15 Jul 2025.
- International Federation of Red Cross and Red Crescent Societies. 2022. Emergency plan of action (EPoA): Zimbabwe/Africa—Tropical depression Ana (MDRZW017). <https://go.ifrc.org/reports/15213>. Accessed 15 Jul 2025.
- Kanakakis, K., and C. McShane. 2016. Preparing for disaster: Preparedness in a flood and cyclone prone community. *Australian Journal of Emergency Management* 31(2): 18–24.
- Kanani, M.R. 2024. Impacts of funding gap on disaster management: A case study of Bangladesh. *International Journal of Innovative Science and Research Technology* 9(9): 23–35.
- Kelman, I. 2025. Disaster by choice: Why “natural disasters” rarely exist. *International Journal of Sustainability and Risk Control* 1(3): 15–18.
- Khoza, S., and G. Nhamo. 2021. Revisiting Zimbabwe’s early warning systems in the light of Tropical Cyclone Idai. In *Cyclones in Southern Africa: Volume 2—Foundational and fundamental topics*, ed. G. Nhamo, and K. Dube, 53–70. Cham: Springer.
- Kitzinger, J. 1995. Qualitative research: Introducing focus groups. *BMJ* 311(7000): 299–302.
- Knutson, T., S.J. Camargo, J.C.L. Chan, K. Emanuel, C.H. Ho, J.P. Kossin, M. Mohapatra, and M. Satoh et al. 2019. Tropical cyclones and climate change assessment: Part I: Detection and attribution. *Bulletin of the American Meteorological Society* 100(1): 1987–2007.
- Koenti, I.J. 2022. Disaster management using a contingency approach in the Special Region of Yogyakarta. *IOP Conference Series: Earth and Environmental Science* 1030: Article 012017.
- Mabumbo, D., N. Nohayi, J.C. Sanchez Ramirez, M. Dessalegn, S. Ruckstuhl. 2024. Navigating climate resilience in fragile settings: A retrospective analysis of the 2023 flood impacts, early warning, and response in Ethiopia’s Somali Region. Colombo, Sri Lanka: IWMI (International Water Management Institute).
- Maloney, E.K., M.K. Lapinski, and K. Witte. 2011. Fear appeals and persuasion: A review and update of the extended parallel process model. *Social and Personality Psychology Compass* 5(4): 206–219.
- Maly, E. 2017. Rethinking ‘build back better’ in housing reconstruction: A proposal for ‘people centred housing recovery’. *IOP Conference Series: Earth and Environmental Science* 56: Article 012025.
- Manyena, S.B., E. Mavhura, C. Muzenda, and E. Mabaso. 2013. Disaster risk reduction legislations: Is there a move from events to processes?. *Global Environmental Change* 23: 1786–1794.
- Matveeva, A. 2006. Early warning and early response: Conceptual and empirical dilemmas. The Hague, the Netherlands: Global Partnership for the Prevention of Armed Conflict.
- Mavhura, E. 2016. Disaster legislation: A critical review of the Civil Protection Act of Zimbabwe. *Natural Hazards* 80(1): 605–621.
- Mavhura, E. 2020. Learning from the tropical cyclones that ravaged Zimbabwe: Policy implications for effective disaster preparedness. *Natural Hazards* 104(3): 2261–2275.
- MSD (Meteorological Services Department of Zimbabwe). 2022. Alert: Tropical Storm Ana (moving towards the coast of Mozambique). Public weather alert issued 24 Jan 2022. Harare, Zimbabwe: MSD.
- Mukwenha, S., T. Dzinamarira, I. Chingombe, M.P. Mapingure, and G. Musuka. 2021. Health emergency and disaster risk management: A case of Zimbabwe’s preparedness and response to cyclones and tropical storms: We are not there yet!. *Public Health in Practice* 2: Article 100131.
- Munsaka, E., C. Mudavanhu, L. Sakala, P. Manjeru, and D. Matsvange. 2021. When disaster risk management systems fail: The case of Cyclone Idai in Chimanimani District, Zimbabwe. *International Journal of Disaster Risk Science* 12(5): 689–699.
- Norton, R., B.R. Jacobson, K. Venkateswaran, K. MacClune, and D. Hillier. 2023. Towards transformative action: The unfulfilled promise of resilient recovery. The Hague, the Netherlands: Zurich Climate Resilience Alliance. <https://zcralliance.org/resources/item/towards-transformative-action-the-unfulfilled-promise-of-resilient-recovery>. Accessed 8 Aug 2025.
- Ramos-Scharrón, C.E., E.Y. Arima, and K.S. Hughes. 2022. An assessment of the spatial distribution of shallow landslides induced by Hurricane María in Puerto Rico. *Physical Geography* 43: 163–191.
- Rangarirai, W., C. Marnani, and A. Rahmat. 2023. Analyzing the impact of community-based approaches on disaster preparedness to the risk of tropical cyclone induced flooding in Chimanimani District, Zimbabwe. *IOP Conference Series: Earth and Environmental Science* 1173(1): Article 012070.
- Serrao-Neumann, S., F. Crick, and D. Low Choy. 2018. Post-disaster social recovery: Disaster governance lessons learnt from Tropical Cyclone Yasi. *Natural Hazards* 93(3): 1163–1180.
- Shahi, S.K. 2022. Revisiting the impacts of Tropical Cyclone Idai in Southern Africa. In *Climate impacts on extreme weather: Current to future changes on a local to global scale*, ed. V. Ongoma, and H. Tabari, 175–189. Amsterdam: Elsevier.
- Shultz, J.M., J. Russell, and Z. Espinel. 2005. Epidemiology of tropical cyclones: The dynamics of disaster, disease, and development. *Epidemiologic Reviews* 27(1): 21–35.
- Taylor, O.G. 2023. The policy landscape and challenges of disaster risk financing: Navigating risk and uncertainty. *Disasters* 47(3): 745–765.
- Terpstra, T. 2011. Emotions, trust, and perceived risk: Affective and cognitive routes to flood preparedness behavior. *Risk Analysis* 31(10): 1658–1675.
- UNDP (United Nations Development Programme). 2022. ZRBF-BRAC crisis modifier end of project report: September 2022. New York: UNDP.
- UNDRR (United Nations Office for Disaster Risk Reduction). 2019. Global assessment report on disaster risk reduction 2019. Geneva: UNDRR. <https://www.undrr.org/publication/global-assessment-report-disaster-risk-reduction-2019>. Accessed 25 Jul 2025.
- UNDRR (United Nations Office for Disaster Risk Reduction). 2023. Cyclone Freddy puts Mozambique’s early warning system to

- the test. Geneva: UNDRR. <https://www.undrr.org/feature/cyclone-freddy-puts-mozambique-s-early-warning-system-to-the-test>. Accessed 25 Mar 2026.
- UNISDR (United Nations International Strategy for Disaster Reduction). 2009. Global assessment report on disaster risk reduction: Risk and poverty in a changing climate. Geneva: UNISDR. <https://www.undrr.org/publication/global-assessment-report-disaster-risk-reduction-2009>. Accessed 24 Mar 2026.
- Wisner, B., and J.-C. Gaillard. 2009. An introduction to neglected disasters. *Jambá Journal of Disaster Risk Studies* 2(3): 151–158.
- WMO (World Meteorological Organization). 2025. Tropical cyclone. <https://wmo.int/topics/tropical-cyclone>. Accessed 28 Jul 2025.
- Yeasmin, M., M.A. Rahman, and M. Shaibur. 2022. The effect of drinking water sources due to Cyclone Aila at Shyamnagar, Sathkhira District, Bangladesh. *Journal of Tropical Resources and Sustainable Science* 10: 1–8.
- Zheng, J., W. Han, B. Jiang, W. Ma, and Y. Zhang. 2017. Infectious diseases and tropical cyclones in Southeast China. *International Journal of Environmental Research and Public Health* 14: Article 494.