Building Climate Resilience in Mozambique

the case of Safer Schools

For a Better Urban Future

UN-HABITAT

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Foreword by
His Excellency Filipe Jacinto Nyusi,
President of the Republic of Mozambique and Champion of the African Union for Disaster Risk Management

I want to begin by congratulating the authors of this publication for its impeccable quality and the richness of its content.

With considerable technical rigor, the text explores and presents the ins and outs of the Safer School Initiative aimed at building resilient public schools, a programme led by the Government of Mozambique and implemented in partnership with several development partners.

Based on the principles of "Building Back Better", this innovative programme has brought about excellent results in the education sector. The commendable outcomes include the strengthening of the quality of our country's response to disasters. The Safer Schools Initiative is a unique experience with limitless possibilities of being replicated in other parts of the continent and the world.

In 2019, the trail of destruction left behind by cyclones IDAI and Kenneth was an important test of resilience for schools rebuilt within the context of the Safer Schools Initiative, based on the Building Back Better principle employed by UN-Habitat in Mozambique, a methodology globally advocated by the United Nations following the Sendai World Conference on Disaster Risk Reduction in 2015. All the building sites where this standard of construction was applied withstood with remarkable effectiveness the wrath of the two extreme weather events that have left behind painful memories in many Mozambicans.

The Safer Schools Initiative is much more than a simple programme of innovative architectural designs and improved construction techniques aimed at resilient rehabilitation or reconstruction of school buildings. Its benefits include significant financial resources savings.

When cyclones or floods occur, these resilient schooling facilities are activated as part of the country's emergency response, turning them into safe havens. In other words, schools temporarily cease to operate as teaching and learning venues and become facilities for the protection of human lives and the relief of the suffering of large numbers of people. Hence, school facilities built within the framework of the Safer Schools Initiative make an important contribution to efforts aimed at strengthening community resilience and adaptation in a country plagued by extreme weather events. These multi-purpose resilient facilities proved their usefulness in reducing loss and damage during the most recent cyclones.

Further, the Safer Schools model is currently inspiring the reconstruction process in other sectors such as the rebuilding of hospitals and community housing projects.

It is perhaps due to the results we are achieving in reducing loss and damage caused by the disasters that the African Union decided in February 2022 to acknowledge our performance by nominating us as the AU Champions for Disaster Risk Management- a decision that not only fills us with pride but also increases our responsibility towards our fellow citizens.

The continental recognition has further increased our commitment to work together with others to accelerate the implementation of the SENDAI Framework for Disaster Risk Reduction and the African Union Roadmap towards the achievement of the continental goals and targets by 2030.

Although over the last twenty years, significant progress has been made at national and continental level, this publication reminds us of the many challenges that persist in disaster risk reduction and climate change adaptation. This calls upon all of us to continually evaluate our strategies and actions in order to improve our response to the challenges posed by the increasingly more frequent and destructive climatic events.

To be more effective, we need to continually reinvent ourselves in order to achieve and sustain the development goals we have set for ourselves.

Filipe Jacinto Nyusi
President of the Republic of Mozambique and
African Union Champion for Disaster Risk Management
Maputo, November 2023

Preface
Ms. Maimunah Mohd Sharif,
Under-Secretary-General and Executive Director of UN-Habitat

I am very pleased that this important publication on the Safer Schools Initiative in Mozambique is seeing the light.

It celebrates over a decade of excellent cooperation between the United Nations Human Settlements Programme (UN-Habitat) and the Government of Mozambique, especially through its Ministry of Education and Human Development (MINEDH), in making schools more resilient to natural hazards in one of the most exposed countries in the world, in particular to cyclones and floods. From my visits to Mozambique, starting in April 2019, in the aftermath of Cyclone Idai, up to the recent Cyclone Freddy, I can confirm that this effort has had a major impact throughout the country. Across the affected areas, all the school classrooms that were built or re-built according to adequate climate-resilient standards, which today stand at over 3,500 all over the country, have withstood these extreme events. The schools have proved dependable in sheltering and protecting thousands of people who have been using them as safe havens, and allowing hundreds of thousands children to keep going to school in safe structures once normalcy has been re-established.

UN-Habitat established its physical presence in Mozambique in 2002, following the major floods in the Limpopo River basin in 2000 caused by Cyclone Eline, which resulted in more than 700 deaths, displaced 500,000 people and affected approximately 2million people. Since that time, UN-Habitat underlined the importance of learning how to live with floods and cyclones, considering the high vulnerability of the country to these natural hazards. It was commonplace that every year, an average of one thousand school classrooms were either destroyed or damaged by strong winds, cyclones or floods, making the recurrent costs of repairing or re-building these social facilities unbearable to the government, and with huge impact on the education outcomes. Clearly, a new approach was required to establish long-term solutions and reduce the recurrent losses and damages.

In 2006-2007 UN-Habitat built the first model of a resilient school in Maniquenique, in Chibuto District, Gaza Province. Indeed, schools are the most widely available public infrastructure across the country. They can function as temporary shelters in case of a disaster emergency, if they are built in the right way, and positively influence the construction of more resilient human settlements in general. This idea was the seed for what later became the Safer Schools Initiative, which is today a flagship Government programme funded by various partners, especially the World Bank, but also the European Union and the United Nations Children's Fund (UNICEF), a true example of climate adaptation and vulnerability reduction at scale. The same approach should be replicated in the health sector, through a Safer Hospitals Initiative, something UN-Habitat is currently working on together with the Ministry of Health, with the support from the Government of Canada and the World Bank.

The Safer Schools Initiative has been so successful that it led to the approval of the Ministerial Decree for Resilient Standards of Schools in 2021, ratified jointly by MINEDH and the Ministry of Public Works, Housing and Water Resources (MOPHRH), which ensures by law that every school in the country is built according to adequate climate-resilient standards. Under this legal provision, the Safer School Initiative was scaled-up throughout the country, thanks to the Guidelines on Resilience to Natural Hazards and Environmental and Social Safeguards in School Buildings. Building back better and resilience building is now being replicated to other human settlements' components, such as for post-cyclone housing reconstruction in Central Mozambique.

Given these achievements, we hope that this publication will allow the Mozambican experience to be known worldwide and to inspire other countries facing similar climatic threats, stimulating innovative thinking and bringing concrete solutions to the challenges of our time, so that, ultimately, human settlements become more resilient and sustainable.

Practical training of local artisans on improved construction techniques to withstand strong winds. Buzi District, Sofala Province | Source: UN-Habitat

Summary

This publication explores, step-by-step, UN-Habitat's interventions in Mozambique to increase a culture of hazard and risk resilience and, through the education sector, promote disaster risk reduction (DRR) within Mozambique's human settlements.

This publication starts with a description of the country's overall natural hazard exposure and then focuses on human settlements' vulnerability in Mozambique (Chapter 1).

In Chapter 2 it describes the first milestone of UN-Habitat's activities - the establishment of the Living with Natural Hazards approach - and its implementation through pilot demonstration buildings. It also gives examples of the construction interventions and methodology adopted in the Participation, Awareness and Didactic Approach.

The narrative of Chapter 3 analyses the education sector. It gives an outline of its historical development and the geographic distribution of school infrastructure, as well as the vulnerabilities and risk profiles. This introduces the second milestone: the start of the preparatory activities, the implementation and the subsequent scaling-up from local demonstration pilots to the national scale. It further describes how the strategic and normative frameworks for resilient school construction in Mozambique have been influenced.

The fourth chapter analyses how UN-Habitat's work resulted in the Guidelines on School Safety and Resilient School Building Codes and how these helped consolidate partnership frameworks and the scaling-up of the Safer Schools Initiative under the leadership of Ministry of Education.

The fifth and final chapter presents the validation of the Safer Schools Initiative, showing how more robust school buildings have all withstood the impacts of the strong cyclones Idai and Kenneth in 2019. This feat made the Government fully confident that the Living with Natural Hazards approach works.

The text concludes with a summary of findings, lessons learned and recommendations for further scaling up of the Safer Schools Initiative in Mozambique and a possible replication in other vulnerability contexts.

List of Acronyms

BBB	Building Back Better
BESP	Basic Schools Emergency Plan
CCCI	Cities in Climate Change Initiative
CEGRC	School Committee for Disaster and Risk Management
CLGR	District Risk Management Committee
CSSF	Comprehensive School Safety Framework
DfID	Department for International Development
DNA	National Directorate for Water
DNE	National Directorate of Buildings
DNG	National Geology Directorate
DRR(M)	Disaster Risk Reduction (Management)
ECHO	European Commission Humanitarian Aid Office
EFA	Education for All Programme
ERRF	Emergency Resilient Recovery Framework
EWS	Early Warning System
FAPF	Faculty of Architecture and Physical Planning
FDI	Foreign Direct Investment
FEWSNET	Famine Early Warning Systems Network
GACOR	Resettlement Coordination Office
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GREPOC	Post-cyclone Reconstruction Office
HCT	Humanitarian Country Team
IDPs	Internally Displaced Persons
INAM	National Meteorology Institute
INGD	National Institute for Disaster Management
IOM	International Organization for Migration
MAE	Ministry of State Administration
MDGs	Millennium Development Goals
MINEDH	Ministry of Education and Human Development
MISAU	Ministry of Health
MITADER	Ministry of Land, Environment and Rural Development
MOPHRH	Ministry of Public Works, Housing and Water Resources
OCHA	United Nation Office for the Coordination of Humanitarian Affairs
ODA	Official Development Assistance
SDGs	Sustainable Development Goals
SDPI	District Planning and Infrastructure Service
TAG	Technical Advisory Group
UCEEs	Provincial School Construction Units
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
UNIDO	United Nations Industrial Development Organization
UNISDR	(now UNDRR) United Nations Office for Disaster Risk Reduction
UNV	United Nations Volunteers
WASH	Water, Sanitation and Hygiene Programme
WFP	World Food Programme
WHO	World Health Organization
WMO	World Meteorological Organization

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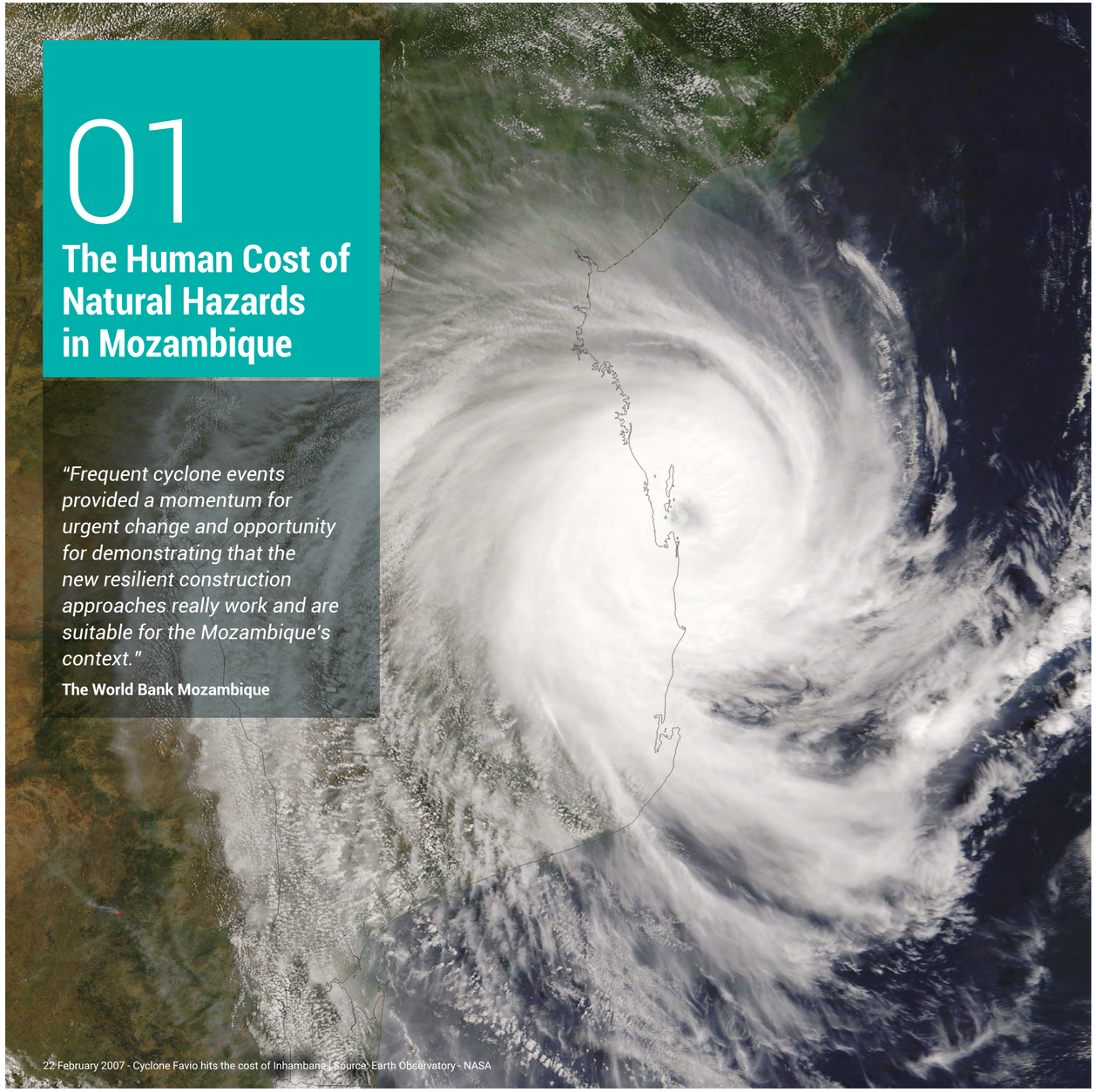


01

The Human Cost of Natural Hazards in Mozambique

"Frequent cyclone events provided a momentum for urgent change and opportunity for demonstrating that the new resilient construction approaches really work and are suitable for the Mozambique's context."

The World Bank Mozambique

22 February 2007 - Cyclone Favio hits the cost of Inhambane | Source: Earth Observatory - NASA

Introduction

Human settlements around the world are continuously changing and, notably in developing countries, are often rapidly growing. They are at the frontline of addressing and adapting to climate change whilst building resilience. Due to their complex and high concentrations of people and assets, towns and cities face the greatest challenges posed by natural and human-induced hazardous events that, as evidence has shown, are increasingly being aggravated by climate change. Mozambique is no exception to this. At the same time, Africa is the least urbanized, but most rapidly urbanizing, region in the world. Currently, 44 percent of the region's population resides in urban areas. By 2035, the region will have half of its population living in cities and will be predominantly urban by 2050. This means that an increasing number of urban dwellers will be at risk of hazardous events. Mozambique's structural vulnerability to natural hazardous events is mainly due to its geographical features and its rapid urbanisation. It has a long coastline frequently hit by cyclones, it is located downstream of nine major river basins and there is seismic threat from the Great African Rift Valley. This multitude of risks, combined with high population concentrations in vulnerable locations, has made Mozambique one of the world's countries most at risk from natural hazards.

In 2019, cyclone Idai hit Malawi, Mozambique and Zimbabwe while, six weeks later, cyclone Kenneth struck northern Mozambique. These two cyclones were among the five worst ever recorded in Mozambique, causing catastrophic flooding in their wake, killing over a thousand people, displacing thousands more and, overall, affecting close to 2.2 million people besides causing damage and losses estimated at USD3.2 billion. Between 2020 and 2022, cyclones Diane, Chalane, Eloise, Guambe, Ana and Gombe and, in 2023, cyclone Freddy have hit Mozambique twice, affecting more than one million people.

However, amidst the wide-spread devastation caused by these cyclones, some recently built structures are still standing in good condition, including several schools constructed by the Ministry of Education and Human Development (MINEDH). The construction of these schools followed the Guidelines on Resilient School Buildings developed in partnership with the United Nations Human Settlements Programme (UN-Habitat) and with funding from the World Bank. They withstood the impacts of two of the worst cyclones in Mozambique's history. This has significance beyond the sheer robustness of these buildings. These schools are the result of over 15 years of UN-Habitat's work in Mozambique aimed at reducing human settlements' vulnerability to natural disasters.

The interventions initially started with awareness raising, drawing up a catalogue of disaster-resistant building solutions, undertaking participatory risk assessments at different levels, developing national recovery/reconstruction strategies and establishing a partnership with the Government of Mozambique (GoM). A rigorous and focussed process was followed to progressively establish, among the stakeholders, a culture of resilience against the unforgiving violence of natural hazardous phenomena.

Primary School Anchilo, Nampula District, Nampula Province | UN-Habitat's resilient rehabilitation after damages caused by heavy rains in 2015 | Source: UN-Habitat, 2019

Mozambique at a glance

Overview

Total Area: 801,590 km2
› Land: **98.37%**
› Water: **1.63%**
› Coastline: **2,500 km**

Total Population (2023): **32,419,747** *(INE)*
Total Pop. Annual Growth Rate (2023): **2.5%** *(INE)*
Urban Population (2023): **11,236,003** *(INE)*
Percentage Urban (2023): **34.66%** *(INE)*
Urban Pop. Annual Growth Rate (2022): **4.22%** *(WB)*
Capital City and Population (2023):
Maputo City: **1,120,867** *(Census Mz Gov)*
Maputo Metropolitan Area: **2,541,629** *(Census Mz Gov)*

GDP Total (2022): **17,85** Billion US $ *(WB)*
GDP Per Capita (2022): **541.45** US $ *(WB)*

Percentage living below US $1.9 PPP Poverty Line (2021): **63,3%**
(Poverty & Equity Brief Mozambique Africa Eastern & Southern April 2021, World Bank Group)

Informal Workers (2020): **88%** *(OIT)*
Improved Water Supply (2020): **49%** *(INE)*
Sanitation Access (2020): **37,2%** *(WB)*

Mozambique has a population of approximately 30 million with about 60 percent living in its coastal areas. The coastline has many critical ecosystems (dunes, reefs, bays and mangroves). The remainder of Mozambique is mostly covered by savannah and secondary forest. The country faces multiple development challenges, including widespread poverty, low life expectancy and gaps in its education system. Twenty-five percent of the country's Gross Domestic Product (GDP) comes from rain-fed agriculture and 80 percent of its population relies on agriculture for their livelihoods. Fisheries and aquaculture are also critical livelihoods, representing about 40 percent of the total export earnings. Mozambique's rich biodiversity and ecosystems also support a growing tourism industry[1].

Since the beginning of the civil war (1977–1992), international aid has been important to Mozambique's economic development. Official Development Assistance (ODA) has represented, on average, some 45 percent of the state budget/ government expenditure since independence in 1975. Today, Mozambique experiences a decreasing aid dependency - from 60 percent in 1990 to 36,5 percent in 2022[2]. Mozambique's annual GDP growth has averaged 7.4 percent over the past two decades with foreign direct investment (FDI) and public expenditure driving this growth. GDP growth is projected to rise to 4.8% in 2023 and 8.3% in 2024, pushed by extractives and agriculture, leading GDP per capita growth to jump from 2.0% in 2023 and 5.5% in 2024.(AfDB, 2023).

[1] USAID – Mozambique: Climate Vulnerability Profile 2013
ECONOMIC AND SOCIAL PLAN AND BUDGET FOR 2023 - PESOE 2023

[2] Economic and Social Plan 2023 (PESOE)

Between 2005 and 2013, Mozambique experienced steady population and urbanisation growth rates of 2 and 4 percent respectively (World Bank, 2015). Urban dwellers currently only make up 34 percent of the total population of approximately 30 million.

Estimates indicate that, by 2050, the number of urban-based people will be 40 percent of the total population.

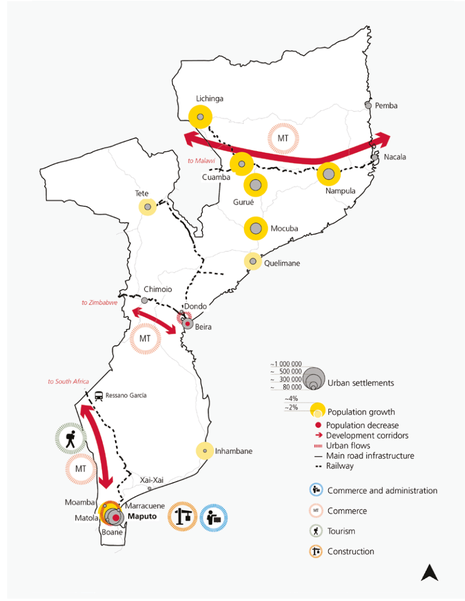
Economic growth and urbanisation have been historically skewed towards the south of the country and have been strongly concentrated in the capital Maputo which produced over 36 percent of the GDP during the last decade (INE, 2023. Maputo is indeed a key node in the national economic revival due to its strategic position at the Maputo Development Corridor and its deep-sea port which has practically no competition from other nearby national or international ports (van Drunen and Veldman, 2008). People have therefore flocked to Maputo over the years, making the Maputo Metropolitan Area with its 2 million inhabitants (almost 40 percent of the national population) the country's most populous urban agglomeration.

Maputo's poverty rates are lower than the national average (36 and 54 percent, respectively)[3]. Its services provision, GDP per capita and minimum wages are all considerably better than in other parts of the country (Tvedten, 2013; World Bank, 2015). However, the recent rapid economic expansion has mostly benefitted small élites in a few geographic areas with only moderate impacts on nation-wide poverty reduction.

Mozambique is ranked 185th out of 188 countries in the 2021 Human Development Index (HDI).

[3] Understanding patterns of climate resilient economic development Maputo: Mozambique

Mozambique's Urban Dynamics



Source: UN-Habitat, 2019

Natural Hazards:
A Regional Perspective

Mozambique borders the Indian Ocean. It has nine major rivers flowing through the country and it is located at the southern-most end of the Great African Rift Valley. These three features all pose significant hazards.

The Indian Ocean is the main source of recurrent high-intensity tropical storms and cyclones that pose a serious threat to the South-eastern Africa region as a whole and to Mozambique in particular. They trigger torrential rains and devastating floods. Due to global warming and the El Niño Southern Oscillation, tropical storms and cyclones have become more frequent and more intense.

Drought is another chronic natural hazard. It dramatically increases the vulnerability of an already poor population in terms of food security and livelihoods. In addition, limited access to safe water causes health problems in poor and crowded urban areas, resulting in higher disease incidence - the spread of COVID-19 is a recent example.

The South-eastern Africa region is exposed to recurrent and increasingly frequent hazardous weather events. These are compounded by earthquakes, volcanic activity and by anthropogenic (human-made) interventions such as land and environmental degradation and uncontrolled urbanisation. These bring risks of profound social instability, endanger critical infrastructure, will potentially cause water crises and associated devastating spread of diseases.

About 60 percent of Mozambique's population lives in low-lying areas along a 2,470 km coastline that is exposed to extreme weather events that put people, infrastructures, coastal agriculture, critical ecosystems and fisheries at risk. Although migration to urban areas is rising, two-thirds of the population still resides in rural areas with limited access to electricity and little or no access to improved drinking water and sanitation. A massive 45 percent of the population lives below the poverty line and 70 percent depends on climate- and rainfall-sensitive agriculture[4].The combination of extreme natural threats and high levels of vulnerability in cities, towns and villages increases the risk of loss of human lives besides a host of negative socio-economic impacts.

[4] USAID – Mozambique: Climate Risk Profile 2018

Mozambique's Climate at a glance

Mozambique has a tropical to sub-tropical climate and experiences a cool and dry season from April to September and a hot and humid season between October and March. Temperatures are higher near the coast and southern lowland regions than in the higher-elevation inland regions.

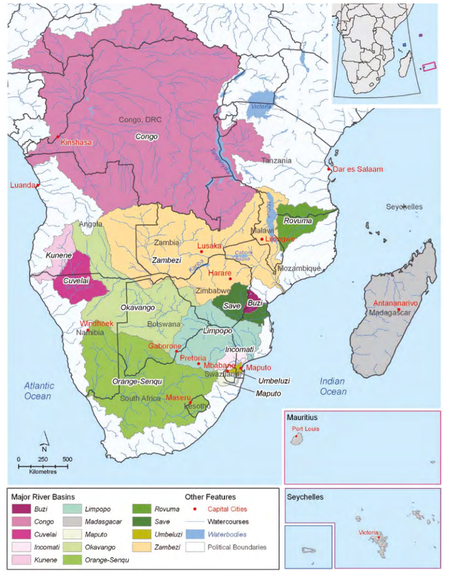
Temperature: Average annual temperatures in the warmer regions of Mozambique range from 20 to 27°C and in cooler regions from 15 to 25°C. The average annual temperature increased by 0.6°C between 1960 and 2006. Mean annual temperatures are projected to increase by 1.0-2.8°C by the 2060s and by 1.4-4.6°C by the 2090s if compared to the 1970-1999 average temperatures.

Precipitation: The wet season lasts from November to April with around 150 to 300 mm of rainfall per month in the North and 50 to 150 mm per month in the South. Average annual rainfall decreased by 2.5 mm per month between 1960 and 2006. However, the frequency of heavy rainfall events increased over the same period, with the largest increases during the wet season and in the coastal regions.

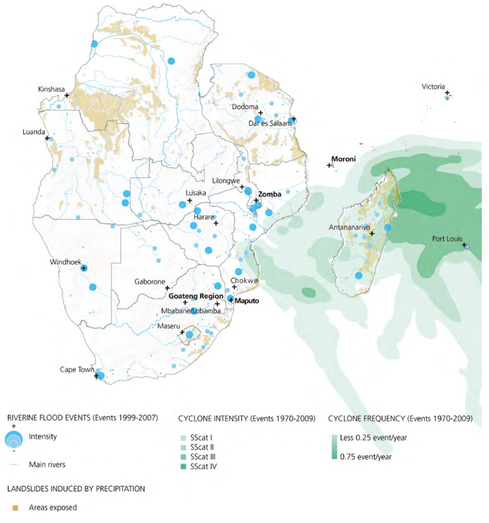
Sea level rise: With the majority of the Mozambique's coastal zone being low-lying areas, the coastline is susceptible to sea level rise. Since sea levels are projected to rise between 0.18 and 0.59 m by the 2090s, if compared to 1980-1999 levels, the risks of flood-induced displacements, food insecurity and water-related illness such as cholera (and their economic implications) are increasing.

Source: USAID, 2018

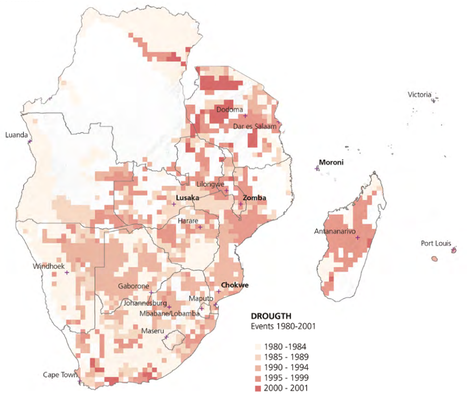
SADC Political Boundaries & Major River Basins
Source: SADC - RSAP IV 2016-2020



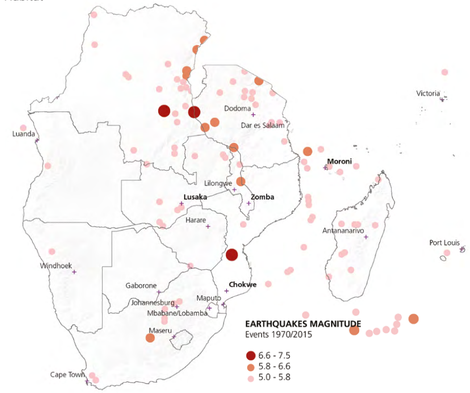
Cyclones / Floods / Landslides Overview in the Region (1970-2009)
Source: UNEP/UNDRR Global Risk Platform 2013
Map: UN-Habitat



Droughts Overview in the Region (1980-2001)
Source: UNEP/UNDRR Global Risk Platform 2013
Map: UN-Habitat



Earthquakes Overview in the Region (1970-2009)
Source: UNEP/UNDRR Global Risk Platform 2013
Map: UN-Habitat



Natural hazards and major disasters (2000-2022)

Natural hazards can become severe or extreme natural events such as floods, storms, earthquakes, volcanic eruptions etc. They only become natural disasters when human lives are lost and when livelihoods are damaged or Natural disasters can be classified by the type of hazard that provokes them: a) meteorological (cyclones/ storms), b) hydrological (floods), c) climatological (droughts) and d) geo-physical (earthquakes/ volcanic activity).

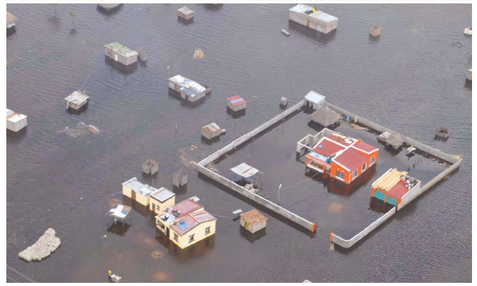
Despite disasters becoming more newsworthy the higher their death toll, their true impacts on human settlements and communities are not conveyed by just mortality rates. Indeed, injury, homelessness and displacement also deeply affect people's livelihoods and development. Natural disasters typically cause destruction of assets, often with huge economic costs. Between 1970 and 2021, 11,778 climate and water disasters were recorded, resulting in 2 million deaths and US$ 4.3 trillion in economic losses, where about 90% of the affected countries are developing countries, according to data from the World Meteorological Organisation.

Each year, approximately 10 percent of all cyclones occurring globally originate in the South-west Indian Ocean. From 1956 to 2016, Mozambique was struck by 56 devastating meteorological events with high winds and heavy rains. Statistically, the central and northern parts of the coast were the most impacted. For instance, in 2000, cyclone Elyne caused major flooding of several river basins and in particular the Limpopo River with more than 700 deaths, 500,000 people displaced and two million affected (WMO). The 2008 tropical cyclone Jokwe killed 16 people and left a trail of destruction, affecting more than 30,000 houses, many industries and electricity supply systems, while uprooting 150,000 cashew nut trees. This had severe socio-economic consequences in the

Aerial view of the damaged areas of Beira, Mozambique, on March 24, 2019.
Gokhan Balci/Anadolu Agency/Getty Images

Nampula Province, affecting a total of 250,000 people. Unfortunately, the overall response was slow due to the compounding effect of floods during the same period.

Tropical storm Dando (2012) hit southern Mozambique, affecting 51,670 people in the Maputo, Gaza and Inhambane provinces. Fortunately, prior to the flooding of the river basins, warnings were sent to the communities at risk which minimized the loss of lives. In mid-January 2012, heavy rainfall in upstream South Africa and Swaziland led to steady level rises of the Maputo, Incomati and Limpopo Rivers causing flooding in nine districts. Several communities were evacuated. But, since many roads had to be closed, rescue efforts and the circulation of goods and people were hampered. Days after this, central and northern Mozambique were hit by cyclone Funso (category 3 and 4) affecting 66,946 and 2,835 people in Zambézia and southern Nampula, respectively. Cyclone Dineo, with winds up to 130km/hr, made landfall



Floods in Chokwe 2000 | Source: UN-Habitat

in Inhambane province in early 2017 damaging 1,600 classrooms, affecting 150,000 students and causing estimated losses amounting to USD 5.5 million[5].

The 2018-2019 South-West Indian Ocean cyclone season caused unprecedented levels of damage. In early 2019, a tropical depression over

[5] CTGC, February 22, 2017

Malawi triggered widespread flooding there. The storm next moved back out to sea to become cyclone Idai which would eventually strike the coastal city of Beira in Mozambique, killing 602 people. This made cyclone Idai the deadliest ever in Africa. Idai also caused considerable damage to vital infrastructure and cut off entire communities thereby hampering rescue efforts. In Mozambique's Sofala Province, 20,000 km^2 were flooded for days with some settlements submerged under 10 meters of water, leading to a subsequent cholera outbreak of more than 6,000 reported cases[6].

Among the four disaster types, hydrological calamities are the most frequent and affect the highest numbers of people globally. From 2000 to 2019, floods were responsible for 64 percent of all natural disaster events in Africa, followed by storms at 15 percent[7]. Riverine floods are a part of life in Mozambique with flooding every two to three years, mostly triggered by the torrential rains of tropical storms and cyclones. Since Mozambique has nine major transboundary rivers which meander to its coast, the severity of floods heavily depends on rainfall quantities and water management in the upstream countries.

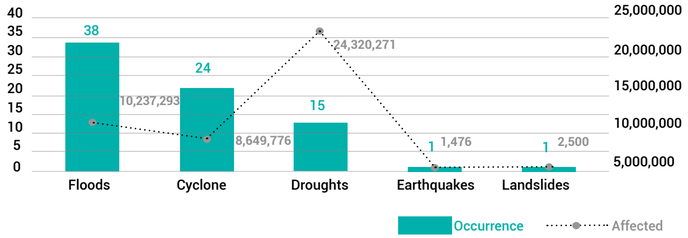
Flooding often occurs along the Limpopo, the Save and the Zambézi rivers. These rivers have population concentrations along their banks which depend on their water for agriculture. Consequently, these communities experience recurrent devastating flooding with loss of life, livelihoods and assets. River flooding, combined with sea level rise, is of great concern since Mozambique's major cities are all located along rivers and/or the coast.

In 2001, 2007, 2008 and 2010, the lower Zambezi River flooded, affecting four provinces (Tete, Manica, Sofala and Zambézia), displacing hundreds of thousands and destroying crops and infrastructure. In 2013, flooding of the Limpopo River killed more than 100 people, with 500,000 displaced and two million people affected. Heavy rains and strong winds during the 2014 and 2015 cyclone seasons led to major destruction in the

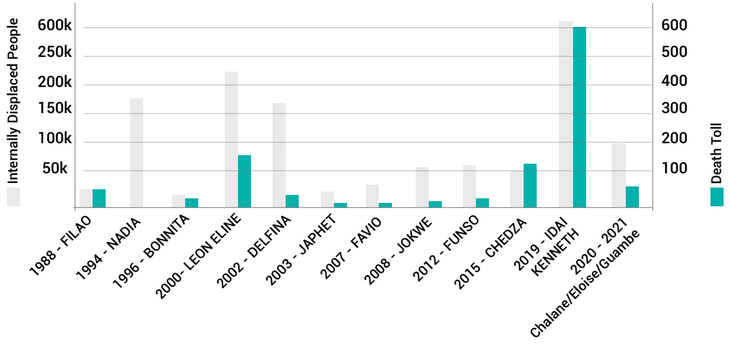
[6] OCHA Situation Report, n°18. Mozambique: Cyclone Idai and Floods

[7] Disasters in Africa: 20 Year Review (2000-2019) – – CRED / USAID

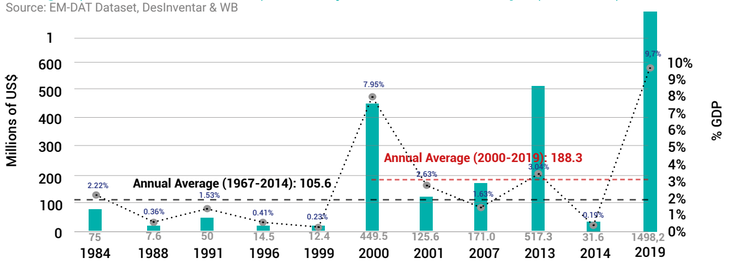
Occurrence of Disasters and Affected People in Mozambique (1956-2022)
Source: EM-DAT Dataset, DesInventar & WB



Summary of the Impacts of Tropical Cyclones hitting the coast of Mozambique (1988-2021)
Source: Accuweather / UN OCHA / Idai: UNICEF



Damages (in Millions of Current US$) **caused by Disasters in Mozambique** (1984-2019)
Source: EM-DAT Dataset, DesInventar & WB



central and northern provinces of Mozambique. The Licungo and Chire Basins in Zambézia were hit by heavy rains, winds and floods. Some 326,000 people were affected and 140 died, while 30,000 houses, 2,362 classrooms and 17 health units were totally or partially destroyed (INGD-2016). Within the education sector alone, the damage was estimated at USD6.2 million and sustainable reconstruction was estimated at USD11.3 million.

By 2050, droughts may affect over three-quarters of the world's population, and an estimated 4.8-5.7 billion people will live in areas that are water-scarce for at least one month each year, up from 3.6 billion today[8]. In Africa, the total number of disasters reached 1,839 between 1970 and 2021. They caused 733,585 deaths and $43 billion in damage to the economy. Droughts accounted for 95% of the reported deaths[9]. available atque between May and October, primarily in its southern and central regions, with a frequency of seven droughts in every ten-year period. Due to this high frequency, affected communities do not have sufficient time to recover from the economic and social impacts between one drought and the next. Moreover, droughts are often accompanied by fires which are now also increasing in number, magnitude and intensity. Droughts dramatically intensify the vulnerability of an already poor population, particularly in terms of food security and livelihoods but also because of the health risks associated with limited access to water. Since droughts can last for several years, some have extensive, long-term economic impacts and cause the displacement of large population sections in Mozambique. In 2016 and 2017, Mozambique was hit by a protracted drought which affected 850,000 children and made 1,427,000 people food insecure (UNICEF, 2019).

Among the four disaster categories, geophysical events are the deadliest, accounting for 55 percent of calamity casualties worldwide over the past 20 years[10]. According to the USGS Global Database, the 7.2 Richter Scale earthquake of 23 February 2006 had its epicentre in Central Mozambique, right at the southern end of the Great African Rift Valley. Movements between the tectonic plates had been generating seismic activity for years but, up until 2006, had not caused any loss of life. In 2016, however, four people were killed and 36 injured. At least 288 houses, six schools, a water tank, three water points and two bridges were destroyed in Machaze and Mossurizi.[11] This event showed the need to also devote attention to geophysical risks and INGD now includes earthquakes in its disaster preparedness efforts.

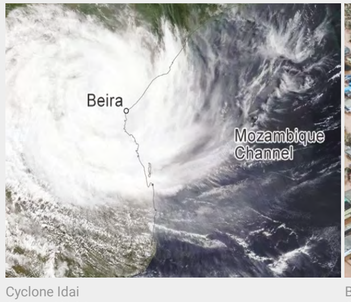
Floods in Chokwe 2013 | Source: UN-Habitat

Cyclones Idai and Kenneth*

Tropical Cyclone Idai, a Category 4 storm, made landfall above Beira, Mozambique on the dawn of 14 March 2019 causing massive damage due to high winds of more than 195 km/h. Cyclone Idai has since been labeled the deadliest cyclone in southern Africa, and the following landfall of Tropical Cyclone Kenneth just 6 weeks later, in northern Mozambique, made a record as the first time Mozambique had felt the impact of two severe storms in the same cyclone season. The impacts of climate change increase the frequency and intensity of these storms, leading Mozambique to be ranked 1st out of 180 countries in the Global Climate Risk Index for 2019.

The following year's cyclone season, 2020/21, brought 2 notable storms to Mozambique, and both impacted the same central region as Idai. Tropical Storm Chalane made landfall on 30 December 2020 with winds at 111 km/h, and affected Sofala, Manica, and Zambézia province, while still recovering from the previous season´s cyclones. One month later, on 23rd January 2021, Tropical Cyclone Eloise, a category 2 storm with winds of 140 km/h and wind gusts of over 160 km/h, hit the same region with high level of rainfall during and after the storm, 250 mm in 24 hours, which caused floods that led to an increase in internally displaced people.

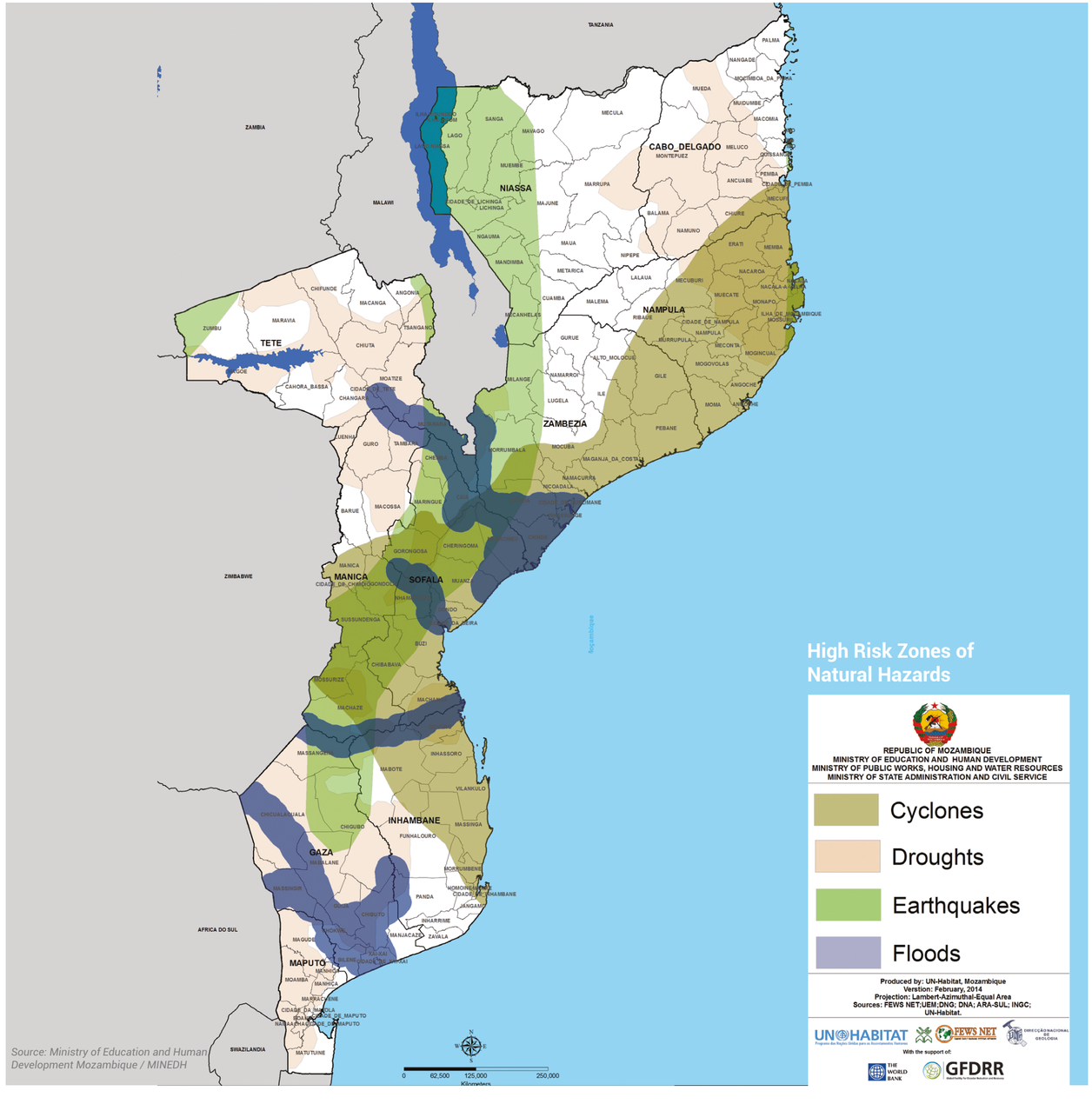
The combination of cyclones with long coastline, extensive plain below sea level, shares large rivers with neighboring countries, high population density in coastal areas, and high poverty levels makes Mozambique particularly vulnerable to cyclone related disaster



Cyclone Idai
Source: NASA

Buzi district in Mozambique
Source: Rescue South Africa

*Reliefweb. 2022. Mozambique: tropical cyclones Idai and Kenneth – emergency appeal nº MDRMZ014, Final Report



[8] Drought in numbers 2022 - Restoration for readiness and resilience

[9] https://news.un.org/pt/story/2023/05/1814787- 27/07/2023

[10] The human cost of natural disasters – UNISDR 1995 - 2015

[11] Mozambique: Earthquake OCHA Situation Report No. 2

Vulnerability of human settlements

Climate change, causing increasing meteorological and hydrological risks, combined with rapid urbanization that concentrates people and assets in high-risk areas, will result in a general increase in vulnerability levels. Natural disasters are stark reminders of inequalities since vulnerabilities differ significantly with income levels. The urban poor rank amongst the most exposed and, due to the combined impacts of rapid urbanization and climate change, this is likely to get worse in the years to come.
The urban population of Mozambique is currently estimated at 34,66 percent of the total[12], with an annual urban growth rate of three percent. The majority of Mozambicans lives in cities along the coast. These cities were established under the colonial rationale of access to resources and ports for export. Even today, the territory away from the coast remains less developed.

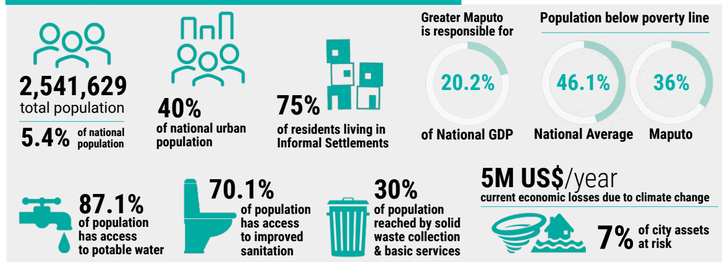
Mozambique's cities tend to do better on all statistical benchmarks if compared with its rural areas. The largest differences, however, appear when Maputo is compared to other cities or districts. Maputo has a real GDP per capita three times the national average of $320[13]. Only Maputo and Beira, the second largest city, have averages higher than the national. While cities pose large and complex issues of their own, they tend to score better on such indicators as access to basic health, education, income and gender equality. The downside is that income inequality is far higher in urban areas than elsewhere in the country. Cities, on the whole, tend to outperform rural areas. However, there is a significant share of the urban population that is actually worse off than their rural counterparts.

[12] INE 2023

[13] MOZAMBIQUE URBAN SECTOR PROFILE, UN-Habitat

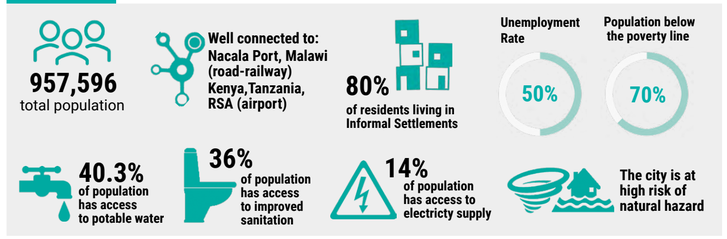
The three biggest urban settlements in Mozambique IN NUMBERS

Greater Maputo (Maputo City + Matola): coastal settlement



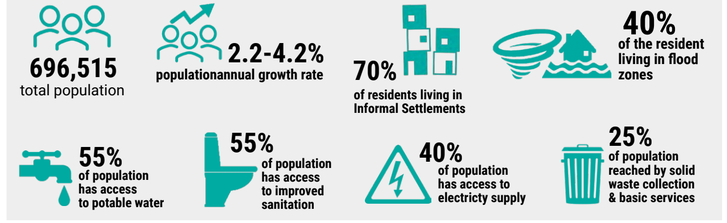
Sources: UN-Habitat, 2015; World Bank, 2015; UNICEF, 2017; INGD, 2009- 2012

Nampula

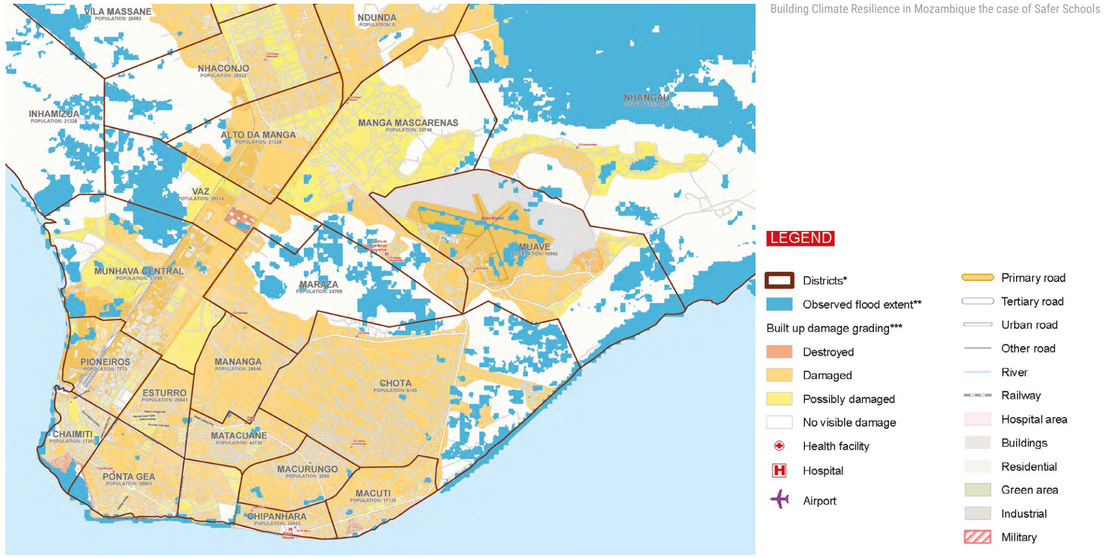


Sources: WB, 2020; INE 2023 UCLG – 2013

Beira : coastal settlement



Sources: UN-Habitat - Financing for Resilient and Green Urban Solutions in Beira, Mozambique, 2020



Source: Medecin Sans Frontiers

Beira Town - Post-Idai Flood Extent 26/03/2019

Three quarters of the urban dwellers in Mozambique are informal settlers. The urban poor, mostly found on the outskirts of cities, are surviving on subsistence agriculture or casual labour and typically have no access to basic urban services such as waste collection, electricity, water supply and sanitation. Many informal settlements sprang up during the civil war (1975 – 1992) when the cities were strained by influxes of refugees from rural areas. After peace was agreed upon and over the past three decades, urban informal settlements continued to expand because the urban population continue to grow while the well-developed, low-risk areas of the formal city were not affordable to most urban dwellers. This forced the poorest to settle in marginal peri-urban areas exposed to flood risk and offering little infrastructure, public services or economic opportunities. Mozambique's high, albeit variable, economic growth over the past decades has continued to improve conditions for the country´s wealthiest sections groups, with little benefit accrued to those living in overcrowded, informal settlements in flood-prone marshlands.

Financially constrained new urban arrivals have been forced to settle in bairros where living conditions are cheaper, but where exposure to hazards is significantly higher. Bairros typically lack social and physical infrastructures and are exposed to ever-worsening hazard vulnerability. Those Bairro residents work in the informal sector and have not benefitted from the recent economic growth because that growth is associated with economic sectors that require skilled labour (i.e. manufacturing and finance). Opportunities to enter these sectors are slim, because under-funded local education limits opportunities to the poorest population groups. Opportunities are even slimer to women as gender disparities persist, illiteracy, school drop-out rates and unemployment higher among females.

The Mozambican school network is exposed to high natural hazard threats that negatively influence school security and eudcation outcomes. About 136 districts are at high risk of at least one hazard. Among a total of 63,551 classrooms, 68 percent were in cyclone-prone areas, 73 percent in earthquake areas, 38 percent in flood-prone areas and 72 percent in areas at risk of drought (UN-Habitat, 2015).

Beira's settlements devastated by cyclone Idai | Source: IFRC

The impacts of climate change also threaten the availability and quality of freshwater resources, both surface and ground water. Despite significant progress over recent years, only half of all Mozambicans have access to improved water supply. (UNICEF,2019). As much as 76 percent of the population do not have access to improved sanitation facilities - 88 percent in rural areas, and 53 percent in urban and peri-urban areas (UNICEF,2019). Women and girls are particularly affected by poor access to safe water and sanitation. Besides having a detrimental impact on their health, poor access to water, sanitation and hygiene (WASH) threatens girls' security, well-being and education.

Informal settlements are also characterised by poorly constructed housing and service buildings. Low quality and unregulated construction are a key mortality determinant when natural disasters occur. Data from 2018 shows that 43 percent of all classrooms nationwide are constructed with local or non-conventional materials, such as clay bricks, bamboo or wattle and daub among others (DIEE-UN-Habitat, 2018).

These are mainly classrooms constructed by parents or other community members with limited or no technical support. Such structures suffer recurrent damage and pose a safety risk to children and teachers alike. This underlines the need to include safer (re)construction standards during the recovery phase after climate emergencies. The principal issue is not related to the construction materials but rather to the way in which these are applied. Communities have limited knowledge of improved construction techniques or safety standards.

Poorly built houses, offices, schools, workplaces and health facilities tend to collapse and kill people during storms and floods. In addition to loss of lives, this destruction generates significant rebuilding costs and a host of long-term social and economic consequences if people are forced to flee their homes. In the long-term, the loss of education and health infrastructures can slow economic and social development for generations to come.

Significant low-income prevalence in Mozambique has been accompanied by a general lack of public sector capacity to address rapid urban growth that occurs without official planning frameworks and standards. Responses to disasters are mostly reactive, short-term reconstruction interventions, implemented by individuals or households. Frequently, these do not use post-disaster situations as opportunities for 'building back better' or durably reducing human settlements' vulnerability. However, despite the limitations descrived above, some lessons have been learned from the big floods of 2000 and the cyclones Idai and Kenneth in 2019.

Since 2005, the central government has mainstreamed climate change adaptation and institutional reform while improving its disaster response capacity. The preventive approach to disaster management adopted by the GoM has led to the adoption of a series of new policies and strategies after the establishment of the National Institute of Disaster Management (INGD) in 1999:

EXPOSURE

The presence of people and assets in places that could be adversely affected by climate change.

IMPLICATIONS:

Informal settlements built in marshlands and along the coast experience rapid population growth, low-quality housing and informal infrastructure. As a result, these communities and structures are highly exposed to the risk of inland flooding and devastation by cyclones.

SENSITIVENESS

The degree to which a system is affected by or responsive to climate stimuli.

IMPLICATIONS:

Wide access to public amenities such as water, sanitation and health services alongside the quality of low-income housing are not guaranteed for the most vulnerable Mozambican urban bairros, which have experienced rapid increases in population density. This increases sensitivity to natural hazards such as storms and floods, both in terms of the number of people affected and the severity of the damage due to the additional strain on public services and the spread of disease.

ADAPTIVE CAPACITY

The potential or capability of a system to adapt or change to better suit climatic stimuli or their effects or impacts.

IMPLICATIONS:

Increased wealth across Mozambique over the past two decades is reflected, among others, in rising home ownership even though the high level of inequality remains. This suggests that the rich benefit most from the recent GDP growth. However, a very modest increase in adaptive capacity occurred across the country, while education and training improved with rising secondary enrolment rates. Climate change and disaster risk reduction awareness programmes are increasingly being established. DRRM committees (Comités Locais de Gestão do Risco de Calamidades (CLGRC)) in vulnerable bairros have been established to provide structure to DRRM activities.

Aerial view of Beira's settlements devastated by cyclone Idai | Source: UNICEF

- **National Plan of Prevention and Mitigation of Natural Calamities (2006);**
- **Master Plan for Disasters Preparedness and Mitigation (2006 - 2016);**
- **National Adaptation Programme of Action (2007);**
- **National Climate Change Adaptation and Mitigation Strategy for the period 2013–2025 (2012);**
- **Master Plan for Risk and Disaster Reduction 2017–2030;**

And more recently:

- **Disaster Risk Management and Reduction Act 10/2020, and;**
- **Regulation of the Disaster Risk Reduction and Management Act 76/2020;**
- **Annual Contingency plans;**

As a result of high exposure and sensitivity levels, combined with low levels of adaptive capacity, Mozambique's human settlements are extremely vulnerable to the impacts of climate change.

Natural hazards impact in diversified and deep ways on national development. Continuous alternations of flood and drought play havoc on primarily agriculture-based and climate-dependent rural livelihoods while variable rainfall and saline water intrusion from sea level rise create water stresses in some areas and flooding in others. Extreme climate events also affect fishery and tourism revenues, especially in coastal cities. But most of all, with every rainy season Mozambique suffers substantial damage to its public physical and social infrastructures. On average, at the national level, annually about 57,000 students are affected and 540 classrooms damaged by natural hazards (Deltares, WB, 2018). The impact of the 2019 cyclone season alone, with cyclones Idai and Kenneth, affected 383,000 students and destroyed or partially damaged more than 3,300 education facilities (PDNA, 2019) and in 2023 about 1.1 million people were affected by Freddy's double landfall in Mozambique (OCHA, Flash Update, No. 12 (as of 28 March 2023). Finally, given the hazard probability and the extreme levels of vulnerability in Mozambique, the risk equation scores 7.2 on a scale of 0 to10 of the INFORM Global Risk Index 2022.

Raising vulnerability awareness is expected to produce a reduction in the vulnerability of the population. Although economic and social infrastructures may still be destroyed during future disasters, there is a tendency towards reduction in human losses. While neither geographic location nor hazardous event magnitude can be altered, some activities can change the impact of hazardous events: warning systems, effective evacuation procedures, response systems and buildings' strength. Vigorous policies are required to reduce low-income human settlements' vulnerabilities.

In view of the importance of both health and education to development, a high priority should be given to (inter)national efforts to protect health and education infrastructures from disaster damage or total destruction. This is why programmes like the Safer Schools Initiative should be fully supported and its experiences shared for worldwide replication.

Build to last

Most sectors of the Mozambican economy suffer significantly from disaster shocks, and they have sizable repercussions for the country's budget. Assets worth approximately 37 percent of the total GDP are exposed to two or more natural hazards. In practice this translates into a 1.1 percent average annual GDP loss. The costs of the floods of 2000 were estimated at almost USD450 million (at current values) or nearly nine percent of the GDP. In 2013, a flooding Limpopo River basin caused damages exceeding USD517 million (at current values), equivalent to over three percent of GDP. In 2019, the total cost of recovery and reconstruction was estimated at 2.9 billion US dollars for the 4 provinces of Sofala, Manica, Tete and Zambezia. The additional needs in Inhambane which was also affected by Idai and in Cabo Delgado and Nampula which were affected by cyclone Kenneth, raise the total recovery needs to 3.2 billion USD (PDNA, 2019). It is estimated that annual economic losses between 1967 and 2014 - a period marked by severe and prolonged droughts and devastating floods - averaged USD105.6 million but grew to USD188.3 million between 2000 and 2014[14].

Despite a proactive approach on climate change and natural hazards, the government needs technical and financial assistance to identify and implement durable and sustainable solutions to mitigate the impacts of natural hazardous events in the long-term and to avoid future protracted and repeated emergency situations. Although technical assistance and financial support have been provided over the years, especially in the form of international aid, this happened predominantly in the aftermath of the more serious disasters.

Evidence from analyses of DRR - a systematic approach to identifying, assessing and reducing the risks of disaster - shows that worldwide international DRR financing over the past 20 years has mostly focused on emergency responses to massive, sudden-impact disasters which had significant media coverage. Slow onset disasters, such as droughts are highly detrimental to the socio-economic fabric of a nation but often receive little or no funding.

While Mozambique's disaster losses over the past 30 years amounted to more than USD40 billion[15], overall funding spent on disasters are a mere fraction of the total development aid. Funds committed to reducing the risk of future disasters are an even smaller proportion. For example, in this 30-year period, the international community only committed just over USD8 billion in aid to Mozambique. Of this, USD1.1 billion was allocated to post-disaster reconstruction and only USD40 million (3.7 percent) to future risk reduction. Clearly, DRR has received a very low priority, reflecting the predisposition of the international community towards the more visible humanitarian response and reconstruction funding, rather than prevention.

For every USD100 development aid spent in Mozambique, just 50 cents (USD1.5/capita) has been invested in defending that aid from the impact of future disasters. Adding to that, post-disaster financing has been fragmented over many and often uncoordinated projects, consistently multiplying administrative costs. One US dollar invested in preparedness can save seven US dollars in response and reconstruction (OCHA,2014). Hence, the more funding invested in prevention, the less will be needed for future emergency responses.

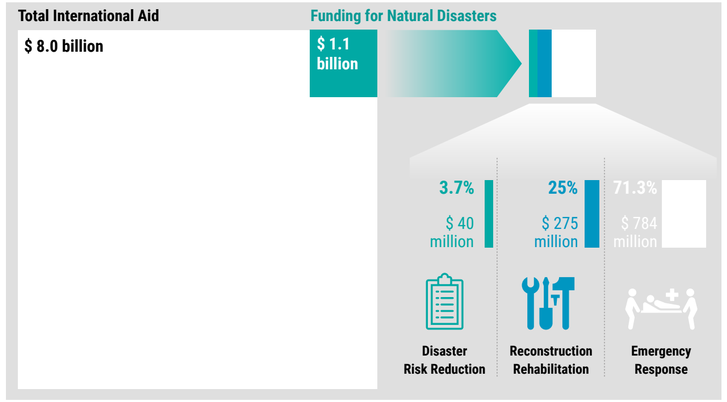
From the Hyogo Framework for Action (HFA), the international community's blueprint for DRR, and the New Urban Agenda it is increasingly clear how risk and development are moving hand-in-hand. For any country that experiences the combination of low levels of government revenue and high degrees of disaster risk, it is crucial to change the approach and direct the majority of efforts and funds towards preparedness and prevention in order to reduce disaster impacts and to save on emergency responses. This would result in less and less funding needed for response and reconstruction, while more could be directed towards further preparedness and development. In other words, DRR should be regarded as a development issue, rather than a humanitarian concern.

Training on Safer Construction for Earthquake Prone Areas
Source: UN-Habitat

[14] Mozambique Disaster Risk Management and Resilience Program Technical Assessment Report February 20, 2019

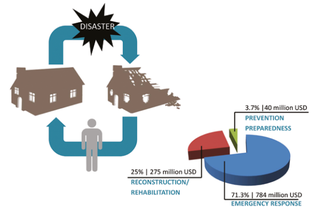
[15] Mozambique Disaster Risk Management and Resilience Program Technical Assessment Report February 20, 2019

Disasters Financing In Mozambique As A Proportion Of Total International Aid

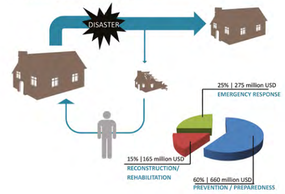


Source: Financing Disaster Risk Reduction | A 20 year story of international aid , 2013

This is the actual scenario:

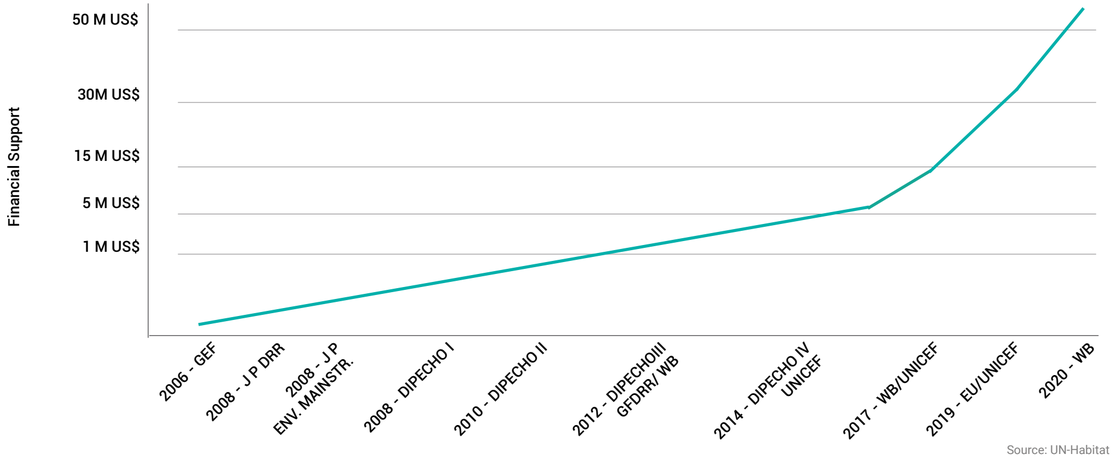


This could be the future scenario ...



Source: UN-Habitat

Funds invested on DRR projects in Mozambique with UN-Habitat work (2002-2021)



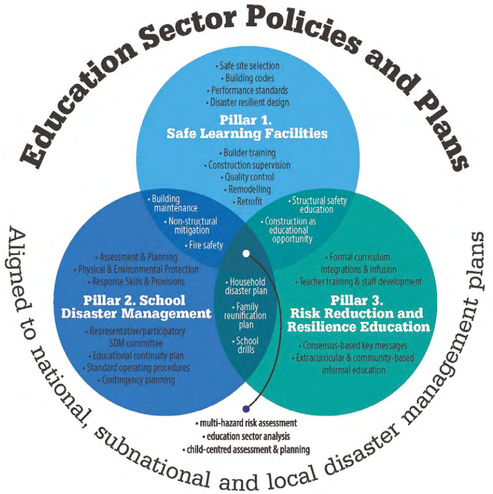
Source: UN-Habitat

From this perspective, The Comprehensive School Safety Framework (CSSF), finalised in 2014 and supported by UN agencies and other development actors, aims at merging humanitarian and development actions. It originated from a necessity to:

- Promote DRR (Hyogo Framework for Action 2005-2015) throughout the education sector along with education for sustainable development (International Decade for Education for Sustainable Development);
- Assure universal access to quality basic education (Sustainable Development Goals, Education for All, Global Partnership for Education, Education First); and
- Incorporate risk reduction into the Millennium Development Goals for education.

The Comprehensive School Safety Framework (CSSF) aims at providing a unified focus for child-centred and evidence-based efforts to promote DRR throughout the education sector and to ensure universal access to quality education. Regardless of the context, schools can serve a role in increasing communities' hazard awareness and engaging people in DRR. The CSSF seeks to advance the goals of the Worldwide Initiative for Safe Schools and the Global Alliance for Disaster Risk Reduction and Resilience in the Education Sector by promoting school safety as a priority area of the post-2015 frameworks for sustainable development, risk reduction and resilience.

The work implemented by UN-Habitat under the Safer Schools Initiative finds its contextualization within the Comprehensive School Safety Framework (CSSF) as an effort to '…contribute to safer and more resilient human settlements, using school building as an entry point…'. During its 20-year work on DRR in Mozambique, UN-Habitat has aimed at building and consolidating a culture of resilience not only in the built environment, but at all levels - social, political and operational. The concept of a school building that lasts over time is not only related to the construction withstanding the impact of a hazardous event, but also suggests gradual step-by-step community-oriented work focused on durable solutions contributing to long-lasting development.



Source: Towards Safer Schools Construction - A community based approach / Global Alliance for DRR & Resilience in the Education Sector

Global Education and School Safety Initiatives

Millennium Development Goals (MDGs)	In 2000, the United Nations adopted the Millennium Development Goals (MDGs), prioritising universal primary education by 2015 as the second highest priority, following the eradication of extreme poverty.
Education for All (EFA)	Initiated through the 2000 Dakar Framework for Action and coordinated by UNESCO, EFA was a global movement to provide quality basic education to all children, youth and adults by 2015.
Hyogo Framework for Action (2005) Sendai Framework for Action (2015)	In 2005, the United Nations Office for Disaster Risk Reduction (UNISDR) coordinated the first 10-year framework describing the roles of different sectors and actors in disaster risk reduction, with the goal of substantially reducing losses by 2015. Priority Action 3 supported the use of knowledge, innovation and education to build a culture of safety and resilience at all levels.
DRR Begins at School	This UNISDR-led campaign seeks to integrate disaster risk reduction into national and local curricula and to further promote school resilience to natural hazards.
Child-Friendly Schools	UNICEF's 2009 Child-Friendly Schools model aims to improve education quality and learning outcomes by addressing student school environment, curriculum and teaching processes.
Sustainable Development Goals (SDGs)	In 2012, the UN Conference on Sustainable Development (Rio+20) led to renewed political commitments and efforts to align Sustainable Development Goals (finally adopted by the UN General Assembly in 2015) with the UN development agenda. The efforts have highlighted how disaster risk reduction is a fundamental component in sustainable development. These efforts have also called for a shift in focus from mere access to education to quality education, including safe buildings that are conducive to learning.
Comprehensive School Safety (CSS)	This framework for climate-smart disaster risk reduction in the education sector was finalised in 2014. The framework is supported by UN agencies and development actors, and aims to bridge humanitarian and development action. The framework is based on three pillars.

The Role of UN-Habitat in Mozambique

Since 2002, UN-Habitat in Mozambique has worked on a sustainable and resilient urban future, developing and implementing a country programme based on priority areas defined by the Government of Mozambique, development partners and the main global development agendas. Currently, UN-Habitat Mozambique's three programme pillars are:

1. **Sustainable urbanisation;**
2. **Disaster risk reduction and climate change adaptation;**
3. **Security of land tenure and affordable housing.**

UN-Habitat has a long history in Mozambique and has gained trust and credibility from the government and different partners for its work in DRR, urban planning, resilience building and housing. The work carried out comprises technical advisory and normative services, a broad array of publications, pilot construction projects (schools, health posts, a radio station, housing etc.), slum upgrading as well as plan and policy development besides training of local, provincial and national staff. UN-Habitat has supported strong community-based and participatory approaches with local communities and authorities included in all its activities in Mozambique.

Since the 2019 cyclones, UN-Habitat has scaled up its projects and programme activities in two crucial thematic areas (Building Back Better and Resilience Building) to assist Mozambique with technical assistance in the sustainable recovery of human settlements and their communities. It has signed a Memorandum of Understanding with the Post-cyclone Reconstruction Cabinet (GREPOC) towards providing technical assistance for: a) resilient housing recovery; b) resilient public infrastructures; and c) integrated urban and metropolitan planning through participatory approaches.

Practical training of local artisans on improved construction techniques. Nhamatanda District, Sofala Province | Source: UN-Habitat

02

Disaster Risk Reduction in Mozambique:

From a concept to a pilot

Maniquenique School was designed by UN-Habitat to be working as a safe haven during floods | Source: UN-Habitat

Introduction

After the massive floods of 2000, a coordinated effort between the Government of Mozambique, the United Nations and NGOs was established for the preparation of plans and strategies to reduce the impacts of future cyclones, floods and drought. UN-Habitat joined Mozambique's DRR efforts in 2002 with two projects to reduce flood vulnerability: a) a subregional initiative in the Limpopo River basin's riparian countries Botswana, Mozambique, South Africa and Zimbabwe; and b) a project targeting flood-prone slum areas in the urban settlements Maputo, Chókwè, Tete and Quelimane. Through participatory action plans, awareness building, training, capacity strengthening, new strategies and concrete interventions, UN-Habitat became deeply involved in Mozambique's disaster management.

During the cyclone and flood cycles of 2007 and 2008, approaches to DRR were consolidated in cooperation with the Shelter Cluster - a working group of government institutions and NGOs seeking to organise emergency responses and coordinate early recovery. UN-Habitat also built strategic partnerships with the Faculty of Architecture and Physical Planning (FAPF) of the Eduardo Mondlane University in Maputo, particularly through its Centre for Habitat Studies and Development. FAPF participated in the development of the project's terms of reference, in the formulation of the diagnosis methodology, as well as in the development of guidelines and building codes/standards. The partnership provided important contributions to slum upgrading, territorial planning and architectural innovation for disaster mitigation. Strengthening this partnership (which now also includes the university's Faculty of Engineering) is instrumental to ensuring the transfer of technical knowledge gained through the solutions, tools and strategies developed.

Community consultation I Source: UN-Habitat

The programme involved two crucial aspects: participation and innovation. UN-Habitat established a participatory planning approach which is now almost fully institutionalised. By involving the targeted communities in the decision-making, while also including local and central authorities, academia, civil society and the private sector, the local population became empowered and achieved the very sense of ownership that makes local interventions more sustainable. Importantly, all solutions identified were generated by the communities themselves. Between 2000 and 2010, UN-Habitat introduced innovative and alternative approaches to increase human settlements' resilience to natural disasters by focusing on the education sector.

One example is the 'Living with Natural Hazards' approach which, if correctly applied, can avoid the resettlement of people living in hazardous areas. Other interventions consisted of 'Building Back Better' (BBB) in flood and cyclone-affected areas and the mainstreaming of rainwater harvesting in arid zones. To achieve these objectives, didactic tools have been produced to raise awareness among all levels and to transmit often complex concepts through simple messages. The solutions identified have been implemented through on-the job training of local communities and through workshops. Some of these training materials are now recognised at the international level and are widely being disseminated.

These activities also proved helpful towards informing public sector decision-making in Mozambique, notably for the preparation and (re) definition of key policy, strategic and legislative tools in the field of DRR; again, with a special focus on school facilities.

The living with natural hazards approach

Given the increasing number of internally displaced persons in Mozambique, primarily driven by natural disasters and the severity of climate change impacts, the government has recognized the need for a strategic approach. In this regard, the Policy and Strategy for the Management of Internally Displaced Persons (PEGDI, 42/2021) has been approved. However, it is crucial for the government to also focus on long-term solutions.

Adapting to and coping with natural hazards is often more sustainable, and, therefore, it should become the government's primary focus in the years to come. By proactively addressing the impacts of climate change and investing in disaster preparedness and mitigation measures, the country can better protect its population and reduce the likelihood of large-scale displacements caused by natural disasters. This integrated approach will contribute to the overall well-being and resilience of communities across Mozambique.

The Living with Natural Hazards approach shows that it is possible to significantly reduce communities' vulnerability with an integrated approach. But this requires information dissemination, advocacy, training, awareness building, innovative building designs, and public regulations.

The partnership between UN-Habitat and INGD (National Institute for Disaster Management) played a key-role in building trust by and among governments at the national and local levels in the first component of the Living with Natural Hazards approach: the 'Living with Floods' strategy. This strategy greatly raised awareness of and enhanced standards for (re) better in cyclone-prone areas. The partnership adapted existing UN-Habitat didactic materials for flood and cyclone awareness and disaster preparedness. INGD disseminated these in large quantities. Awareness raising and participatory planning became the pillars of working with communities and teaching them how to live and cope with natural hazards.

During the first decade of 2000, funding from the European Commission Humanitarian Aid Department's Disaster Preparedness Programme I and II (DIPECHO) and collaboration with UNDP allowed UN-Habitat to implement several pilot demonstrations of the Living with Natural Hazards approach, especially from a construction perspective. Different solutions for adaptive construction were developed and tested to make housing and infrastructure more resistant to different kinds of natural hazards.

Since 2021, UN-Habitat is implementenig a USAID funded project in Sofala province to build multi-purpose "support platforms", intended as public infrastructure buildings (e.g. school, community warehouse, market, health center), Because of its construction features, these public buildings/ infrastructures serve a "dual purpose": 1) to serve their primary purpose during regular times; 2) to be used as a shelter/safe haven during cyclone and/or flood emergencies, thanks to its solid structure and good location.

Card Game to teach communities how to "Live with Floods"
Source: UN-Habitat

Card Game to teach communities how to "Live with Floods" /
Source: UN-Habitat

Overview of Major Disasters 2000-2013

2000: Cyclones Eline and Gloria and Floods
Gaza / Sofala / Manica
Two million people affected *(WMO,2000)*
Estmated US $500 million damage *(Meteo France,2000)*

2006: Earthquake
Manica
Damaged: **288** houses, **six** schools, **three** water points *(INGD,2006)*

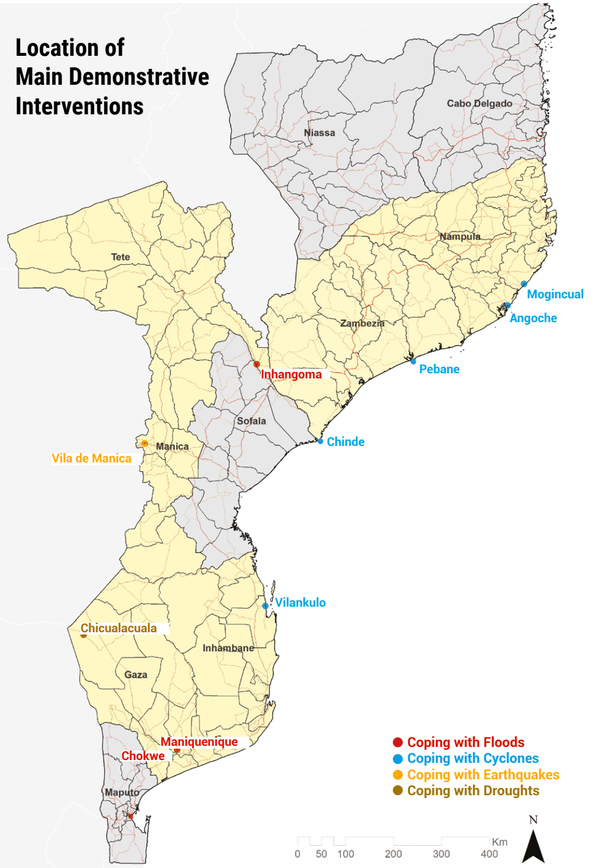
2007: Cyclone Favio and Floods
Inhambane
160,000 people affected *(FEWS, 2006)*
Damaged: 130,000 houses, **130** schools *(UNICEF,2006)*

2008 : Cyclone Jokwe
Nampula
250,000 people affected *(UN Country Team,2008)*
Destroyed: 9,316 houses, **80** schools, **one** bridge *(OCHA,2008)*
Damaged: 3,220 houses *(OCHA,2008)*

2012 Cyclones Dando, Funso and Irina
Maputo / Gaza/Inhambane/Zambezia
159,718 people affected
Destroyed: 28,000 homes destroyed
Damaged: 822 classrooms, **33** health units, **68** houses *(OCHA, 5 Apr 2012 / UNCT 2012 /PDNA UN-Habitat, Apr 2012)*

2012-2013 Floods (October to January)
Gaza/Nampula/Zambezia
420,000 people affected
250 classrooms affected *(Gov of Mozambique)*

Location of Main Demonstrative Interventions



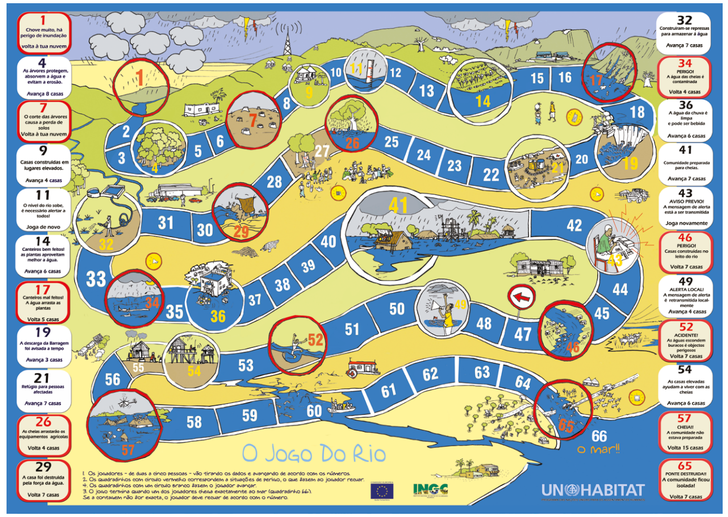
Source: UN-Habitat

Working with communities

Awareness and Didactic Materials

Awareness raising and didactic materials belong to the non-structural measures of DRR. The challenge with many non-structural measures lies in involving and securing the agreement of the institutions and communities. It includes the provision of resources for awareness raising and preparedness activities over many years, often without any hazardous event actually occurring. This is a challenge because the memory of disasters tends to fade over time. Most non-structural measures are designed to minimize rather than to prevent damage. However, many prefer the greater visibility of structural measures that show immediate physical outcomes. Generating attitude and behaviour changes takes time and investments in broad-based communication and consultation. Since 2003, UN-Habitat has developed several tools for awareness building in the areas of preparation for and adaptation to natural hazardous events, as well as recommendations on technical innovation for construction and infrastructure solutions in vulnerable settlements.

Sometimes the River and The Change are two animated short movies produced by UN-Habitat and its partners as part of awareness building, risk reduction and adaptation to climate change in Mozambique. These short movies have even been played via a mobile cinema system in the most remote communities of the country. Booklets have been prepared that, in simple and visual language, explain natural disasters and give recommendations on improved construction of buildings in either traditional or modern materials. This highly successful booklet series includes: **Learning How to Live with Floods** - a manual associated with a card game to familiarize children and community members



The River Game | Source: UN-Habitat

with the floods, **Building with the Winds** - simple recommendations on how to build in cyclone-prone areas, **Keeping the Water** - explaining rainwater harvesting techniques, **Building in Earthquake-Prone Areas, Contributions to Participatory Planning** describing inclusive planning processes in six easy steps, and My Village - short stories for community radio broadcasts seeking to stimulate a sense of belonging among resettled families. Posters were produced to create awareness in flood-prone areas and were reproduced in a small booklet for distribution in schools. A striking product is the River Game - a card game associated with the booklet **Learning How to Live with Floods** which, through play, teaches communities how to deal with floods.

The recommendations and technical solutions proposed and tested in the pilot demonstrations played important roles in involving and training communities as well as local builders. These tools and design solutions have been the main aspects of UN-Habitat's conceptual framework to explain complex DRR concepts and to raise awareness at all levels while providing contextualised solutions for long-term sustainability.

Participatory planning

One of the main principles of the **National Policy for Disaster Management** is to make vulnerable communities relevant in the planning, programming and implementation of disaster management activities through an integrated approach that combines prevention with development interventions.

UN-Habitat's participatory planning in Mozambique, which includes working with communities, local authorities and government technicians from the central, provincial and district/local levels, helped the development of methodological tools based on six sequenced phases. The first two steps cover the description and mapping of the current situation in the study area. Step three defines the existing problems. Step four identifies possible solutions.

Step five is the formulation of an action plan, while step six is the preparation for implementing the priority interventions. At the end of this exercise the community has an agreed action plan for implementing the interventions. Moreover, the plan can also serve as a valuable local planning tool at the district level that can be integrated into plans at the provincial, regional and national levels.

UN-Habitat has assisted communities, local authorities and the governments of Botswana, Mozambique, South Africa and Zimbabwe in the preparation and dissemination of **Guidelines for Participatory Local Development Planning.** It presents in a clear manner the sequence of planning. It can be used for other local development projects involving the targeted population and local authorities.

The construction of an elevated school in flood prone Maniquenique, which will be examined in detail in the following section, constitutes a prime example of the above approach. The full involvement and commitment of the community was vital for the success of this project in which women took the lead. Its implementation lasted eight months and a site supervisor was hired to guide a team of builders from the community. The selection of school buildings as entry point to increase communities' resilience to natural hazards was the outcome of participatory planning sessions and exercises during which the communities pointed out the importance of this type of building in their daily lives and traditions.

Mapping the risks

Participatory planning exercises also found application and further development in several risk mapping activities such as, for example, a sub-regional project implemented in the Limpopo River basin from 2004 to 2007 aiming at the development of participatory land use tools and plans for reducing the impacts of floods. Funds provided by the Global Environmental Facility allowed UN-Habitat to apply territorial planning and flood risk mapping through satellite imaging, aerial photo interpretation and land cover classification within a dedicated GIS environment.

Card Game representing a participatory planning session| Source: UN-Habitat

Participatory Construction of the Elevated School of Maniquenique, Gaza Province | Source: UN-Habitat

Pilot demonstrative interventions

Technological Innovations

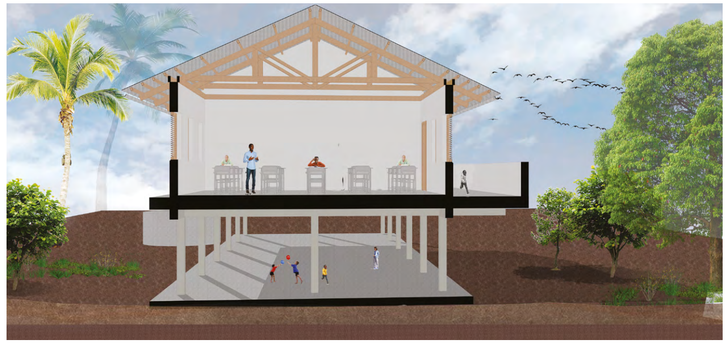
Between 2002 and 2015, after awareness raising on the Living with Natural Hazards approach, UN-Habitat moved from concept to construction through pilot demonstration buildings, both schools and housing, applying an array of different solutions. Elevated platforms, reinforced roof structures, vaulted roof shapes, A-shaped wooden structures, reinforced brick patterns, ring beams, lintels and materials such as ferro-cement and stabilized soil blocks were tested to find the most effective and sustainable options. These pilot interventions were carried out in different areas and addressed different kinds of hazards.

One of the adaptive ideas was the concept of 'dual purpose' buildings, mainly developed under the Safer Schools Initiative. Schools, besides their primary educational function during normal times can also serve as venues where vulnerability reduction and resilience knowledge is taught to adults and children to enhance community awareness (the soft component). If adequately designed and built, schools can also serve as a shelter or safe haven, both during and after emergencies. Admittedly, this dual-purpose function proved not always optimal because it tends to result in longer schooling interruptions for pupils, but it brought an innovative added value to schools in DRR and preparedness approaches.

Dual Purpose Building

Because of its construction features, civil infrastructures serve a "dual purpose":

1) the buildings serve they primary purpose (e.g. school) during regular times;
2) the buildings can be used as a shelter and safe-haven during cyclone and/or flood emergencies, due to its structure and location.



Elevated School in normal condition / Source: UN-Habitat

Elevated School during emergency | Source: UN-Habitat

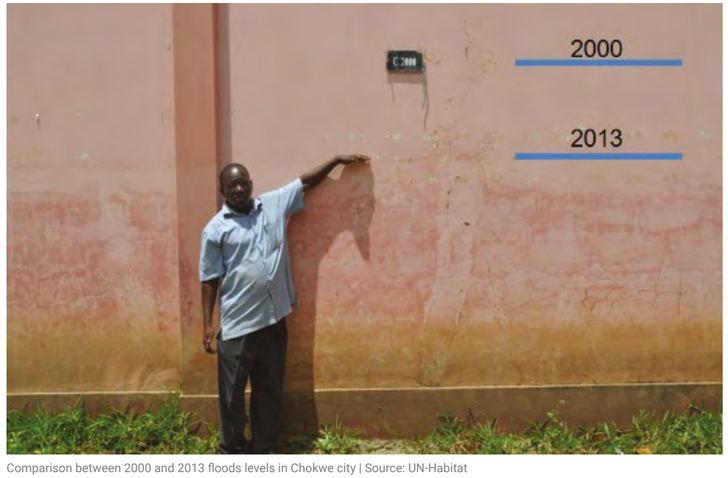
Elevated Radio construction process | Source: UN-Habitat

Coping with floods: impacts 2000-2013

Mozambique's Gaza and Tete provinces, crossed by the Limpopo and Zambezi rivers, respectively, were the areas most affected by devastating flood between 2000 and 2010. In 2000, the Limpopo floods left 1,500 km2 destroyed, forced the evacuation of hundreds of thousands, wiped out crops and livestock, while over 100,000 families also lost their livelihoods. Aid and assistance from the government and the international community was slow to get through.

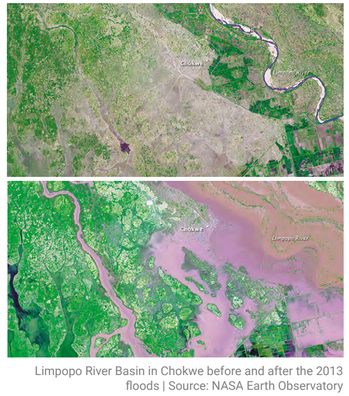
In 2007, torrential rains throughout the Southern Africa region led to overflowing rivers, pressure on dams and wide-spread flooding in central and southern Mozambique. The Zambezi, a flood plain river with three major dams burst its banks. The National Institute for Disaster Management activated its national disaster response plan and began evacuating people from low-lying areas in the river basin . But the rains continued and, according to the government (INGD, 2007), caused the further displacement of some 74,000 people requiring the temporary relocation of 29,000 in accommodation and resettlement centres which had been established after the 2001 floods. The most affected provinces were Zambezia, Sofala, Manica and Tete, where flooding caused destruction of countless houses, 130 schools, four health centres, roads, bridges and 45,000 ha of crops. Throughout the affected areas diarrhoea, malaria and cholera incidence increased dramatically.

The overflowing of the Limpopo River that hit Mozambique in 2013 triggered memories of the devastating floods of 2000 that had struck the same area. Flooding started in October 2012 and continued until April 2013. Heavy rains in January 2013 lasted more than one week and significantly increased the levels of the Limpopo, Incomati, Inhanombe and Save rivers in the South



Comparison between 2000 and 2013 floods levels in Chokwe city | Source: UN-Habitat

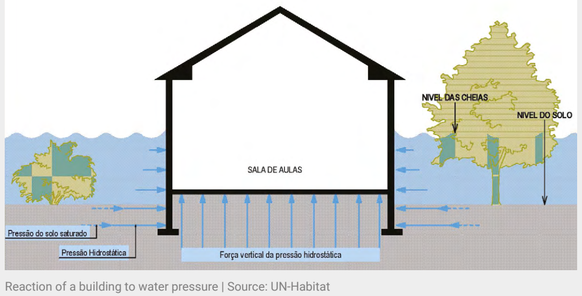
and of the Zambezi, Pungoe and Buzi rivers in Central Mozambique. As the impact of the floods rapidly increased, the government issued a range of orange emergency alerts, later raised to red alert. Maputo City and the Gaza, Zambezia and Inhambane provinces were the most affected, but also other areas such as Nampula, Niassa and Cabo Delgado with the latter experiencing a cholera outbreak. Flood waters displaced many, inflicted significant damage to homes, livelihoods and trade as well as to basic social services (schools and healthcare centres) and infrastructure (roads, bridges, electricity and drainage systems). The Government indicated that almost 420,000 people had been affected. A total of 119 people lost their lives with 17 additional deaths due to a subsequent cholera outbreak.



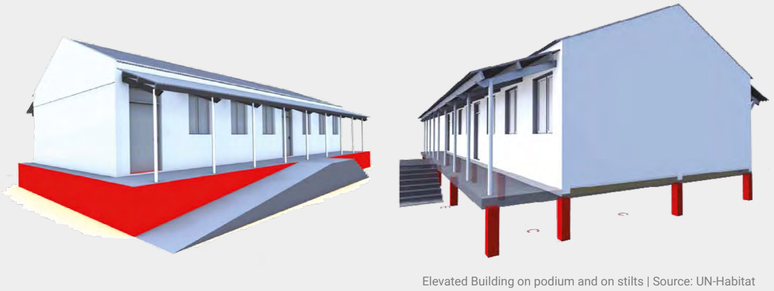
Limpopo River Basin in Chokwe before and after the 2013 floods | Source: NASA Earth Observatory

Main Principles of Coping with Floods

The main challenge with floods is to identify sustainable alternatives to massive resettlement away from areas at risk. The recommended approach - 'Living with Floods' - consists of strengthening local disaster preparedness capacities among communities and local authorities and implementing small-scale adaptation/mitigation solutions such as dual-purpose public buildings raised on elevated platforms that can double as places of refuge during flood emergencies. Other options to reduce the impact of floods include:



Reaction of a building to water pressure | Source: UN-Habitat



Elevated Building on podium and on stilts | Source: UN-Habitat

- Locating schools away from sloping terrains susceptible to landslides;
- Locating schools away from river edges, other buildings or big trees;
- Providing a regular, compact and symmetrical building footprint and roof shape, with long perimeter walls stabilized by orthogonal internal walls;
- Raising school floor levels by building them on an elevated base or on stilts;
- Using water-resistant materials for foundations and reinforced walls for the elevations; and
- Reinforcing roof structures to prevent overloading by people seeking refuge on top of them.
- Implement rainwater harvesting systems and improve Water, Sanitation, and Hygiene (WASH) facilities in schools, promoting proper hygiene practices and ensuring a safe and healthy learning environment for students

Elevated Primary School
Maniquenique, Gaza Province

Maniquenique, located in the Gaza Province, is an isolated area in the Limpopo River Basin subjected to recurrent heavy rainfall and cyclical floods. An elevated school building, constructed by UN-Habitat, was the first implementation of the 'dual-purpose' and platform concepts. The elevated platform allows school functions during normal times, but it can also shelter 850 people during flooding. The building has a rectangular plan measuring 9 by 22.5m, with a total floor area of 200 m2. It has two classrooms of 60 m2 and a central space for the entrance and use by teaching staff. The floor slab - a grid of pine wood beams supported by on-site cast reinforced concrete pillars - is raised 1.5m above the ground, that is, above the 2000 flooding level.

The walls along the long sides are of concrete blocks allowing for light entry and ventilation. The side walls of 20 cm thick reinforced solid concrete are six meters high along the main facade and 4.5 meters at the rear. This creates a sloping roof that allows for rainwater harvesting into a 50,000-liter cistern. The roof has triangular semi-trusses in pine wood and can support the weight of at least 50 people.

Why is this intervention adaptive?

The design of the school applied participatory planning for site selection. It used local knowledge, local building materials and local labour. The raised platform and reinforced roof allow the dual use of school in normal times and a safe haven during flood emergencies

CHALLENGES: Keeping a consistently high level of community involvement during the project development.

LESSONS LEARNED: Flood proof buildings need a larger investment due to their high structure and it is necessary to train the community on how to use the building in times of emergency.

Maniquenique School working as a safe haven during emergency | Source: UN-Habitat

Maniquenique School construction process | Source: UN-Habitat

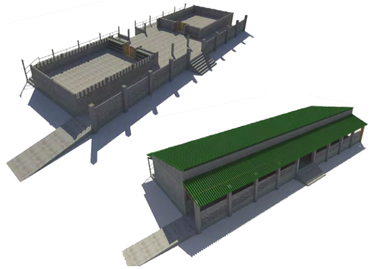
Elevated Primary School Chirembwe
Inhangoma, Tete Province

About 60,000 people live in a few settlements around Inhangoma at the confluence of the Zambezi, Chire and Dzive-Dzive rivers. The land is very fertile and gives good harvests, but it is cyclically affected by moderate flooding rising to between 0.60 and 1.2m. There are no elevated places that enable authorities to resettle the population.

Participatory planning exercises were held by UN-Habitat. Flood mitigation and preparedness interventions were prioritised, and sustainable local strategies set up to enhance existing coping capacities. This was followed by the construction of an elevated, flood-resistant public building and several raised low-cost houses. The intervention was complemented with training, capacity-building and awareness-raising. The intervention followed the dual-purpose building concept - public structures that can provide shelter during flooding and that will help authorities evacuate people in a safer manner. In normal times the building serves as a school. Therefore, the district's education authorities assist and support INGD with maintenance and functioning of this safety infrastructure.

During the construction period, UN-Habitat recruited a qualified technician based nearby for managing materials, transport and other logistics. Community members and local builders built the structure, while UN-Habitat deployed qualified technical staff to organise, supervise, monitor and support the process on site: two national staff (one architect/urban planner and one DRR specialist) experienced in participatory planning and local training delivery as well as two international architects with knowledge of local building techniques and construction works.

To make the community feel at ease with the new building, traditional architectural elements widely used in the area were reinterpreted and integrated into the design. The principal element of these is the veranda, a roofed space between the external walls and the external pillars that surround traditional houses in Mozambique. It is a flexible space, closed or open depending on the weather conditions or use. The veranda and straw mats that enclose it protect the building from wind, rain and sun. The sloping roof helps rainwater harvesting and provides safe drinking water, especially in times of disaster.



Source: UN-Habitat

Why this architecture intervention is adaptive

Each of the three main spaces of the building has a specific function, both during normal and emergency times. The open space facilitates evacuation; the semi-closed area can be used for emergency awareness building activities; and the closed spaces, normally the classrooms, can accommodate people's possessions during crises.

CHALLENGES: One of the major challenges was the remoteness of the site. This affected community mobilization, transport of materials and other logistics.

LESSONS LEARNED: The size of the building could compromise the intervention's replicability, especially in remote areas.

Source: UN-Habitat

Elevated Primary School
Chókwè, Gaza Province

An intervention, implemented under the DIPECHO III[16] project in Chókwè, aimed at addressing the vulnerability of communities in the Limpopo River Basin. The 2013 flood affected 250 schoolrooms and other key public and community facilities. The project provided an adapted, dual-purpose primary school in Chókwè City for its primary purpose of education and, secondarily, giving shelter to people and protecting their portable assets in case of flooding. The intervention focused on an existing school at Bairro 5b consisting of five classrooms built with a mix of conventional and local materials. The adapted building was raised about 2.5m on a concrete slab and provided with a metal roof. Gender-separated toilets, rainwater harvesting with a 5,000-litre tank and solar panels were introduced. The ground floor remained a semi-open space for school and community activities.

The intervention sought the scaling-up and enhancing this experimental model with stakeholders and multilateral partners involved in school construction in Mozambique. It revealed a need to train community and municipal technicians in the use of adapted infrastructures and their maintenance, before, during and after floods. It became clear with this project that, to facilitate its replication, a costs-benefit analysis was required to assure that adaptation costs will not exceed 20 percent of the cost of a common primary classroom.

Source: UN-Habitat

Why this intervention is adaptive

The building followed the dual-purpose building concept, serving as a school or a safe heaven, as and when required

CHALLENGES: The main challenge proved the scaling-up of this experimental model by the main stakeholders (the Ministry of Education and multilateral partners).

LESSONS LEARNED: Access by handicapped people had been raised as an issue and access ramps need to be included in future replications.

From the design through the construction to the finished building | Source: UN-Habitat

[16] The European Commission Humanitarian Aid department's Disaster Preparedness Programme (DIPECHO)

Elevated Radio Building
Chókwè, Gaza Province

The 2013 flooding of the lower-Limpopo River basin affected more than 50,000 people in Chókwè and Lionde alone. Key infrastructures such as schools and hospitals as well as houses of precarious construction were extensively damaged. The Community Radio Rádio Vembe was completely washed away. People were forced to seek refuge in transitional accommodation centres 25km away.

Following the flooding, the Rádio Elevada (elevated radio) project aimed at replacing the radio building that had been washed away. The goal was to quickly be ready for renewed radio broadcasting services, especially in times of flood emergency. The building now also serves the dual-purpose of a safe haven.

The building has a first floor of 40m2, elevated above the level of the historic highest flood peak of 2.5m. It has an office, a broadcasting studio and a bathroom. During emergencies the building can use its independent generator system so that broadcasts will not be affected.

The project was financed by DIPECHO, implemented with UN-Habitat technical assistance and with UNICEF for the provision of radio broadcasting equipment. UNICEF also trained those managing the radio facility, with a focus on emergency prevention management.

This intervention, although experimental, immediately showed its potentially great impact on promoting safer communities, both at local and the national levels. However, it still needs an advocacy campaign among broadcasting organizations, social communication institutes and support organizations to encourage investment in the security of radio communication facilities so that their services will not be interrupted should a calamity occur. It further became evident that the building intervention should be complemented with training of managers and community involvement through emergency simulations.

CHALLENGES: The association managing the radio facility and the local authorities dealing with natural disaster management should both be trained and prepared to respond during emergencies.

LESSONS LEARNED: The focus of this project was on adapting the building to withstand specific disasters in addition to strengthening the capacities of technicians and communities through continuous radio management training for emergency simulations.

Above and right side: Elevated Radio, Chokwe | Source: UN-Habitat

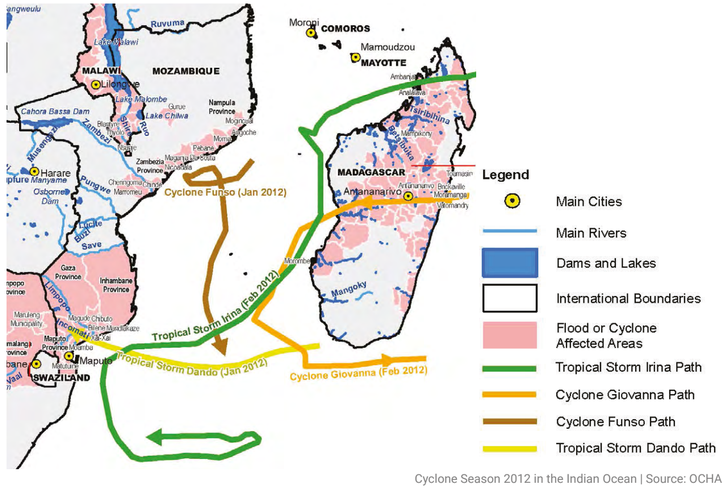
Coping with cyclones: impacts 2000-2013

The number of cyclonic events in Mozambique has dramatically increased since 2000. In particular, the urban concentrations in the provinces of Inhambane and Nampula were badly hit during 2000-2010.

In February 2007, tropical cyclone Favio (category 4) made landfall in Vilankulo District, Inhambane Province and then continued through the Sofala and Manica provinces. It also hit some coastal areas of Central Mozambique, generating torrential rains and wind speeds up to 220km/h in an area which had already been flooded the month before. High wind speeds caused most of the damage. According to the INGD, the cyclone killed 10 people and affected more than 160,000, destroying crops and threatening local food security. In the immediate aftermath of the cyclone, INGD, together with the World Food Programme (WFP), responded with food assistance. One month later, damage assessments of housing and public facilities revealed that most damaged or destroyed buildings had had inadequate construction quality and techniques.

In March 2008, tropical cyclone Jokwe hit Northern and Central Mozambique. Heavy rainfall caused extensive damage to homes, schools and road infrastructure. This cyclone affected 200,000 people throughout Mozambique, with a total of 55,000 people left homeless and 16 recorded deaths. An estimated 100,000 ha of crops was also washed way .

Cyclone Jokwe was the first tropical cyclone to make landfall in Mozambique since Favio in the previous year. Jokwe crossed Northern Madagascar as a 'category 5' tropical storm before intensifying into a cyclone with peak winds of 195 km/h striking North-eastern Mozambique. Across the Nampula Province it destroyed at least 80 school roofs and a bridge across the Mogincual River, which left the town of Namige isolated. Favio also destroyed 9,316 houses and damaged 3,220 more.

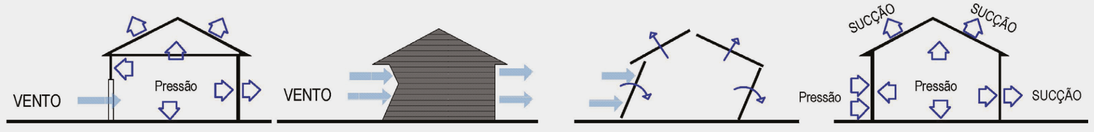


Cyclone Season 2012 in the Indian Ocean | Source: OCHA

In January 2012, the moderate tropical storm Dando hit Southern Mozambique, affecting 51,670 people in the Maputo, Gaza and Inhambane provinces. Days later, the central and northern regions of the country were affected by cyclone Funso (category 3-4) with winds between 166 and 212 km/h and heavy rainfall affecting 66,946 and 2,835 people in Zambézia and southern Nampula provinces, respectively. A considerable number of houses, schools and health centres were damaged in six districts of Zambézia province which was the worst affected. The death toll, mostly caused by falling roofs was reportedly 44.

During January 2012, the deep vulnerability of Mozambique to natural disasters was strongly reconfirmed by these new disastrous events. Damage and need assessments following the emergency showed extremely high vulnerability of communities' housing and public infrastructures. To a large extent this was the outcome of low community capacities. The assessment indicated that immediate humanitarian assistance should ensure sustainable recovery using the existing coping strategies of these communities. However, helpful as humanitarian assistance may be, it usually does little to reduce the impact of future calamities.

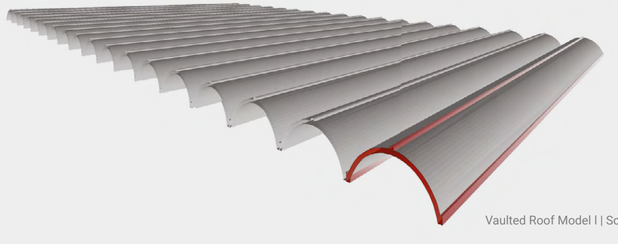
Two activities, as examples of the possible shift from an emergency to a development approach are low-cost solutions for improved reconstruction and low-cost solutions for retrofitting and reinforcement of non-affected houses to prevent future damage.



Main Principles of Coping with Winds

A building's resistance to cyclones is dependent on its shape, weight and technical makeup. Extreme wind action induces a variety of loads on a building.
While the side of the building facing the wind is subjected to a lateral pressure load pushing the wall inward, the rest of the building's sides are pushed outwards while the roof is lifted by suction generated by the pressure drop which normally happens in proximity of the lee sides. Cyclone resistant buildings, besides a compact design and few openings, are roofed with structural elements whose shape, slope, weight and mutual connections are designed to resist the lifting generated by the pressure drop.
Basic construction rules to be applied to reduce cyclone impact on buildings are:

Building with Winds Manual / Source: UN-Habitat



Vaulted Roof Model I | Source: UN-Habitat

- Locate the building away from sloping terrain susceptible to landslides and from river edges, other buildings and big trees;
- Provide a regular, compact and symmetric building footprint and roof shape, with long perimetral walls reinforced by orthogonal internal partitions;
- Provide cross-bracing for side walls;
- Limit the number of doors and windows and provide shutters to seal them during storms and cyclones; and
- Reinforce the roof structure, mutual connections amongst roof elements and improve roofing elements' quality.

Cyclone-Resistant Kindergarten & Shelters
'Living' Workshop' in Vilankulos

Vilankulo, in the Inhambane Province, is an Indian Ocean coastal village in one of the most cyclone-affected areas of Mozambique. Here, UN-Habitat conducted a 'living workshop' of innovative examples of cyclone-resistant construction for housing and schools. The resultant catalogue of technical solutions evaluates the technical feasibility of various solutions in the manual Building with Winds. This manual targets master builders and technical staff to encourage replication of the solutions proposed.

The project was implemented under the guidance of and in partnership with the Vilankulo City Council, which provided UN-Habitat with office space and qualified technical support between November 2007 and March 2010. The proposed models of low-cost, cyclone-resistant housing were further developed in consultation with the targeted communities, notably ferro-cement technology for roofs. A participatory mitigation and preparedness plan for the selected neighbourhood was prepared and training and capacity-building delivered.

Since a building's resistance to cyclones is related to its shape, weight and technological characteristics, cyclone-resistant structures typically feature a compact plan. However, the real innovation is the proposed roof - a prefabricated wire mesh concrete vault, whose shape, slope and weight ensure excellent cyclone resistance.

Vilankulo's kindergarten is another example of the dual-purpose building serving as a shelter in the event of cyclones. The school has a 200m2 plan divided into a multipurpose room, a cafeteria with kitchen, an office and female/male toilets. The project came about as the result of UN-Habitat's prototype 'Living Workshop' implemented with the Municipality of Vilankulos. A year later the municipality decided to replicate the experience and build a resilient kindergarten and health centers with international funding and UN-Habitat's technical assistance.

Why this intervention is adaptive

Different roofing solutions proved to increase resistance to strong winds and cyclones and will therefore allow vulnerable communities to carry on with life after storms and cyclones.

CHALLENGES: One of the major challenges of the project was the remoteness of the areas. This affected community mobilization, transport of materials and other logistics.

LESSONS LEARNED: The design applied did not include a possibility for houses to be modified or extended in the future. The high cost of ferro-cement, if compared with the average income of the families, prevented a large-scale uptake.

School innovative roofing system | Source: UN-Habitat

Cyclone-Resistant Community Shelters and Housing

On islands like Angoche and Mogincual, in Nampula Province, cyclone exposure is very high and their remoteness makes emergency interventions complicated. It is therefore important that authorities and communities are well-trained in emergency responses, adaptation and mitigation. To this end, UN-Habitat established, through participatory planning, small-scale demonstration interventions, training sessions and capacity-building. These promoted innovative building techniques while strengthening preparedness and mitigation capacities so that asset losses in the future would be minimized. It further included the construction of temporary safe shelters (notably community shelters in isolated locations), training in low-cost reinforcement of houses and public buildings.

Construction of grain storage barns was also encouraged. Where possible, these demonstration structures incorporated local building techniques and materials to facilitate maintenance and replication by the communities themselves.

Shelters of 120-150 m2 can accommodate a maximum of 250-300 persons. These A-shaped, reinforced wooden structures have a 40-45 degree slope with reinforced bracings and ballast foundations to resist uplifting forces. Their roofing consists of reinforced woven palm leaves and a rainwater harvesting system. Sanitation facilities were also provided.

Why this intervention is adaptive

An A-shaped building and compact plan, the building's orientation, site selection and the reinforced anchorage of the main wooden posts to the ground all contribute to increasing wind resistance.

CHALLENGES: The hardest challenge for community mobilization and project implementation was the remoteness of the islands on which the shelters were constructed.

LESSONS LEARNED: Dual-purpose use of public structures should be stimulated and replicated among more communities.

Housing reconstruction
in Chinde and Pebane

Housing reconstruction in Chinde and Pebane in the Zambezia Province was implemented in 2012. It was coordinated at the provincial and district levels by INGD, the Ministry of Public Works (MOPHRH) and shelter cluster members. IOM provided the funds and general coordination. The NGOs CONCERN Worldwide and Samaritans Purse provided logistical support, training, site selection and preparation, building materials and tools, as well as transport. UN-Habitat was responsible for providing technical assistance through didactic tools and technical materials to support training sessions in the field on 'Building Back Better' practices adapted to local construction techniques. The project was carried out in a participatory way, involving local technicians, master builders and community mobilization.

Two different housing prototypes of 20-28m2 and 35m2 were developed; one for Chinde and one for Pebane. The prototypes took into consideration the different social, economic and environmental backgrounds of each district and incorporated relevant local construction techniques and materials.

From the design through the construction to the finished building | Source: UN-Habitat

Why this intervention is adaptive

A compact and squared housing shape was designed to better resist strong winds. The foundation was set at increased depth (0.7-0.9m) unlike the local tradition, and the main structural wooden posts were strongly anchored to the ground by cross bracing them with horizontal wooden elements. Diagonal bracing posts were anchored to the vertical structure with increased connections of nails, vegetal rope and iron wire. Openings in the frameworks were reinforced with lintels.

A participatory approach involved the beneficiaries in the construction phase. After UN-Habitat staff had provided the main reinforced structure of the houses, the dwellers plastered and finished their property.

Coping with earthquakes 2000-2013

Capacity-Building for Earthquake-resistant Construction and Housing

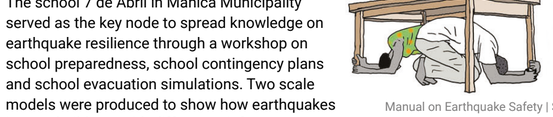
Together with INGD and the Ministry of Housing and Public Works, UN-worked on building awareness and people's involvement in mitigating the impacts of future earthquakes. This commenced with a study of non-engineered, earthquake resistant house design based on traditional techniques using local materials. The targeted communities were interviewed to illicit the best design. The proposed solution involved double walls of stabilized soil blocks with a flexible bamboo structure between them and with reinforced concrete foundations.

Next, the project focused on training local master builders and sensitising the local population. Training materials (posters, manuals and publications) were developed for use in broad-based dissemination of earthquake knowledge among vulnerable communities.

The school 7 de Abril in Manica Municipality served as the key node to spread knowledge on earthquake resilience through a workshop on school preparedness, school contingency plans and school evacuation simulations. Two scale models were produced to show how earthquakes impact buildings with different reinforcement systems.

UN-Habitat signed a cooperation agreement with the Municipality of Manica for providing assistance with producing plans for the construction of 30 earthquake-resistant housing units in a new development area of the municipality. The project particularly aimed at promoting improved standards of living among female urban entrepreneurs by supporting their access to land and property.

Different construction models were designed, from the larger 50m2 to the smaller 25m2 option, either with an interior bathroom or external VIP latrine, depending on affordability levels. The housing was built with stabilised soil bricks on a reinforced, elevated foundation and with wall reinforcements of bamboo or chicken wire. It also included a rainwater harvesting facility and wind- and earthquake-proof roofing.



Manual on Earthquake Safety | Source: UN-Habitat

3D visual of Earthquake Resistant Housing Units
Source: UN-Habitat

School Training in Manica
Source: UN-Habitat

Why this intervention is adaptive

A building's shape is a major factor in earthquake-resistance, disproving a common belief that disaster-resistant measures necessarily imply much higher costs. The building should have a compact square shape, with buttresses, a ring beam and internal walls reinforcing the outer walls. These features do not necessarily drive the cost up.

CHALLENGES:During this activity seismic risk was, for the first time in Mozambique, the subject of awareness building, construction training and evacuation simulations.

LESSONS LEARNED: Earthquake risk awareness needs to become more wide-spread and scaled up.

Training on Earthquake Resistant Construction using bamboo slats | Source: UN-Habitat

Earthquake Resistant Housing Units in construction | Source: UN-Habitat

03
National DRR approach for Schools

SAFER SCHOOLS PROJECT Workshop III / Maputo, 23 June 2014 | Source: UN-Habitat

Introduction

In early 2012, cyclone Funso made landfall at the central-northern coast of Mozambique. In the aftermath of this event UN-Habitat joined forces with the Government of Mozambique, and the World Bank to widen the scope of DRR activities in Mozambique. An extensive post-disaster damage and needs assessment was conducted. Architectural and construction weaknesses were catalogued and adequate solutions to mitigate future cyclone destruction identified. Based on the findings, UN-Habitat developed training materials and ran on-the-job training for a 'Building Back Better' (BBB) approach to schools. UN-Habitat's interventions were next scaled up from the local to the national level and influenced the government's policy, strategic and normative frameworks for resilient school construction.

The assessment results further showed that, because of inadequate design, poor quality construction and/or inappropriate location and orientation, school buildings have little resistance to the impacts of high winds, flooding and earthquakes. It revealed that more than 70 percent of the schools is at high risk of one or more of these hazards (UN-Habitat, 2015). It also became clear that Mozambique's current number of schools is unable to absorb the increasing demand and it needs approximately 40,000 additional classrooms (UN-Habitat, 2015).

In 2012, UN-Habitat partnered with the National Institute for Disaster Management (INGD), the Ministry of Education and the Ministry of Public Works in a 3-year operation to review, improve and accelerate school construction in Mozambique. This initiative, funded by the World Bank, also aimed at systemically reducing natural disaster damage to schools. A broad-based consultative group was established to review school design, construction techniques, management and administrative processes. It also reviewed the legal and normative frameworks with a view to harmonizing the institutions and governance of school construction while mainstreaming resilience of schools to hazardous events. As a result, the Guidelines on School Safety were issued and the Resilient School Building Standards were adopted. This, in turn, helped consolidate partnerships and the scaling-up of the Safer Schools Initiative.

Cyclone Resistant School | Source: MINEDH

Analysis of school construction in Mozambique

Since 1975, primary and secondary school development in Mozambique went through four different phases:

I. The immediate post-Independence phase saw a pronounced increase in the number of schools;

II. During the civil war phase (1983-1992) about 60 percent of the EP1 schools was destroyed, affecting almost 1.5 million students. From 1983 until 1989 (the last year for which data on post-war damage of education facilities was recorded), about 18 percent of the schools were either closed or had been destroyed, thereby affecting 13,266 students;

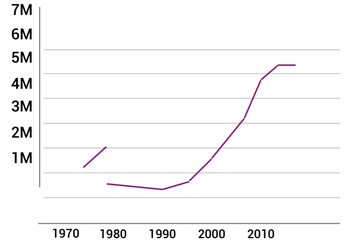
III. During the stability phase after the Peace Accords, the number of schools started to increase again, notably for EP2 (462 percent), while the number of secondary schools tripled; and, finally

IV. The next phase which started in 2003 saw the establishment of the Accelerated School Construction Programme which included modified goals and practices of school construction and a general increase in the number of schools at all education levels.

Prior to 2003, the Strategic Plan for Culture and Education (PEEC 1999/2005) was targeting broad-based access to education at all levels with fast-tracked school construction being one of its key priorities. When Mozambique, in 2003, joined the Education for All - Fast-Track Initiative (EFA-FTI), the Accelerated Construction Programme was launched to further speed up schools' construction while reducing the average cost of classrooms. This programme aimed at delivering 6,000 classrooms annually at an average cost of USD10,000, equivalent to half the average cost of a classroom prior to that time. Consequently, from 2005 to 2012, the number of schools grew from 10,206 to 15,834 (a 50 percent increase) providing educational facilities to 6.2 million students - two million more than in 2004.

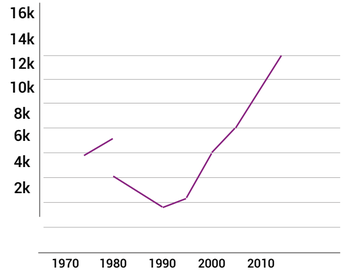
Consequently, the geographic distribution of schools then broadly matched Mozambique's population distribution. The most populous provinces, Nampula (4.8 million) and Zambézia (4.6 million), now have 2,799 and 3,825 schools, respectively. Together, these two provinces account for 42 percent of the total number of schools. The remaining provinces have figures ranging from 750 to 1,300 schools, with the exception of Maputo City's 247 schools. Central Mozambique has the largest number of schools: 7,343 or 46.4 percent of the total . The current stock value of conventional schools is estimated at USD550/m2 for primary schools and USD650/m2 for secondary schools.

Evolution of Nr of Students 1975-2012



Source: UN-Habitat | MINEDH

Evolution of Nr of Schools 1975-2012



Source: UN-Habitat | MINEDH

Evolution of the number of schools and students / 1975 - 2012

Period	Year	Nr of Schools				Total Schools	Total Students (thousands)
		EP1	EP2	ESG1	ESG2		
Phase 1: After Independency	1975	5235	26	7	5	5273	709,3
	1980	5730	99	19	3	5851	1492,5
Phase 2: War destabilization	1985	4616	156	41	5	4818	1453,7
	1990	3441	169	39	5	3654	1400,6
Phase 3: Stability after the Peace	1995	4167	232	49	10	4458	1602,7
	2000	7072	522	93	20	7707	2690,3
Phase 4: Acelerated Construction Programme	2005	8713	1304	154	35	10206	2005
	2008	9662	2210	287	76	12235	2008
	2010	10458	2991	376	119	13944	2010
	2012	11164	4068	446	156	15834	2012

Source: UN-Habitat / MINEDH

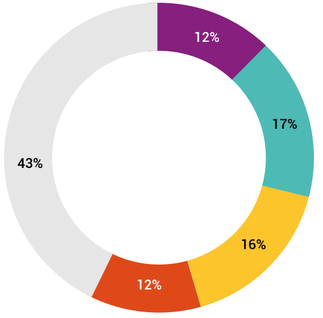
Main characteristics of school construction

From a construction materials' perspective, there are three categories of schools in Mozambique: a) conventional materials schools, b) local materials schools and c) mixed materials schools. In this publication only the first two categories will be analysed.

Conventional materials schools are government--built with the DIEE (Direcão de Infraestructuras e Equipamentos Escolares) responsible for school design and construction supervision. Conventional materials schools mostly consist of reinforced concrete pillar and beam structures with cement block walls, cement screed floors and a wooden roof structure covered with corrugated metal sheets. Up until 2012, conventional materials schools generally did not include disaster vulnerability reduction in their construction. They typically had up to three classrooms, latrine blocks, an administration block (annexed or separate) and sometimes housing units for teachers.

Given the insufficient number of conventional schools and the currently overcrowded classrooms, local communities often spontaneously added one or two more classrooms. These typically consist of local materials like wattle and daub walls (pau-a-pique/maticado) and a wooden roof structure covered with thatch. Since all secondary schools are built by the government, spontaneous construction in Mozambique normally occurs only for primary schools. There is, however, a significant deficit in both the number and quality of conventional schools. Of a total of 63,551 classrooms classified as 'conventional' in 2013, about 46 percent are poorly constructed, i.e. with wood, wattle-and-daub and/or other local materials.

Local material classrooms often are built next to conventional classrooms | Source: UN-Habitat

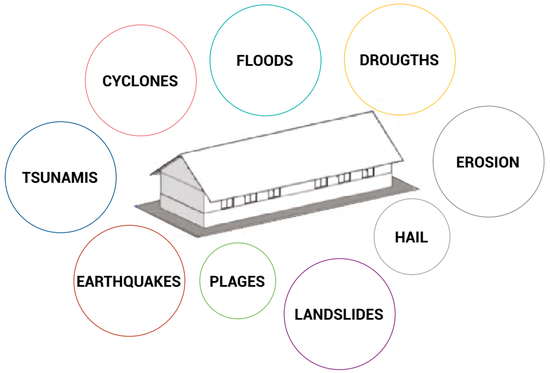


Typical Conventional School | Source: UN-Habitat

Typical Mixed Materials School | Source: UN-Habitat

Typical Local Materials School | Source: UN-Habitat

Risk profile of schools



Relationships between Disaster Damage and School Construction

It is estimated that 25 percent of Mozambique's population lives in areas exposed to recurring disasters (UN-Habitat, 2015). Consequently, hazardous events affect a high number of schools and their users.

To generate a school exposure map for the four key hazards (floods, cyclones, earthquakes and droughts), data on the school network was analyzed and superimposed onto charts so as to produce natural hazard maps. To this end, geo-referenced data from the World Bank database (2007) was combined with non-georeferenced data from MINEDH (2012). This exposure mapping was then superimposed onto the historical records of impacts and sensitivity using a sample of 836 classrooms in seven provinces. As a result, this has allowed for risk approximations of schools.

After the 2015 risk assessment by UN-Habitat and as part of the World Bank's Global Programme for Safer Schools, a more recent (2018) and expanded multi-hazard disaster risk assessment (riverine floods, coastal floods, cyclone winds, earthquakes, landslides) was undertaken by Deltares . However, the current chapter uses UN-Habitat's assessment data. Wherever more updated and/or disaggregated data from the Deltares' assessment has been used, this has been specified.

Hazard Profiling

Based on hazard profiles and literature reviews conducted for the Safer Schools Initiative, the main data sources for the four key hazards (earthquakes, cyclones, droughts and floods) were identified. The following institutions were consulted as data sources for the above hazards: the National Directorate for Water (DNA), the Famine Early Warning Systems Network (FEWSNET), the National Geology Directorate (DNG), the National Meteorology Institute (INAM), the National Disaster Management Institute (INGD) and the Faculties of Geology, Sciences and Architecture of the Eduardo Mondlane University, among others.

Then the frequencies and intensities of each hazardous event over the past 30 years was categorized and modeled. The likelihood of hazardous events' incidence was classified as 'low', 'moderate', 'high' or 'extremely high'. The above enabled the production of a map for each type of hazard using a GIS platform which gave a national picture of hazardous event distribution and risk levels by district.

Vulnerability Assessment

In order to estimate the vulnerability of the school network, two aspects were taken into account:

a) Identification of exposure: Documentation of schools exposed to hazards through cross-referencing the hazard mapping and the database of classrooms per district; and

b) Technical sensitivity analysis: An approximation of schools' sensitivity according to the construction materials as recorded by the MINEDH classroom database.

Exposure to Hazards

The MINEDH database enabled risk approximations by cross-referencing the hazard maps with the spatial distribution of 63,551 classrooms across the country and across all public education levels. It revealed that 46 percent are unconventional classrooms of precarious construction. The exposure mapping generated three important conclusions:

a) Each new school constructed in a risk area implies, by necessity, that the overall degree of schools' disaster exposure will increase;

b) A large number of schools is simultaneously exposed to different natural hazards. The solution in such cases should be a gradual retrofitting process or improved post-disaster reconstruction. However, if only the 27,500 presently precarious classrooms would be replaced and if new primary education classrooms would be built to address education currently taking place outdoors, more than 34,000 new classrooms will be required just to remedy the present deficit; and

c) Finally, over the next 30 years most of the national population growth will occur in coastal areas exposed to tropical storms and cyclones. Assuming a likely relationship between population density and school distribution, it must be understood that the number of schools exposed to natural hazard risks will increase.

Sensitivity Analysis

The MINEDH database used to map the distribution of classrooms includes data on the construction materials used. This information was cross-checked by UN-Habitat during field assessments of 836 classrooms in seven different provinces. It recognized conventional classrooms, built with concrete cement and bricks, and non-conventional classrooms built with local materials. The 63,551 classrooms nationwide use 44 percent conventional and 46 percent non-conventional materials.

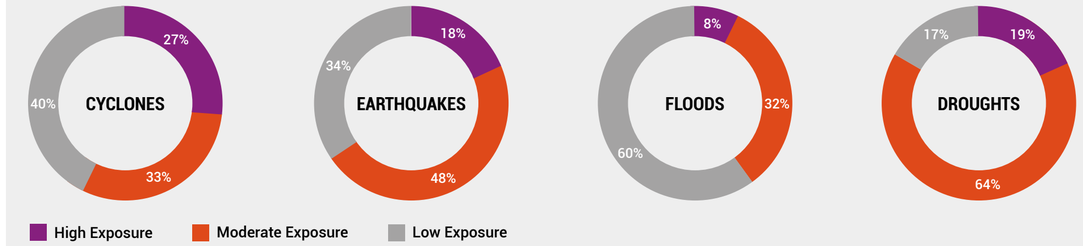
Conventional classrooms are generally less sensitive to hazardous events' impacts than non-conventional or mixed-material classrooms - a conclusion based on the 836 classrooms assessed. Sensitivity to the impacts of disasters other than droughts normally manifests itself through construction weaknesses and ultimate failure of school buildings. Four common weaknesses and material failures have been identified by UN-Habitat in both conventional and non-conventional structures. In the case of local material use construction deficiencies notably resulted from: a) poor construction, b) poor quality of materials, c) non-consideration of the prevailing wind direction, d) failure to use cyclone-resistant construction techniques, and e) outstanding maintenance.

Any failure of school buildings during a disaster not only causes major education interruptions and exposes pupils and teachers to dangerous conditions but also causes serious repercussions for overall community development. School buildings are often the sole local community infrastructure and have secondary uses as a meeting place and/or as a refuge or shelter during emergencies.

Dogola School, mixed material, Maganja da Costa | Source: UN-Habitat

Mugoloma School, conventional and mixed material, Maganja da Costa | Source: UN-Habitat

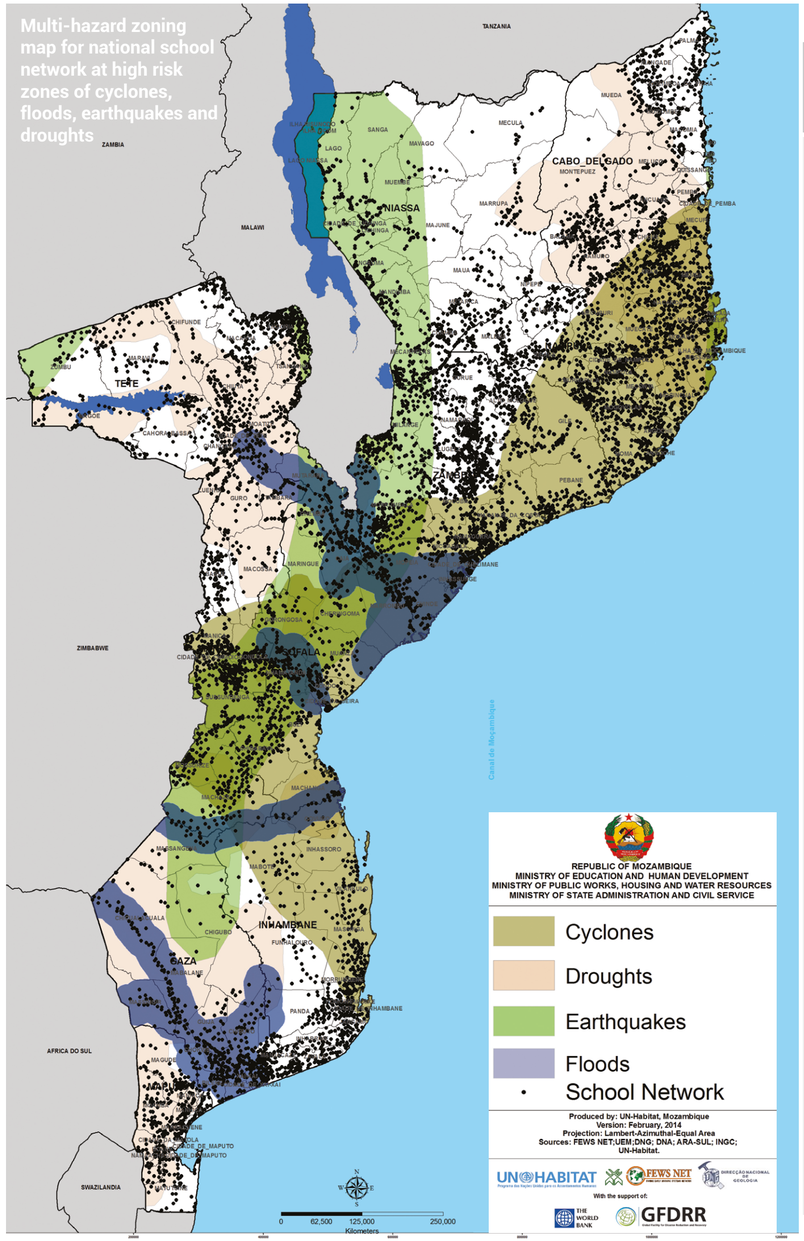
Exposure of school network to hazard -2015



72% of the schools are in high-risk areas of one or more natural hazards

Source: UN-Habitat / MINEDH 2015

Multi-hazard zoning map for national school network at high risk zones of cyclones, floods, earthquakes and droughts



ASPECTS OF SENSITIVITY:
Direct & Indirect Factors

DIRECT FACTORS INFLUENCING SENSITIVITY:

- **Geographical exposure of the school**
- **Construction location, framing and implantation in the specific area**
- **Project design**
- **Execution techniques**
- **Building components and materials**

CO - FACTORS INFLUENCING SENSITIVITY:

- **Implementation, Management and Administration Practices**

The fact that the entire selection, contracting, supervision and inspection process is carried out exclusively at the local level is pointed out by many as one of the reasons for the poor quality of the schools built. The selection and contracting of school contracts, and public works in general, do not take into account the technical quality of competitors, exaggerating the lowest price criterion.

- **Ability to apply existing rules, and future ones**

Norms that fairly and efficiently regulate the construction process and the actions of the actors involved in it, from the design to the maintenance of school buildings.

- **Scope of harmonization of stakeholders**

The construction of schools in Mozambique is the responsibility of MINED, which has a department with the tasks of planning, managing and regulating school infrastructure in Mozambique. One of the main challenges concerns the relationship between DIEE and other government actors involved in the construction of schools and public buildings in general - more specifically, with MOPHRH (*Ministerio das Obras Públicas, Habitação e Recursos Hídricos*)

- **Cultural and Socio-economic factors, including knowledge and awareness of risk**

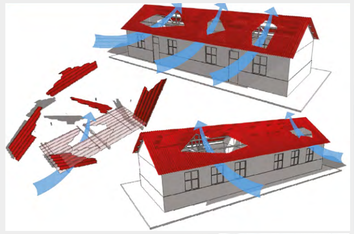
Source: UN-Habitat / MINEDH 2015

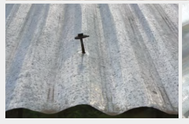
Sensitivity

manifests itself with failures of the school building in case of occurrence of a striking hazard, such as Cyclones, Floods and Earthquakes. Drought is a threat that does not cause damage to the school building but compromises the safety of children in areas in which it occurs.

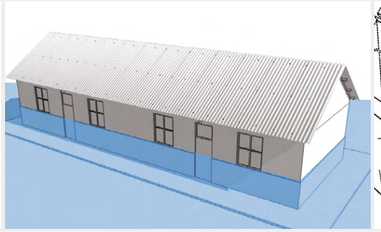
Summary of recurrent failures in the event of a cyclone In conventional and non-conventional classrooms

Examples of typical building failures in case of cyclone

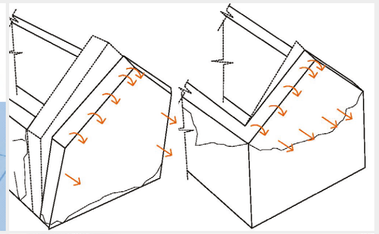




Examples of typical building failures in case of flood



Examples of typical building failures in case of earthquake



The failure of the school building in case of occurrence of an hazard...

reflects in continuous interruptions of the curricula and precarious conditions of learning.

This has direct repercussions on the children and teachers' wellbeing, as well as on the development of the overall community.

Source: UN-Habitat

Source: UN-Habitat

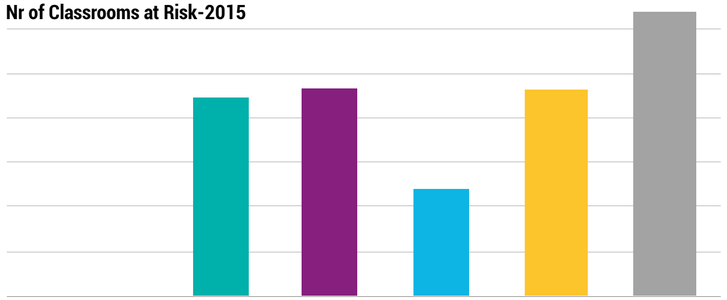
Multi-hazard risk assessment

Based on its hazard mapping and vulnerability analyses, UN-Habitat estimated the relative exposure of classrooms by risk category. It showed that 95 percent of all classrooms face at least one of the four main hazards. About 68 percent face cyclone risks, 73 percent are at risk from earthquakes, 38 percent from floods and 72 percent from droughts. If disaggregated by the construction material used, the proportions of hazard risks in highly vulnerable districts are similar: non-conventional classrooms 95.4 percent and conventional classrooms 95.5 percent .

According to Deltares, each year an expected 50,000 pupils will experience disaster impact on their schools. Cyclones contribute the lion's share (70 percent), followed by coastal flooding (14 percent), riverine flooding (12 percent) and earthquakes (3 percent).

In terms of monetary impacts, the average total expected annual disaster damage is USD2,125,000 for conventional classrooms and USD39,000 annually for unconventional classrooms. Disaggregated data from Deltares not available from the UN-Habitat study are shown below.

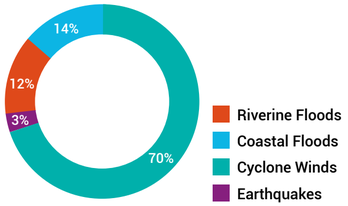
Nr of Classrooms at Risk-2015



	Cyclones	EQ	Floods	Droughts	Total
%	68.7	73.1	38.1	72.1	95
Nr of Classrooms	43666	46462	24213	45796	63551

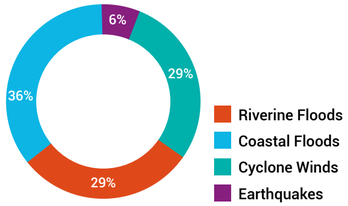
Source: UN-Habitat 2015

Annual expected nr of pupils affected



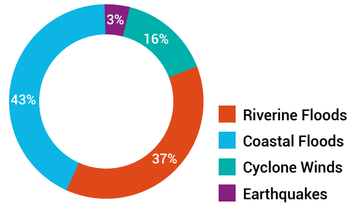
Source: Deltares 2018

Annual expected damage unconventional classrooms (US$/year)



Source: Deltares 2018

Annual expected damage conventional classrooms (US$/year)



Source: Deltares 2018

Build to last: cost benefit calculation

Mozambique's estimated deficit of 40,000 classrooms would require the construction of more than 1,000 classrooms annually. Although this has been scheduled, the effectiveness of the programme will be compromised if natural disasters keep on destroying schools. Safer schools with more rational designs, in the long run, will cost less than schools that must be rebuilt every time a natural disaster occurs.

Therefore, the school designs and construction materials will have to be adapted to each type of risk to achieve an acceptable balance between the safety and costs. It also requires better site selection and/or building orientation, structural reinforcement of existing buildings, as well as more appropriate building practices and improved maintenance.

Adaptation options and design parameters must go through a rigid process of cost-benefit analysis to promote the best options for large-scale school building. One of the ways to calculate the economic benefits of adaptation to natural threats is considering 'non-caused damage' (that is, 'reconstruction costs avoided' and 'non-lost assets') against the costs of emergency responses and reconstruction.

Mazoao School - before and after reconstruction process I Source: UN-Habitat

Torrone Velho School - before and after reconstruction process I Source: UN-Habitat

Cost - benefit calculation for 500 classrooms

In the case of school buildings in Mozambique, it can be assumed that the average cost of a conventional classroom is between USD25,000 and USD40,000 and that reconstruction of a partially destroyed conventional classroom costs an average of USD8,000. On this basis, it is possible to assess the typical annual damage and how much could be saved through adaptation measures in new building construction.

Initial Cost of one classroom in conventional materials	**USD 32,500** (25,000 and 40,000 averaged, including a share of the cost of toilets and an administrative office.)
Reconstruction Cost at 20-30 percent of the initial cost	USD15,000 per classroom including surveys, tender and implementation USD15,000 * 500 = **USD 7,500,000**
Cost of Emergency Response	USD 200 USD on average per classroom USD 200 * 500 = **USD 100,000**
Cost of Asset Losses Damaged school supplies, furniture, books.	USD 300 (average) per classroom USD 300 * 500 = **USD 150,000**
TOTAL COST OF RECONSTRUCTION (AFTER DISASTER)	**USD 7,750,000**
Cost of including adaptation measures in the original project @ 20 percent of the initial cost	USD 6,500 per classroom USD 6,500 * 500 classrooms = **USD 3,250,000**
TOTAL COST OF MITIGATION MEASURES (before disaster):	**USD 3,250,000**
PROJECTED ECONOMIC BENEFITS for 500 classrooms with measures incorporated in the original project	**USD 4,500,000**

This cost-benefit table shows a comparison of integrating versus not integrating adaptation measures. The economic benefits of incorporating adaptation in 500 classrooms' initial construction are USD 4,500,000. Considering that more than 40,000 classrooms in Mozambique would have to be built, the total benefits of including adaptation measures would be USD 360 million.

In addition to any direct financial benefit of more resilient education facilities, the additional social benefits should also be considered, although these are hard to express in terms of money and have, therefore, not been included in the cost benefit analysis. These benefits include:

- Avoiding interruptions in education programmes;
- Preserving school archives that otherwise would be destroyed;
- Psychological benefits for pupils and teachers not affected by a cyclical school destruction; and
- Avoiding consequential emergency situations, including separation of children from their families, sexual abuse and psychological trauma.

In conclusion, the Safer Schools Initiative can have considerable economic benefits. Comprehensively reducing disaster vulnerability in school environments by promoting integrated interventions further increases civic awareness of vulnerability, risk and resilience and what can be done to address risks.

The normative component

Guidelines on school safety and resilient school building codes

Given the increasing frequency and severity of natural disasters and growing awareness, stakeholders in school construction and disaster management have started to engage in providing safer learning environments for their children. The GoM has changed its DRR approaches and now leads lasting mitigation of the impacts of disasters on schools.

In July 2012 the General Principles and Guidelines for Safer Schools and the Safer Schools Building Regulations in Mozambique project was launched under the leadership of MINEDH and the INGD. The project was financially supported by the World Bank while UN-Habitat and the Eduardo Mondlane University provided the technical coordination and led the implementation. The overall goal was to produce guidelines on school safety and to promote construction of more resistant schools by first:

- **Generating consensus on the need to build safer schools among stakeholders in school construction;**
- **Identifying areas for improvement and analyzing alternatives for achieving safer schools; and**
- **Generating consensus on guidelines, technical measures and the normalization of processes over the medium and longer term to build schools resistant to natural disasters.**

Through consultations, various government bodies became actors in safer school construction. A Consultative Technical Group was established that included an appointed technical focal point from each institution involved. This assured representation, participation and harmonization within the project. This proved important to its success. The group's focal points ensured linkages between the project's technical team and the institutions they represented. They also guaranteed the relevance and appropriateness of the project's outcomes. To this end, the group reviewed designs, construction options, project management and administration, legal and normative matters, institutional harmonization, governance and, last but not least, the mainstreaming of DRR in public education.

Safer Schools Project Workshops | Source: UN-Habitat

Partners represented within the consultative technical group of the safer schools project

Political National Institutions	Technical National Institutions	Private Sector	Civil Society and International Organizations
Ministry of Education and Human Development (MINEDH)	National Institute of Meteorology (INAM)	Association of Mozambican Consulting Companies – AEMC)	World Vision, Save the Children, FASE, DfID, Plan International, Cristian Council of Mozambique
Ministry of Public Infrastructures and Housing (MOPH)	National Institute for Standardization and Quality (INNOQ)	Building Contractors (represented by the Mozambican Federation of Building Contractors)	Board of Mozambican Engineers
Ministry of State Administration (MAE)	National Directorate of Geology (DNG)		UN-Habitat, UNDP, UNICEF
National Institute for Disasters Management (INGC)	National Directorate of Water Resources (DNA)		Eduardo Mondlane University, Faculties of Engineering and Law
Ministry of Finance	National Directorate of Construction Materials (DNMC)		
	National Directorate of Buildings (DNE)		

Timeline and work phases

The Guidelines on School Safety and Resilient School Building Codes project was implemented from July 2012 to February 2015, through five phases, as described below.

Working Package 1 represented the inception phase for partner mobilization; establishing the terms of reference for the diagnostic studies under phase 2; and organizing a First National Workshop, in November 2012.

Working Package 2, comprised the diagnostic phase, including a field survey of 836 classrooms in seven provinces to assess the vulnerability of three building typologies: conventional, local/ traditional, and mixed. The main outcomes of this phase were:

- Risk profiles of school infrastructure for the four hazard types;
- A catalogue of possible interventions to improve schools in areas prone to natural disasters; and
- A legal and technical review of building standards and regulations.

Working Package 3 involved the drafting of the Guidelines on School Safety and the Resilient School Building Codes. The main outcomes of in this phase were:

- Validation of the Diagnostic Study and general guidelines by the government;
- Adoption of short-, medium- and long-term recommendations;
- Discussions of the technical measures and interventions;
- Approval of the steps to be taken; and
- It was suggested that an inter-ministerial platform be established for institutional coordination

Working Package 4 not only validated the proposed guidelines and building codes but also prepared a revised version of the assessment after consolidating the inputs received during the 2nd workshop. The 3rd and final national workshop endorsed:

a) the diagnostics and recommendations;
b) the school risk assessment;
c) the catalogue of technical interventions;
d) the disaster risk mapping profiles; and
e) a road map for the legal review of the Safer Schools Building Codes.

Safer Schools Project Workshops | Source: UN-Habitat

At the 3rd workshop, each institutional representative identified one or more recommendations to be implemented by his/her institution in the short-, medium- or longer term. The representatives also decided to proceed with the formulation of an Inter-ministerial Decree - a flexible and rapid legal instrument to improve school building with immediate effect.

Working Package 5 focused on documenting the implementation of the Safer Schools Initiative. It marked the completion of the project, including its finalisation of the cyclone and storm risk mapping. It described the project's main challenges, its recommendations, the lessons learned and the methodologies used to access and process information, share ideas, promote dialogue and build consensus.

Working Package 1 (WP1)	Working Package 2 (WP2)	Working Package 3 (WP3)	Working Package 4 (WP4)	Working Package 5 (WP5)
BEGINNING OF THE PROJECT Partners Mobilization and stablishment of consensus	Diagnostic and Recommendations	Preliminary Elaboration of Guidelines for Safety Schools Pré-validation of outputs	Elaboration and validation of outputs	Documenting, revision and edition of all outputs END OF THE PROJECT
July 2012 - Feb 2013	Mar 2013 - Julv 2013	July 2013 - Dec 2013	Jan 2014 - Oct 2014	Nov 2014 - Feb 2015
WorkShop 1 14 November 2012		Workshop 2 31 October 2013	Workshop 3 23 June 2014	

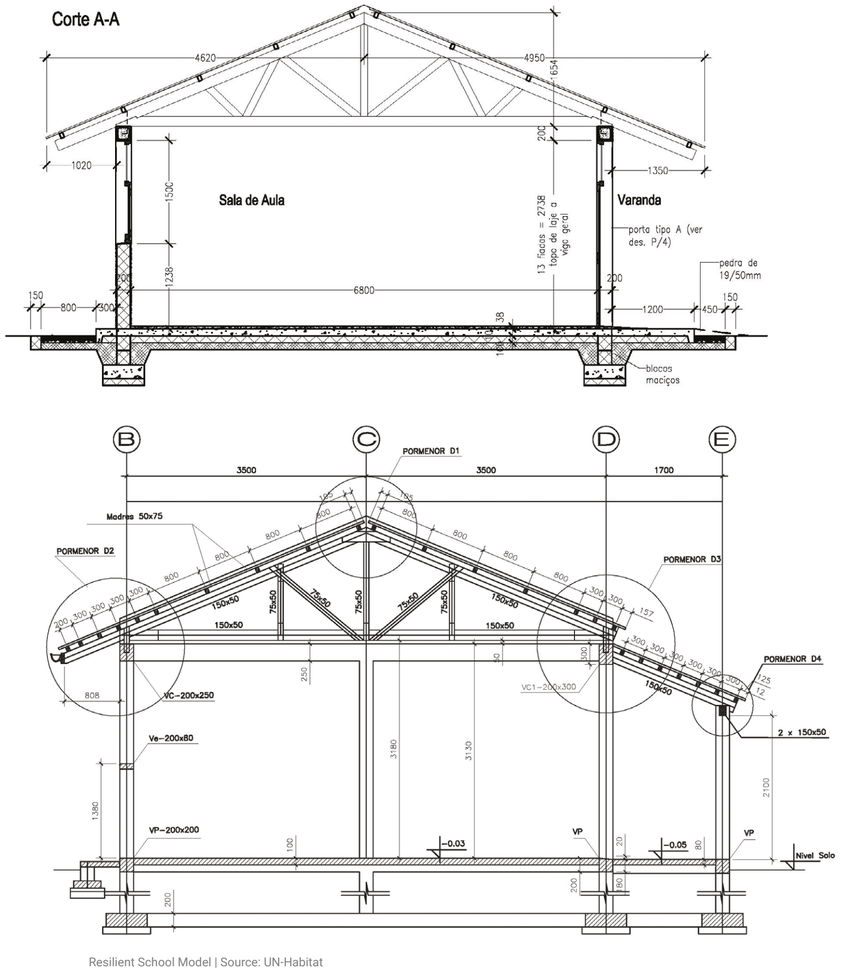
Main achievements of safer schools initiative

- Three joint missions for school damage pre-assessments by MINEDH, MOPHRH, INGD, UEM-FAPF and UN-Habitat after the 2011-2012 disasters and four field technical assessments of school classrooms (830 assessed in total).
- Three ministries cooperating throughout the project implementation.
- Eight Consultative Technical Group meeting and several coordination and consultative meetings with the directors of DIPLAC-CEE, INGD, DNE and other institutions, including 20 interviews.
- Three national workshops with 37 partner institutions.
- One analytical matrix prepared including analyses of more than 30 norms and legal regulations.
- Four natural hazards studies undertaken (cyclones, earthquakes, floods and drought), producing a related set of risk maps.
- Four catalogues produced on technical interventions for safer construction in areas prone to cyclones, earthquakes, floods and droughts

List of Outputs

1. Document on lessons learned while developing guidelines on school safety and resilient school building codes in Portuguese and English;
2. Document on diagnoses and recommendations in Portuguese (with English executive summary);
3. English Document on School Network Multi-risk Assessment;
4. Hazard Mapping & Hazard Zoning Maps for Cyclones, Floods, Droughts and Earthquakes:
   - Six English language hazard maps on: (i) High risk zones of natural hazards, (ii) School infrastructures at high risk of natural hazards, (iii) District winds and cyclone hazard map, (iv) District drought hazard map, (v) District earthquake hazard map, (vi) District flood hazard map;
   - Cyclone Zonning Map at the level of Administrative Posts spatial units (noting that Moz is spatialy structured in Provinces, Districts, Administrative Posts, Localities and human settlements-povoacoes- Constituicao da Republica de Mocambique.
5. Catalogues of technical interventions for school construction in areas prone to cyclones, droughts, earthquakes and floods.

Example of the evolution of MINEDH school building model
as a result of the Safer Schools Project

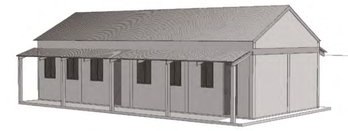


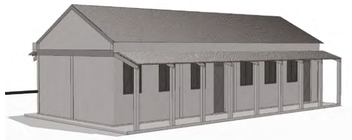
Resilient School Model | Source: UN-Habitat

It is evident how the Safer School Project positively impacted the features of the school building model designed by the Ministry of Education in Mozambique.

The roof structure's design became stronger and more braced, with additional number of structural elements and improved connections.
This to increase the resilience to the winds impact.

Also, the veranda roof became an element disconnected from the main coverage, this to avoid the main to roof to excessively projecting outside the building perimeter, thus creating a weak edge easily lifted by strong winds.





Key findings 2012-2015

Finding 1: With the growing number of schools in Mozambique their exposure to natural disasters will further rise if newly built schools do not incorporate vulnerability-reducing aspects.

Finding 2: Schools are extremely vulnerable to the impacts of hazardous events because of poorly adapted designs, inappropriate construction materials, poor building construction and indiscriminate location selection and/or orientation of the build- ings.

Finding 3: Given school construction shortfalls across Mozambique and the need to rapidly increase the number of schools or classrooms, the risk of significant future disaster damage is extremely high.

Finding 4: Technical shortfalls and vulnerabilities are quite easily addressed from a technical perspective. Good designs, improved construction technologies and better engineering solutions are all available in Mozambique

Finding 5: A lack of consistent preventive maintenance leads to building degradation over time and increases vulnerability. Main- tenance is as important as improved construction. However, regular funds disbursement for maintenance remains a challenge. A policy on preventive maintenance awareness building could be integrated in retrofitting and reconstruction campaigns. Realistically, however, the cost of a nation-wide programme for retrofitting all exposed schools would be prohibitive. Seizing recurrent disaster impacts as an opportunity to build back better is a viable alternative.

Finding 6: Technical failing of school buildings is both directly and indirectly related to factors of a normative, pragmatic, economic and governance nature. For example, existing legal instruments are often obsolete, insufficiently detailed or do not clear- ly set out roles, obligations and responsibilities. Other challenges relate to the relationship between the DIEE and other government and non-government actors involved in public building construction, notably the Ministry of Public Works and NGOs.

Recent developments

Recent Development 1: Awareness of exposure is growing within the government and society alike.

Recent Development 2: Based on modelling and data on each hazard type over the past 30 years, the likelihood of each of these hazardous events occurring was classified as ‘low’, ‘moderate’, ‘high’ or ‘extremely high’, enabling the pro- duction of hazard zoning maps by type of disaster.

Recent Development 3: In 2019, the resilience interventions implemented proved their value. Schools built or adapted for resil- ience resisted cyclone Idai without significant damage.

Recent Development 4: UN-Habitat published a guideline book on each of the four main hazard types. These state the current major building vulnerabilities and provide, in a user-friendly way, different technical solutions to reinforce school buildings with locally available materials..

Recent Development 5: Various public building maintenance documents have been issued by the Ministry of Public Works while the Ministry of Education has developed one specifically for schools. A retrofitting approach is being test- ed nation-wide targeting 3,000 classrooms under a new UN-Habitat technical assistance project funded by the World Bank.

Recent Development 6: As a result of the Safer Schools Initiative, a progressive revision of building regulations towards the de- velopment of building codes with standards for disaster-resistant construction was commenced in 2015 when MINEDH revised the national construction models for conventional schools. Today, MINEDH, with technical assistance from UN-Habitat, is seeking to fix the normative and technical standards for a disas- ter resilience education infrastructure with a Ministerial Diploma.

Key findings 2012-2015

Finding 7: Safer schools result from an efficient interplay between institutional, legal, procurement, capacity and technical factors. However, improving this will make little difference without improving the capacities of those who execute the works in the field. Lack of capacity among provincial, district and local building contractors has been singled-out as an important factor in poor construction that increases vulnerability. A partnership of technical institutes, academia, as well as public and pri- vate sector organizations is now seeking to address this.

Finding 8. Works supervision is often underprovided due to logistical challenges, limited technical capacities within the districts and administrative deficiencies. These essential aspects of quality control should be enhanced to promote better contract management by the institution or individuals responsible for oversight or contractor training

Finding 9. Today, there is a stronger political will in Mozambique to address school vulnerability.

Finding10. Although the primacy of conventional technologies and materials in public construction is legitimate and recognized, 45 percent of all classrooms in the country still consist of local or mixed materials. As these 'precarious' buildings are grad- ually being replaced with conventional buildings, support should also be given to communities for construction of more resistant schools in mixtures of local resistant materials.

Finding 11. Following surveys of disaster-affected schools, technical construction experience and know-how has accumulated in Mo- zambique. Although global data show that integrating resistance solutions into the school designs is on average between 5 and 15 percent more expensive, the savings on both direct and indirect costs are significant.

Finding 12. Access to and availability of data is problematic in many developing countries. This can be overcome through the collection of basic data and partnerships with academia.

Recent developments

Recent Development 7: UN-Habitat has developed, jointly with the Ministry of Education, different training packages on resilient school reconstruction that have been recognized by all partners. Several assessment instruments devel- oped by UN-Habitat have also been adopted.

Recent Development 8: Despite legally required supervision continuing to be a challenge, technical capacities are increasing, albe- it still suffering from poor logistics and some reluctance amongst administrators.

Recent Development 9: The Safer Schools Initiative validated and consolidated the political will when, in 2019, the buildings it had rehabilitated withstood the impacts of cyclones Idai and Kenneth.

Recent Development 10: The successfully adopted methodology of mixed materials is an important achievement. In 2017, MINEDH officially adopted the 'mixed materials' school as one of the approved models to resist high winds predominantly in rural areas.

Recent Development 11: Field experience has shown that, with new construction, the costs of resistance upgrading are barely 10 percent. In rehabilitation and reconstruction, however, such adaptation costs can be up to 25 percent.

Recent Development 12: Currently, UN-Habitat, with ECHO funding, is supporting MINEDH with updating the Carta Escolar, a data- base on education infrastructure in Mozambique, to mainstream emergency preparedness and responses to disasters and to strengthen cross-referencing data with other information such as meteorological maps.

04
Partnering and scaling up

On the job Training in Resilient School Reconstruction in Nicoadala | Source: UN-Habitat

Introduction

UN-Habitat consolidated the partnerships established under the Safer Schools Initiative to implement the guidelines and to scale-up the impacts.

National building codes and blueprints of school designs for different risk zones had been revised by MINEDH in line with the recommendations of the Consultative Group. With World Bank and UNICEF funding, hundreds of classrooms have since been built or rehabilitated under MINEDH's leadership using conventional and mixed (i.e. combinations of local and conventional) materials.

Following the floods of 2015 and cyclone Dineo in 2017, UN-Habitat partnered with UNICEF to rehabilitate classrooms with traditional and conventional materials while delivering on-the-job training to local master builders and community members. Through the Basic School Emergency Plan (BESP) , community awareness increased.

Overview of major disasters

Main Disaster Events in Mozambique, 2015–2017

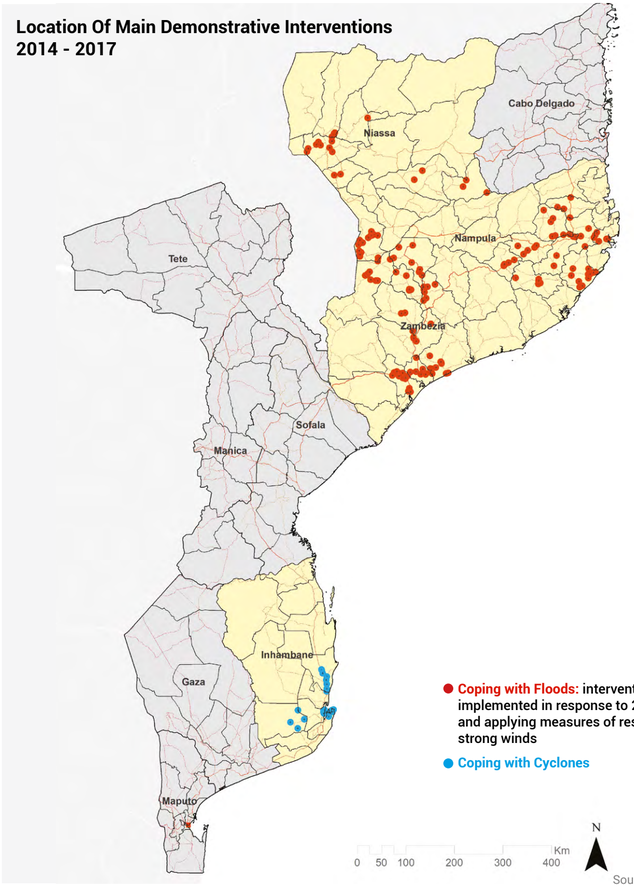
2015 Floods

Over 320,000 people, including 50,000 internally displaced persons (IDPs), were affected by flooding in Zambézia, Nampula and Niassa. Approximately 73,000 hectares of crops were washed away affecting 85,000 families' food security. An estimated 30,000 houses were totally or partially destroyed, along with 2,362 classrooms. The overall death toll was 158. *(HCT/WB, Feb 2015)*

2017 Cyclone Dineo

Dineo affected 1,743 households and destroyed 1,313 houses *(CVM,2017)*. The communities themselves were safe since they had moved to safer ground, but their houses and 13,477 ha of crops were swamped by water. Winds and floods damaged 1,600 classrooms affecting about 150,000 students (UN-Habitat, 2017).

Location Of Main Demonstrative Interventions 2014 - 2017



Source: UN-Habitat

Building back better

Key Concepts and Glossary

To explain the implementation process and methodology for increasing community resilience to disasters, it is appropriate to start by clarifying the fundamental concepts on which the interventions were based.

Building Back Better (BBB)

Building Back Better (BBB) focuses on rebuilding stronger and more resilient systems. It seeks to mitigate future disasters by increasing communities' resilience to external shocks, whether physical, social, environmental or economic. In this way, DRR also influences development. Yet, BBB, as distinct from development, does not focus on rectifying a country's developmental deficits but rather seeks to make communities more resilient and recovery efforts more sustainable.

BBB applies to all aspects and sectors of post-disaster recovery. In infrastructure reconstruction, BBB supports communications, education, energy, health, transport, water and sanitation services. In livelihood recovery, BBB extends to agriculture, commerce, employment, industries and public services. BBB also applies to cross-cutting issues such as gender, the environment and governance.

The following would be BBB activities:

- Introducing DRR measures (including effective building codes and regulations) to increase the resilience of physical assets (e.g. raised floor elevation in flood areas);
- Introducing and enforcing appropriate land-use planning regulations to curtail (re)construction in high-risk areas; and
- Using rebuilding to 'right-size' infrastructures to better match current and future needs.

On-the-job training on resilient school construccion. Sofala 2022

Key Concepts of BBB in Education Infrastructure

The BBB approach applied to Mozambique's education system uses the post-disaster recovery process to make school buildings more resistant. It introduces the 'dual purpose' concept whereby school buildings also serve as a community shelter or refuge in case of emergencies. BBB is a natural evolution from the Living with Natural Hazards approach described in Chapter 2. It capitalises on previous post-disaster experiences and seeks to mainstream DRR through improved construction practices and building codes.

BBB's approach in Mozambique goes beyond the 'hard component' of mere reconstruction. It also drives home the 'soft component' of training and capacity-building so that families and communities will be empowered to realise their own recovery. Nonetheless, local governments must also be empowered to help manage communities' recovery efforts.

Reconstruction and Rehabilitation

BBB uses two intervention types that differ in scope: reconstruction and rehabilitation. Reconstruction implies a complete building restoration, while rehabilitation is a partial intervention, applied when there is less or minor damage. Both types integrate adaptation measures to increase the resilience.

The Floods and Strong Winds of 2015

During the rainy season of 2014-2015, flooding overwhelmed Mozambique's response capacities. The government declared a red alert and the INGD, through its Coordination Office for Reconstruction (INGD-GACOR), appealed for assistance for the most affected populations, especially in Zambézia, Nampula and Niassa.

RECONSTRUCTION AND REHABILITATION

Direct versus Indirect Implementation: Pros and Cons

Reconstruction and rehabilitation can be managed in two ways: a) direct implementation by MINEDH hiring building contractors; and b) indirect implementation via an NGO supplying the building contractors. Through experience, UN-Habitat has identified the pros and cons of each option:

1) Direct implementation by MINEDH hiring building contractors

Pros:

- It guarantees official support to the capacity-building component at different stages;
- A competency-based tender can reduce costs;
- MINEDH has provincial and district departments that can support supervision;
- This type of contract can insist on a contractual guarantee

Cons:

- The process can be delayed by administrative red tape;
- An oversight technician is indispensable to ensure construction quality;
- Transparency in building site management requires supervision by MINEDH.

2) Implementation via an NGO hiring building contractors

Pros:

- The NGO, normally, guarantees community participation;
- Environmental and social safeguards are easily monitored;
- The contract can be an Agreement of Cooperation that allows for sharing the implementation responsibility and costs;
- The administrative process can be faster;
- Cost overruns are more easily controlled.

Cons:

- Some NGOs have no construction expertise or may not know the procedures well;
- Large NGOs can be very expensive due to their administrative costs;
- It is necessary to have alignment between the authorities and the NGO to meet standards and regulations;
- The overall cost can be higher depending on the intervention's complexity.

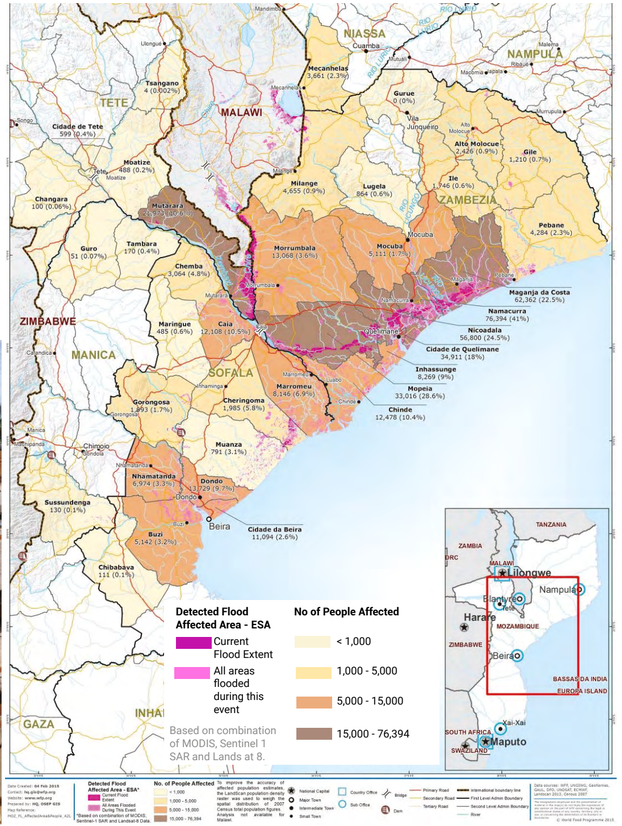
Coping with floods and strong winds

The floods and strong winds 2015

From January to March 2015, the Licungo and Chire River Basins in Zambézia were hit by heavy rains, strong winds and flooding. This impacted 326,000 people and caused 158 fatalities while 30,000 houses, 2,362 classrooms and 17 health units were totally or partially destroyed. The estimated damage in the education sector alone was around USD6.2 million and sustainable reconstruction was estimated at USD11.3 million . The floods also hit 110,602 ha of crops while 72,965 ha were totally destroyed thereby rendering 85,420 smallholder-families food insecure (SitRep#6 UNRCO 2015).

Source: UN-Habitat

Map of Flooded Areas



Source: WFP

Shelter and spatial planning capacity

The dangers facing communities living within the river basins of the Zambézia Province became evident during the 2014-2015 rainy season. As a result of flooding, most of the population was moved to temporary accommodation centers and then 10,045 families or 50,423 people in total were further moved to government resettlement areas (INGD 2015).

To this end, 43 resettlement areas were created in Zambézia. By the end of March 2015, 12,000 new plots had been established and 10,400 had been assigned to communities from the lowlands of the Licungo River Basin. This resettlement programme was part of a medium- and a longer term plan to progressively relocate people away from flood-prone areas, thereby offering them a safer place to establish new livelihoods and build houses with basic public services.

However, this was hampered by several problems. There were too many targeted families while the households were too poor and had insufficient technical knowledge to build their own shelters and WASH facilities. Harvesting of construction material damaged the surrounding environment and the chosen relocation lacked adequate spatial planning. As a result, entire communities were exposed to inadequate living conditions in these new places. These relocations also raised livelihood concerns, while lack of technical assistance hindered a smooth transition from basic shelter to incremental housing and the establishment of durable long-term villages.

Transition from the emergency to the recovery and reconstruction phases requires a variety of shelter interventions. Resettlement contexts need to be considered, because durable shelter solutions require either housing provision or capacity-building for self-help. Therefore, UN-Habitat and IOM, with ECHO funding, provided technical assistance: a) to improve vernacular shelter, b) to support basic incremental housing construction and c) to enhance spatial planning for the densest new settlements in the Zambézia Province.

The main objectives of these interventions were:

a) Increasing communities' capacities to access suitable shelter solutions through construction training targeting the most vulnerable in dense resettlement areas of Zambézia Province; and

b) Increasing provincial-level spatial planning competence by developing cadastral maps and land titling for five resettlement neighbourhoods.

The Ministry of Public Works, Housing and Water Resources (MOPHR), together with INGD and the Ministry of Land, Environment and Rural Development (MITADER) in Zambézia, provided overall coordination at the provincial level. Early involvement of these authorities proved highly productive. Government technicians took part in monitoring missions, on-the-job training and in the preparation of cadastral maps. The Housing Directorate liaised with the district administrations (SDPIs) to integrate all comments on the technical housing blueprints for improved vernacular building designs.

The above activities were coordinated by local district governments, key community actors and local committees in charge of disaster management.

A UN-Habitat team of architects experienced in DRR, shelter and urban planning coordinated and delivered the initiative at the provincial level. This team ensured liaison with IOM, Welthungerhilfe and CONCERN Worldwide - the partners involved in training and in the distribution of tarps and shelter tool kits in Zambézia. The main outcomes were:

- Seven on-the-job training sessions on BBB for vernacular construction techniques and materials delivered;
- The quality of households' existing shelters improved;
- Households trained in the use of the shelter tool kit; and
- Households' knowledge of basic concepts of neighborhood organization enhanced.

To encourage immediate replication, UN-Habitat provided rapid training-of-trainers on improved vernacular shelter construction. During on-the-job training, which was delivered to groups of 25-30 people, active participation was encouraged. A total of 216 people from relocation areas participated, as well as technicians from the district's SDPI and Welthungerhilfe. With feedback from the communities and the local authorities, three calamity-resistant vernacular housing models were developed.

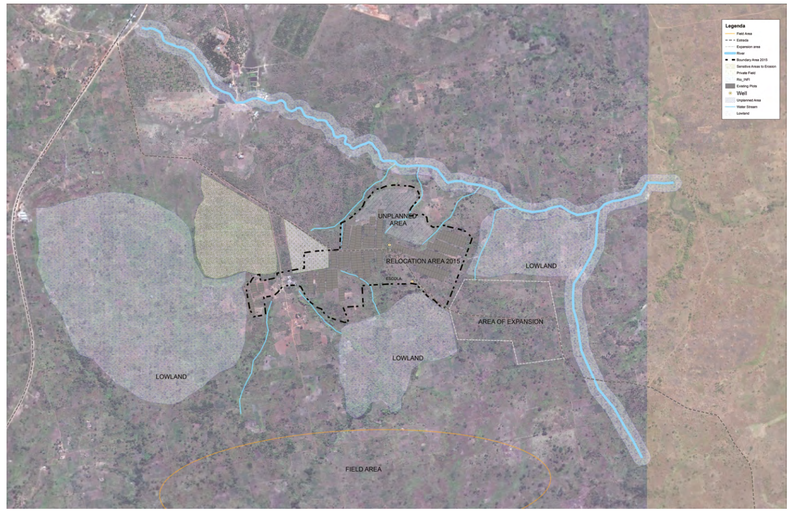
Participatory Planning | Source: UN-Habitat

Development of cadastral maps

- Cadastral maps were developed to facilitate land registration and to issue land titles. Land title documents are fundamental in generating a sense of ownership and belonging. They encourage households to root in the resettlement areas. They further ensure that the investments made by the public authorities and the new owners are protected by the land laws. Land titling involves different steps and actors, from the authorities at the local, district and provincial levels to the beneficiaries. Consultative meetings and field surveys support information flows among the communities and the key authorities.

- With UN-Habitat assistance, sufficient information was generated about the resettlement areas to establish fully-fledged land registration processes by the local governments. As a result, UN-Habitat could quickly produce five cadastral maps for the relocation settlements. These maps, together with related technical information and a description of the methodology applied were then delivered to the provincial authority (MITADER). This with a view to informing the establishment of land registration processes elsewhere in the province. UN-Habitat also provided maps to help restructure neighbourhoods where the grid and plots had, until then, not been well organized.

Above and below - Elaboration of Risk Mapping in Nacogolone new resettlement camp. Zambezia province



Reordering plan in Mucoa new resettlement camp. Zambezia province

Primary School 4 de Outubro, Nicoadala

The floods and winds of the 2014-2015 rainy season affected more than 140,000 in Zambézia and partially or totally destroyed more than 2,500 classrooms. Reconstruction focused on quickly delivering improved classrooms in different construction materials through the BBB approach. Funded by the EU, the project was implemented by UN-Habitat and its partners, while government bodies provided oversight. These interventions also aimed at strengthening technical capacities for emergency preparedness and responses at provincial and district levels. Through advocacy and training they further sought to sensitize technicians and builders about DRR, BBB reconstruction, and Water, Hygiene and Sanitation (WASH) facilities in schools.

When the project started, the school 4 de Outubro in Munhonha had 41 teachers, 934 primary and 1,225 secondary students. The school used the three construction types of Mozambican schools: two of its four classroom blocks had been built according to standards adapted to strong winds; one had been built with the conventional methodology; and a fourth had been constructed with traditional materials.

As can be expected, the conventional and the traditional classrooms were the most wind- and water damaged. Reconstruction consisted of reinforcing the roof structures; rebuilding the gables; replacing the roof covers; and repairing the floors and walls. This work was carried out under the supervision of Welthungerhilfe, with UN-Habitat providing the coordination.

Damages at Nicoadala's school | Source: UN-Habitat

On the job Training in Resilient School Reconstruction in Nicoadala | Source: UN-Habitat

Primary School " 4 de Outubro" - Rehabilitation Process | Source: UN-Habitat

BBB Reconstruction of 32 Classrooms

Following the 2014-2015 flood and wind destruction of schools in Nampula, Zambézia and Gaza, UN-Habitat, provided technical assistance to the BESP projects with the provision of designs, planning and technical assistance for BBB reconstruction with a view to:

a) strengthening central and local level response and adaptation capacities for mitigating natural disaster impacts on schools, including the provision of child-friendly WASH facilities. Assistance was provided with improved designs and more resistant building techniques with mixed construction materials;
b) supporting the introduction of BESPs with educational materials on emergency preparedness for children and teachers; and
c) emphasizing, at high political levels, the need for additional school safety and disaster-resistant public infrastructure as well as the incorporation of sustainable reconstruction in all sectors.

Community participation and local DRR capacity building was achieved through workshop and on-the-job training under supervision by UN-HABITAT. Partners in resilience education contributed to the training while NGOs assisted with the construction and upgrading of classrooms built in mixed materials. The project was also supported by World Vision International, Care and ASF.

Improved local construction techniques and materials were used in adapted architectural models. A large share of the workforce came from local communities. This helped strengthen the residents' capacities to mitigate the risks of disasters. This pilot BESP project linked resilient infrastructures with the schools' risk profiles and with the measures to be taken before, during and after an emergency. The project achieved three main outcomes:

OUTCOME 1:

Community-based BBB helped reduce the vulnerability of schools in Zambézia while affordable, child-friendly sanitation facilities were provided. To achieve this, 32 mixed-material classrooms were selected across the flood-prone zones of Namacurra and, in collaboration with the District Government, were rebuilt or rehabilitated applying the BBB approach. This entailed three steps:

1. Analysis: Post-disaster assessment showed that major problems were caused by poor construction materials and poor wind orientation;
2. Preparation of architectural and structural drawings, bills of quantities and technical specifications: These were all provided by UN-Habitat; and
3. Reconstruction: The foundations were rebuilt; the walls were reinforced and plastered with soil cement; the roof was made cyclone resistant. These activities were undertaken by NGOs, artisans, local builders and community members (who had benefitted from on-the-job training).

Technicians from MINEDH, MOPHRH and INGD represented the provincial and central levels.

Despite logistical difficulties, experiments with new technologies and materials proved successful. Different school types (in terms of materials used) were (re)constructed in seven locations, delivering 32 improved classrooms and seven administrative rooms. Since sanitation facilities were unhealthy and/or unsanitary, a sanitation model, in line with the Norms and Standards for Water and Sanitation Facilities was introduced for the provision of 40 affordable, culturally adapted and improved latrines, urinals and handwashing stations.

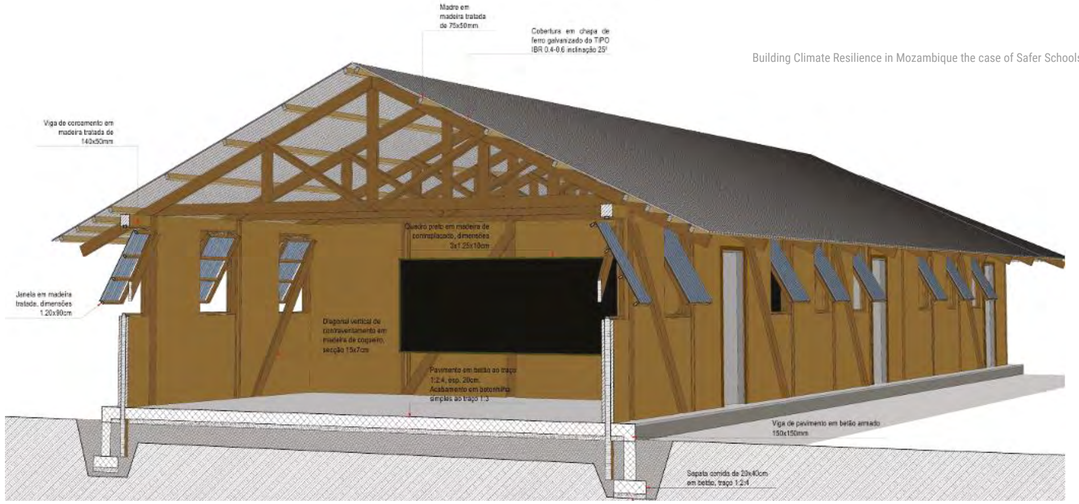
The project offered on-the-job training for master builders, school councils, pupils, NGO partners and the Local Disaster Risk Management Committee (CLGR) in each school.

OUTCOME 2 :

The need for better school safety was emphasized by promoting the integration of resilient reconstruction considerations into the national policy for school (re) construction. At the end of 2017, UN-Habitat organised a workshop on school infrastructures and child safety. It also evaluated the lessons learned during project implementation. It was attended by stakeholders from the education and DRR sectors and concentrated on:

a) Recording the outcomes of and lessons learned from reconstruction processes using mixed materials;
b) Rehabilitating a conventional-materials school in Inhambane Province;
c) Implementing BESPs in six schools throughout Mozambique, (re)establishing School Committees of Disaster and Risk Management (CEGRC); and
d) Establishing evacuation routes, learning first aid and creating a safe zone within the school.

Reconstruction Process | Source: UN-Habitat



Mixed Materials Resilient School Model | Source: UN-Habitat

Above: Brigodo School - Reconstruction Process - Below: Construtions Finished | Source: UN-Habitat

Mazoao School - Reconstruction Process | Source: UN-Habitat

Adapted Sanitation Models and Trainings | Source: UN Habitat

Mazoao School - Reconstruction Process | Source: UN-Habitat

OUTCOME 3 : School emergency preparedness and response activities are reinforced at local level by developing and testing the first version of the Basic Emergency School Plan (BESP) and its results are validated and adopted by MINEDH in order to prepare the replication phase

BESPs helped reinforce local level school emergency preparedness and responses. This approach was adopted by MINEDH in preparation for replication in selected schools based on district or province risk profiles, past recurrent disaster exposure and impacts, and likely future impacts. The project emphasized the need for school emergency responses before, during and post-emergency.

BESP implementation | Source: UN-Habitat

Main Steps of the BESP Pilot

Step 1:
Preparation of training materials

Eight technical meetings were held by UN-Habitat, UNICEF and MINEDH that resulted in the development of a first BESP model to be completed by the CEGRC members through a participatory process. Nineteen posters were produced illustrating the BESP process and six posters on retrofitting techniques and improved basic reconstruction in schools. A further eight posters on first aid were also prepared.

Step 2:
Establishment of the CEGRCs

A second mission to six schools was carried out to establish CEGRCs and provide training, with 23 members in each committee. CEGRCs participated in the development of six BESPs. This included risk mapping, risk planning and identification of measures to consider before, during and after emergency events.

Step 3:
Monitoring, evaluating and implementing BESPs

Remote monitoring was put in place for implementing the activities proposed by CEGRC.

Step 4:
Final review and lessons learned

A joint team of UN-Habitat, UNICEF and MINEDH carried out a first revision of the guidelines for BESP development and the BESP model, based on the product delivered, the results and the lessons learned.

Technical Support within the ERRP

School reconstruction under the Emergency Resilient Recovery Framework (ERRP)applied the recommendations of the Safer Schools Initiative. The Framework's significance lies in the adoption of normative change by MINEDH and coordination with MOPHRH and the National Directorate of Buildings (DNE) as strategic partners in the provinces. The project sought alignment with other school upgrading projects, community-based school reconstruction pilots in Zambézia, and the implementation of BESPs. It capitalised on the benefits of reconstruction initiatives and put down the foundations for future post-disaster recovery strategies and actions in Mozambique.

The technical approach applied was based on the following elements:

- Knowledge transfer: The reconstruction and rehabilitation, due to its participatory nature drove an integrated process of capacity building and knowledge sharing.
- Information and communication management: Information, communications and knowledge management were key to the success of the intervention. Community sensitization through learning materials and audiovisual teaching was particularly relevant.
- Technical aspects of rehabilitation and improved reconstruction: The most important outcome was the establishment of a normative framework to reconstruct schools under controlled construction standards.
- Good practices: Good practices have been identified for possible replication worldwide.
- Quality evaluation: Evaluation and quality control during and after the construction process were important sustainability factors.

Monapo School, Nampula Province - Reconstruction Process | Source: UN-Habitat

- The 'hard component' of the project - large-scale (re)construction of classrooms affected by the 2014-2015 rainy season - delivered the following:
- Reconstruction or rehabilitation of 372 classrooms in conventional materials by contractors hired and supervised by MINEDH. It integrated improved technical solutions while it also improved the BBB capacities of constructors, provincial technicians and supervisors; and
- Reconstruction or rehabilitation with community participation of 267 classrooms in mixed materials. UN-Habitat provided technical support and assisted MINEDH with organizational and institutional matters, including documentation; capacity reinforcement; monitoring and supervision.

Main Steps of the Emergency Resilient Recovery Project

Step 1: Start of project activities (February 2017)

Establishment of the institutional platform (including the methodology, work plan and the ToR of the technical group). Acquisition of a list of damaged schools and the writing of the school-selection criteria.

Step 2: Project launch, preparation of tools and documents and damage assessment (February 2017–June 2017)

Development of technical and organizational documents for project implementation. Writing of the ToRs for the selection of NGOs, contractors, supervisors and survey technicians. Establishment of the Technical Group. Survey of construction materials and selected schools in three provinces. Desk analysis and prioritization of assessed schools. Development and provision of training packages. Organization of the first seminar of stakeholders in the educational sector and disaster management.

Step 3: Technical support to tendering processes (July 2017–December 2017)

Preparation of the tender documents; tender screening process and tender awarding.

Step 4: Technical support, training and monitoring of implementation (January 2018–November 2021)

Development of a Maintenance Guide for Classrooms. Training of contractors, the overseer(s), NGOs and the communities. Supervision of the (re)construction of classrooms.

Step 5: Final report on technical assistance (December 2021)

Development of the final report and its submission to MINEDH, including copies of all technical documents produced during the project implementation.

Cheia-Cheia School, Niassa Province - Before and After reconstruction | Source: UN-Habitat

Above and Below : EPC Muchaleque in mixed materials - Nampula Province | Source: UN-Habitat

Above and Below : EPC Nacorro - Nampula Province | Source: UN-Habitat

Above : EPC Mecutusse in mixed materials - Nampula; Below : EPC Mulucune - Nampula | Source: UN-Habitat

Above : Sanitation Facilities in Mixed Materials | Source: UN-Habitat

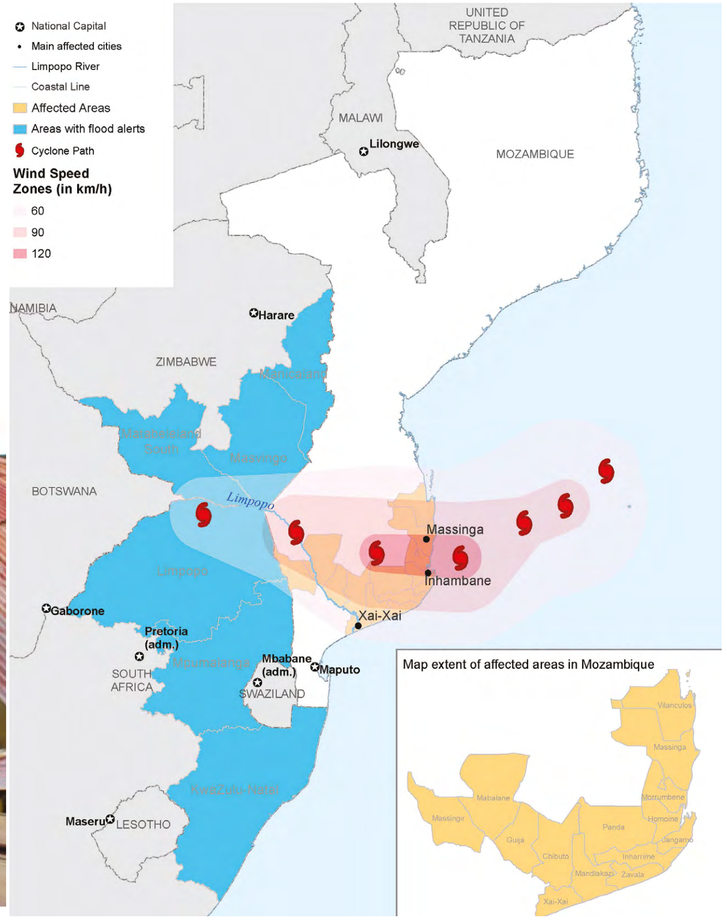
Coping with Cyclones

Cyclone Dineo

In February 2017, cyclone Dineo hit the southern coast of Mozambique with strong winds and torrential rains. Dineo was a category-3 cyclone. It caused major destruction along its path through the Gaza and Inhambane provinces with winds of 130km/h; and, heavy rains caused rivers to overflow. Dineo destroyed 1,313 houses and forced 1,743 households to move to safer locations. They left behind 13,477 flooded hectares of crops. Winds and floods also damaged 1,600 classrooms that affected approximately 150,000 students (UN-Habitat, 2017).

School damaged by Dineo
Source: Earth Chronicles News earth-chronicles

Cyclone Dineo's Trajectory



Source: IFRC

Disaster-resilient roofing

Following cyclone Dineo, UN-Habitat integrated DRR into the recovery of physical infrastructures. This was part of an earlier agreement with UNICEF under which UN-Habitat was to provide technical support for emergency recovery of primary schools in Inhambane to facilitate an early resumption of education. To this end, disaster-resilient roofing was applied to partially destroyed schools while temporary learning spaces were set up for schools with extensive damage. Associated project outcomes included reinforcing BBB capacities, rebuilding classrooms with improved technologies and DRR training for technicians, school communities, local artisans and contractors.

Repair and reconstruction with more-resilient roofing was started after the completion of a post-damage assessment that had reviewed 48 classrooms in the Jangamo and Morrumbene districts. Most classrooms had poor quality roofs that were either seriously damaged or had totally collapsed. A project was formulated and tender documents prepared. The interventions completely reconstructed the roofing with new trusses, purlins and cover plates. Wherever classrooms had sustained less damage and only new roof covers were needed, mere rehabilitations took place with reinforcement of the joints between structural roof elements. Both approaches assured enhanced resistance to high winds.

The architectural design used was the standard, nation-wide model promoted by MINEDH - a 'cooky-cutter' school model that would make mass production easier. However, it was soon realized that a 'one-size-fits-all' approach was not sustainable and that a tailored approach was needed for each school.

The governmental bodies MOPHRH, INGD, UCEE together with UNICEF and UN-Habitat monitored the above program. NGOs provided on-site supervision while interested donors followed the process. In Inhambane, UN-Habitat provided capacity-building and training to contractors, master builders, local authorities and NGOs. This improved the local BBB knowledge and how to identify structural weaknesses in school buildings while also enhancing understanding of disaster cycles.

Es 1º de Maio Chicuque / Maxixe

Es Chambone / Maxixe

Arquitectura sin Fronteras (ASF) supported as implementing partner with financial support of Irish Embassy | Source: ASF

Key findings and lessons learned

More than two decades of recurrent natural calamities in Mozambique has shown that one of the main challenges of DRR is maintaining a focus on long-term solutions that allow for better living standards in the affected areas. It is important to not only repair damage but to also promote a broader vision of recovery that supports development in the aftermath of a disaster.

Due to the rising number of schools repeatedly experiencing natural hazardous events, regulation of school design and construction is becoming ever more important in Mozambique. Indeed, the government has made significant progress in providing models for primary schools that are better adapted to withstanding extreme natural events.

The Minister of Education has taken responsibility for the development of different school models and for implementing the Emergency Resilient Recovery Project. Large-scale 'building back better' of educational facilities is now taking place.

The introduction of building regulations for schools, combined with improved recovery actions, has highlighted the effectiveness of multi-level (national, provincial and local) efforts involving government authorities, the Humanitarian Country Team (HCT), partners and donors.

The main lessons learned during 2015-2017 can be summarized as follows:

1. School construction continues to be challenging in Mozambique from a DRR perspective, as in terms of finding the right methodology for scaling-up to the national level.

2. Mixed-material construction is appropriate for post-disaster rebuilding needs and is also practical within the Accelerated Classroom Construction Programme. Its large-scale application contributes to rapidly and cost-effectively reducing the number of schools in precarious structural conditions. It also guarantees less-interrupted education for primary school pupils.

3. Valuable experience and technical information on (re)construction of classrooms and sanitary blocks in mixed material is now available.

4. During the transition from emergency to recovery, the BBB approach has experienced drawbacks. BBB demands significant time because it is a multi-stepped process that requires field assessments, tendering, hiring of contractors and additional technical assistance.

Source: UN-Habitat

Key findings and lessons learned

5. Reconstruction and rehabilitation projects create opportunities to increase local capacities for disaster risk responses, adaptation and mitigation.

6. It is fundamental to ensure that school communities, besides becoming involved in rehabilitation, have the technical know-how to identify structural problems in their school buildings and solve these with the help of local artisans before calamities occur.

7. In general, direct implementation is a challenge. Pilot projects covering up to 15 classrooms can be managed by NGOs, but large, scaled-up programmes need subcontractors at provincial and district levels.

8. Outstanding preventive maintenance remains one of the key challenges for the safety of educational buildings. Preventive reinforcement and retrofitting should not only be promoted but also followed up with recurrent inspection and maintenance during the medium-term (5 years).

9. School building resilience requires soft and hard interventions. The Basic Emergency School Plan (BESP) is an effec- tive option for making school communities resilient to disaster risk and capable of emergency responses. The BESP combines physical and non-physical measures to reinforce local technical capacities for natural hazard mitigation, response and recovery. It helps school communities manage disaster risk with local capacities without dependence on central institutions of disaster management.

10. To replicate the BESP in high-risk zones, it is fundamental to develop tools that complement the implementation of the Training of Trainer Manual and the Pupils Manual.

11. The reconstruction is an opportunity to adapt and upgrade existing buildings to provide universal accessibility (ramps, handrails) as well as to rethink educational spaces to better adapt to special gender needs.

05
Validation of Resilience Standards

Introduction

Through its diversified multi-level approach to natural hazard resilience in Mozambique's human settlements, UN-Habitat identified school vulnerability as a proxy to estimating the magnitude of communities' overall vulnerability. Indeed, public infrastructure buildings, like schools and health centers, are often communities' only disaster-resistant structures. Safe schools are therefore central to communities' safety and resil ience.

This understanding has prompted UN-Habitat in Mozambique to start the Safer Schools Initiative in 2011-2012. The Initiative's initial activities included:

1. An assessment of schools' natural disaster exposure;
2. Climate risk mapping;
3. Development of building guidelines; and
4. Technical assistance to the central government in developing improved building codes.

By introducing new normative and construction standards for repair and reconstruction the Safer Schools Initiative proved very effective in promoting systemic changes in school construction. The Initiative enhanced coordination and built construction capacities of sub-contractors and communities engaged in school building. With strong support by the government and academia, the Safer Schools Initiative managed to achieve unprecedented impacts and became a global best practice.

After the development of national guidelines for safer construction (2012-2015), the Initiative established a strong partnership with UNICEF that allowed for implementation of the new guidelines and the scaling-up of activities. In 2017, UN-Habitat was engaged by the Ministry of Education

UN Secretary-General's visit to the school 25 of June hat withstood Cyclone Idai in Beira : the different condition of a resilient school and a vulnerable school | Source: UN-Habitat

and Human Development to provide technical assistance to a USD15 million World Bank-funded school reconstruction and retrofitting programme. Between 2018 and 2020, almost 1,100 classrooms were rehabilitated or re-built in Central and Northern Mozambique, benefitting approximately 50,000 children.

CYCLONES IDAI AND KENNETH

In 2019, the cyclones Idai and Kenneth validated the Safer Schools Initiative and its concepts. Despite the great striking power of these two cyclones, all the newly rehabilitated or (re) constructed school buildings withstood the cyclones' onslaught. This also showed that UN-Habitat's 'Living with Natural Hazards' approach could work.

The 2019 storm season brought one of the world's worst cyclone disasters and caused an unprecedented loss of lives and devastation in Mozambique. For the first time ever, two major tropical cyclones made landfall in Mozambique during the same cyclone season, suggesting that cyclone activity is increasing with climate change, a trend that has been confirmed by the cyclone seasons of 2020 to 2023.

Idai made landfall twice in Mozambique. First as a tropical depression on 5 March 2019, affecting Quelimane City and the central and northern provinces - Zambézia and Nampula in particular. Then, during the night of 14 to 15 March it struck as a category-4 tropical cyclone. It made landfall in the cities of Beira (530,000 inh.) and Dondo (150,000 inh.) where it caused major destruction before moving westwards through Sofala and Manica provinces until it died off in Zimbabwe. The cyclone and the subsequent riverine floods affected some three million people in South-eastern Africa, half of whom were living in Mozambique. Cyclone Idai left behind a trail of destruction in Gaza, Inhambane, Manica, Sofala, Tete and Zambézia provinces. The coastal city of Beira was hit the hardest with an estimated 90 percent of its infrastructure being destroyed.

Then, on 25 April 2019, tropical cyclone Kenneth made landfall in northern Mozambique, hitting Cabo Delgado and Nampula with impacts similar to those of cyclone Idai. With its 220km/h wind speeds Kenneth was the strongest cyclone ever to make landfall in Africa. Ibo Island - in the process of becoming a UNESCO World Heritage Site - was destroyed. The city of Pemba, as well as the rural districts Macomia, Mecufi, Mueda, Muidumbue and Quissanga were heavily affected, especially by the subsequent flooding. Kenneth lashed out at almost 200,000 people. Political instability in those parts of the country made emergency relief operations difficult and further deteriorated the already precarious conditions caused by fragile healthcare and weak water and sanitation infrastructures - notably for children, women and the elderly.

The post-disaster assessment was conducted under the leadership of the Government, through the Post- Cyclone Idai Cabinet for Reconstruction, and supported by a global partnership that included the World Bank, the United Nations System and the European Union (EU), using the internationally recognized Post-Disaster Needs Assessment (PDNA) methodology. UN-Habitat gave assistance during the process on housing and educational public infrastructure. It was estimated that Idai and Kenneth caused about USD1.4 billion in damages and another USD1.4 billion in losses. The total recovery and reconstruction costs were estimated at some USD3.0 billion for the provinces of Sofala, Manica, Tete and Zambezia alone. The additional costs for Inhambane, Cabo Delgado and Nampula raised the total recovery needs to USD3.2 billion.

More than 1.5 million people out of the 13.5 million people living in Manica, Sofala, Tete and Zambézia were affected, with more than 600 deaths and over 1,600 injured. An estimated

The visit of the UN Secretary General to the schools affected by Idai and the resilient schools constructed according to UN-Habitat's standards | Source: UN-Habitat

Human Impacts

750,000 people needed urgent assistance, of which 53 percent were women, 47 percent men, 254,000 children under 18 years of age and 63,000 elderly people over 60 years of age. Idai and Kenneth increased multidimensional poverty in Mozambique and they drastically diminished Mozambique's development gains of the last decade.

Province	# Affected Students	# Affected Teachers	# of schools affected	
			Conventional	Local Materials
Sofala	237,186	7.232	2,055	1,160
Manica	70,991	1,283	179	11
Tete	19,524	196	46	174
Zambezia	7,314	78	8	68
Inhambane	1,200	26	10	-
Cabo Delgado	41,694	897	169	477
Nampula	5,300	62	8	45
Total	383,209	9,774	2.475	1,935

Source: PDNA Report Mozambique Cyclone IDAI for distribution, 22 May 2019

Impacts on Children and Education

Mozambican children are among the most deprived in the world. They constitute more than half of the country's 28 million population. The 2017 Census showed that Mozambique had 14,261,208 children of whom nearly 10 million experience poverty in one form or another. It is estimated that there are 6.1 million child-headed households (12-14 years) and about two million orphans.

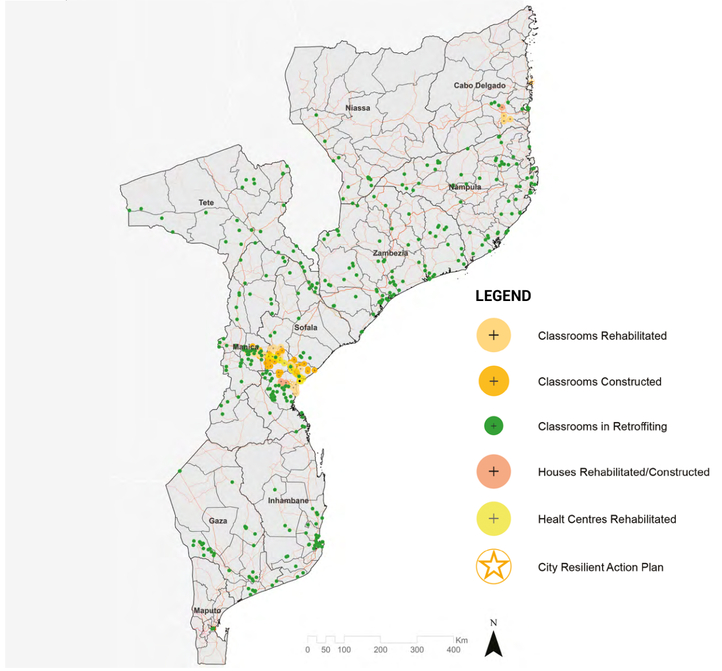
Idai and Kenneth damaged or destroyed more than 4,000 classrooms, impacting 380,000 students. A high number of schools suffered major damage to roofs, windows and doors, administrative blocks and latrines. The most-affected schools lost all of their supplies so that teachers and children had no more access to learning materials. This situation contributed to rising school dropout rates, reportedly already high in the pre-crisis period.

In the aftermath of emergencies and crises, children who do not attend school are more vulnerable, in terms of health, protection and well-being than those children who do. There is evidence that children out of school for prolonged post-disaster periods are less likely to ever return to the classroom. High displacement rates, damage to schools, homes and transport infrastructure as well as increased teacher absenteeism all have direct impacts on students' ability and willingness to return to school.

There is risk associated with a lack of positive and educational attention to adolescents. High drop-out rates can fuel community or political tensions by frustrated young people concerned about their futures. It can also lead to intensification of negative strategies to cope with extreme poverty and other economic impacts, including child labour, forced child-marriage and survival sex. For all of these reasons, it is critically important to provide immediate post-emergency access to learning for children.

Children studying in a devastated classroom | Source: UN-Habitat

Building Back Better and Resilience Building Strategy



Map of Areas where UN-Habitat supports the reconstruction efforts | Source: UN-Habitat

After the disastrous 2019 cyclone season, the Post-disaster Needs Assessment (PDNA) produced by the Government of Mozambique estimated that a total of USD3,2 billion in damages and losses had been caused. During the donor pledging conference, in Beira June 2019, a total of USD1,2 billion was promised for reconstruction and recovery, with further funds to be mobilized once clear strategies and mechanisms had been defined. Having worked within climate resilience in Mozambique for more than 15 years and significantly contributed to the PDNA, UN- Habitat formulated at the time a strategy to provide a coherent framework for guiding short-, medium- and long-term interventions in post-cyclone reconstruction - the Building Back Better and Resilience Building Strategy. This Strategy aims at enhancing climate change adaptation capacity in Mozambique and at promoting resilience at all levels by mainstreaming UN-Habitat's 'Living with Natural Hazards' approach.

The Strategy aims to consolidate and scale-up UN-Habitat's Building Back Better (BBB) approach towards reducing the risk of disasters and seeks to implement an integrated and replicable approach to urban resilience within neighbourhoods and cities and urban district scales.

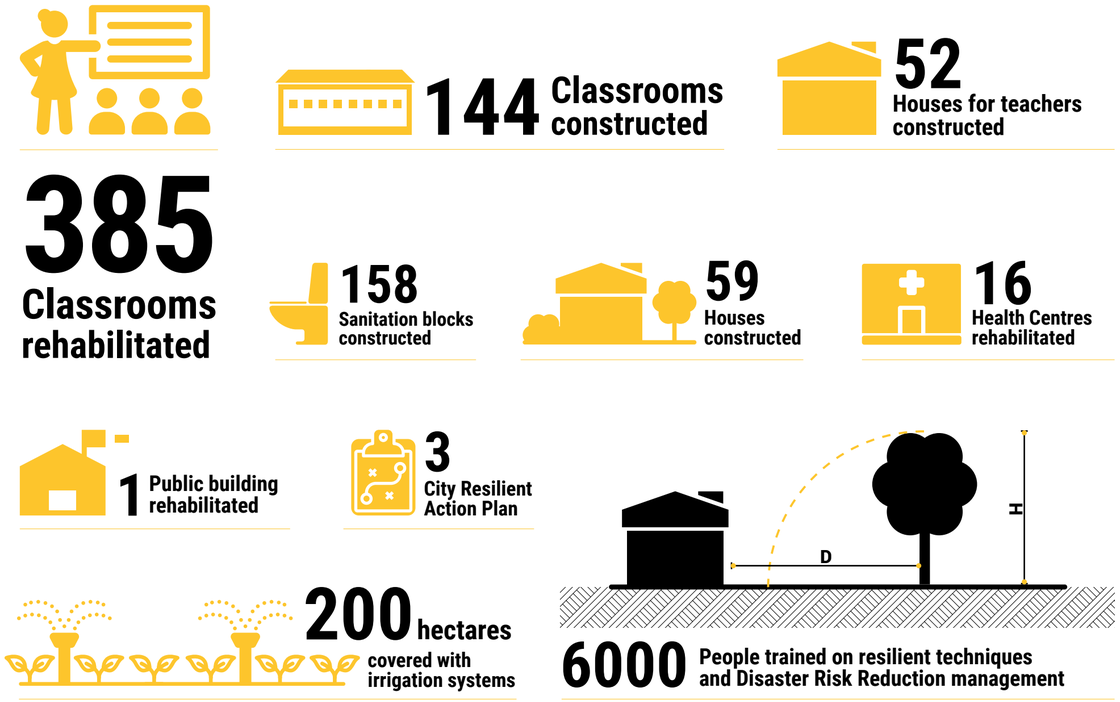
The Strategy's first objective seeks to build continuity and to scale-up the Safer Schools Initiative, shifting to a comprehensive BBB strategy for different infrastructures. It seeks to rehabilitate or rebuild public facilities in a more effective manner - whether in rural settlements or in urban neighbourhoods - so that these facilities can withstand the impact of hazardous events and can also be used as safe havens during in case of emergency. The second objective complements the first by supporting projects promoting integrated urban recovery and reconstruction strategies at the neighbourhood, town, city and metropolitan levels.

This Strategy builds on the recognition that UN-Habitat has gained in Mozambique since 2002 as a result of its work promoting long-term interventions towards Climate Change Adaptation, Disaster Risk Reduction and Resilience Building. The Strategy further seeks to provide continuity by consolidating and scaling- up the mechanisms developed during the Safer Schools Initiative.

The Building Back Better and Resilience Building Strategy provides an umbrella to a package of projects with different time frames and expected outcomes. However, all projects are integral parts and are aligned with the overarching Strategy.

This Strategy aims at supporting populations and human settlements regularly affected by often devastating climatic events. It is expected that by the completion of the Strategy the people living in these areas will have access to safer schools and health centres, more resilient housing and improved neighbourhoods.

The Building Back Better and Resilience Building Strategy is a multi-partner initiative, co-funded by the World Bank, United States Agency for International Development (USAID), the European Union, the Government of Canada, the Government of Italy, Education Cannot Wait and the results of which are shown in the graph below:



Contribution towards the Paris Agreement, the SDGs and the New Urban Agenda

All UN-Habitat's activities in Mozambique converge within the DRR framework and are recognized as fundamental to ensuring stable development. The strategy to provide a coherent framework to recovery and reconstruction over the short, medium and longer term is aligned with recent global development and urban resilience targets such as the Sustainable Development Goals (SDGs) the New Urban Agenda, and the Sendai Framework for Disaster Risk Reduction.

The Sustainable Development Goals, also known as the SDGs, were adopted by all United Nations Member States in 2015 as a global call to action to end poverty, to protect the planet and to ensure that all people enjoy peace and prosperity by 2030. The 17 SDGs are integrated, meaning that they recognise that action in one area will affect outcomes in the others and that development must balance social, economic and environmental sustainability.

Among the 17 SDGs, four are of particular relevance to the work of UN-Habitat in Mozambique:

SDG 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

SDG 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

SDG 11. Make cities and human settlements inclusive, safe, resilient and sustainable.

SGD 13. Take urgent action to combat climate change and its impacts.

The New Urban Agenda was adopted in 2016 at the United Nations Conference on Housing and Sustainable Urban Development (Habitat III) in Quito, Ecuador and endorsed by the United Nations General Assembly in December 2016. It mobilizes UN Member States and other key stakeholders to drive sustainable urban development at the local level. To this end, the New Urban Agenda contributes to the localization of the 2030 Agenda for Sustainable Development in an integrated manner and to the achievement of the SDGs and targets, including Goal 11 of making cities and human settlements inclusive, safe, resilient and sustainable.

UN-Habitat Resilience Strategy in Mozambique: Links to the Sustainable Development Goals

The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by all United Nations Member States in 2015 as a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030. The 17 SDGs are integrated—that is, they recognize that action in one area will affect outcomes in others, and that development must balance social, economic and environmental sustainability.

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

Make cities and human settlements inclusive, safe, resilient and sustainable

Take urgent action to combat climate change and its impacts

The New Urban Agenda was adopted at the United Nations Conference on Housing and Sustainable Urban Development (Habitat III) in Quito, Ecuador, on 20 October 2016. It was endorsed by the United Nations General Assembly at its sixty-eighth plenary meeting of the seventy-first session on 23 December 2016. The New Urban Agenda is an action-oriented document that mobilizes Member States and other key stakeholders to drive sustainable urban development at the local level. The implementation of the New Urban Agenda contributes to the localization of the 2030 Agenda for Sustainable Development in an integrated manner, and to the achievement of the Sustainable Development Goals and targets, including Goal 11 of making cities and human settlements inclusive, safe, resilient and sustainable.

Paragraph 51: "We commit ourselves to promoting the development of urban spatial frameworks, including urban planning and design instruments that support sustainable management and use of natural resources and land, appropriate compactness and density, polycentrism and mixed uses, through infill or planned urban extension strategies, as applicable, to trigger economies of scale and agglomeration, strengthen food system planning and enhance resource efficiency, urban resilience and environmental sustainability."

Paragraph 77: "We commit ourselves to strengthening the resilience of cities and human settlements, including through the development of quality infrastructure and spatial planning, by adopting and implementing integrated, age- and gender-responsive policies and plans and ecosystem-based approaches in line with the Sendai Framework for Disaster Risk Reduction 2015-2030 and by mainstreaming holistic and data-informed disaster risk reduction and management at all levels to reduce vulnerabilities and risk, especially in risk-prone areas of formal and informal settlements, including slums, and to enable households, communities, institutions and services to prepare for, respond to, adapt to and rapidly recover from the effects of hazards, including shocks or latent stresses. We will promote the development of infrastructure that is resilient and resource efficient and will reduce the risks and impact of disasters, including the rehabilitation and upgrading of slums and informal settlements. We will also promote measures for strengthening and retrofitting all risky housing stock, including in slums and informal settlements, to make it resilient to disasters, in coordination with local authorities and stakeholders."

Paragraph 78: "We commit ourselves to support moving from reactive to more proactive risk-based, all hazards and all-of-society approaches, such as raising public awareness of risks and promoting investments to prevent risks and build resilience, while also ensuring timely and effective local responses to address the immediate needs of inhabitants affected by natural and human-made disasters and conflicts. This should include the integration of the "build back better" principles into the post-disaster recovery process to integrate resilience-building, environmental and spatial measures and lessons from past disasters, as well as awareness of new risks, into future planning."

Paragraph 79: "We commit ourselves to promoting international, national, subnational and local climate action, including climate change adaptation and mitigation, and to supporting the efforts of cities and human settlements, their inhabitants and all local stakeholders as important implementers. We further commit ourselves to supporting building resilience and reducing emissions of greenhouse gases from all relevant sectors. Such measures should be consistent with the goals of the Paris Agreement adopted under the United Nations Framework Convention on Climate Change, including holding the increase in the global average temperature to well below 2 degrees Celsius above preindustrial levels and pursuing efforts to limit the temperature increase to 1.5 degrees Celsius above pre-industrial levels."

Paragraph 80: "We commit ourselves to supporting the medium- to long-term adaptation planning process, as well as city-level assessments of climate vulnerability and impact, to inform adaptation plans, policies, programmes and actions that build the resilience of urban inhabitants, including using ecosystem-based adaptation."

The Sendai Framework for Disaster Risk Reduction was adopted in 2015 at the Third World Conference on Disaster Risk Reduction, in Sendai, Miyagi, Japan. During the Conference, States reiterated their commitment to disaster risk reduction and building resilience to disasters. This commitment needs to be addressed with a renewed sense of urgency in the context of sustainable development and poverty eradication and, as appropriate, to be integrated into policies, plans, programmes and budgets at all levels and considered within relevant frameworks. The Sendai framework focuses action within and across sectors by States at the local, national, regional and global levels in the following four priority areas:

1 Understanding disaster risk: Policies and practices for disaster risk management should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment. Such knowledge can be leveraged for the purpose of pre-disaster risk assessment, for prevention and mitigation and for the development and implementation of appropriate preparedness and effective response to disasters.

2 Strengthening disaster risk governance to manage disaster risk: Disaster risk governance at the national, regional and global levels is of great importance for an effective and efficient management of disaster risk. Clear vision, plans, competence, guidance and coordination within and across sectors as well as participation of relevant stakeholders are needed. Strengthening disaster risk governance for prevention, mitigation, preparedness, response, recovery, and rehabilitation is therefore necessary and fosters collaboration and partnership across mechanisms and institutions for the implementation of instruments relevant to disaster risk reduction and sustainable development.

3 Investing in disaster risk reduction for resilience: Public and private investment in disaster risk prevention and reduction through structural and non-structural measures are essential to enhancing the economic, social, health and cultural resilience of persons, communities, countries and their assets, as well as the environment. These can be drivers of innovation, growth and job creation. Such measures are cost-effective and instrumental to save lives, prevent and reduce losses and ensure effective recovery and rehabilitation.

4 Enhancing disaster preparedness for effective response and to 'Build Back Better' in recovery, rehabilitation and reconstruction: The steady growth of disaster risk, including the increase of people and assets exposure, combined with the lessons learned from past disasters, indicates the need to further strengthen disaster preparedness for response, take action in anticipation of events, integrate disaster risk reduction in response preparedness and that ensure capacities are in place for effective response and recovery at all levels. Empowering women and persons with disabilities to publicly lead and promote gender equitable and universally accessible response, recovery rehabilitation and reconstruction approaches are key. Disasters have demonstrated that the recovery, rehabilitation and reconstruction phase, which needs to be prepared ahead of the disaster, is a critical opportunity to build back better, including through integrating disaster risk reduction into development measures, making nations and communities resilient to disasters.

Key findings and lessons learned (2000-2021)

Key Findings

Establishing an effective resilience culture is a long-term process in any society. It requires fine-tuning the balance between long-term development and shorter-term DRR interventions, such as building the capacities of public institutions for policymaking and executive coordination, protracted awareness raising on the one hand, and piloting innovative and impactful interventions in the form of 'quick wins' on the other. The latter can then be scaled-up to further influence policymaking and strategy formulation. Such a balance is hard to achieve and needs to be contextualized within the local social, political and financial realities UN-Habitat's Safer Schools Initiative has progressively increased human settlement resilience in Mozambique through integrated territorial approaches. However, it has, by its very nature, not addressed wider developmental matters.

UN-Habitat's activities over the past two dec- ades have raised awareness of schools' vulnerability to the impacts of natural hazardous events. The viability and effectiveness of resilient construction solutions have been identified and carefully assessed before being implemented. The successful 'building back better' (BBB) approach in school (re) construction has now been endorsed by the government and is being incrementally institutionalised. The Safer Schools Initiative in Mozambique now needs further evaluation to extract all lessons and establish the conditions for its scaling-up.

The multi-level and multi-faceted approaches applied by UN-Habitat involve central and local authorities, communities, the private sector (construction companies in particular), academia and local masons among others. Broad participation has played a key role in the success of the Safer Schools Initiative. Innovative and explorative ways have been applied to finding appropriate solutions, including adaptive architecture pilots, didactic materials, awareness raising, institutional capacity-building, local training etc. This holistic approach has contributed to progressively increased knowledge of and experience in resilient (re)construction while also stimulating political interest.

Mozambique has been prepared for resilient construction approaches that can now be systematically applied both in new buildings and infrastructures but also in post-disaster recovery and (re)construction activities. The approach includes all the required components, from damage assessment to rehabilitation, retrofitting, capacity-building and community involvement, based on BBB principles.

Lessons Learned

Led by the government, with World Bank funding and UN-Habitat technical support, a large number of post-disaster school rehabilitation/reconstruction initiatives is currently ongoing in Mozambique. This initiative aims at retrofitting 3,000 classrooms. Laudatory as these activities may be, the focus has overwhelmingly been on post-disaster responses rather than prevention. It is important that resilient construction standards are more systematically applied for reducing or preventing disastrous impacts, as well as to better connect humanitarian responses with sustainable recovery and development goals through integrated approaches in which resilient (re)construction is just one of the key aspects.

Furthermore, an element shoud be addressed in school (re)construction campaigns is the aesthetics of the current architectural models. While the Safer School Initiative has focused on guaranteeing buildings' robustness, architectural designs and the appearance of school buildings still has room for improvement. Periodic maintenance of schools is another undervalued but important factor in guaranteeing resilience over time. Unfortunately, regulation of maintenance, maintenance guidelines and procedures or the associated funding mechanisms have not yet been adequately covered.

While over the past 15 years the knowledge and practice of BBB and resilient (re)construction techniques have increased, the same cannot be said about the overall resilience of urban settlements. This entails even more comprehensive and integrated approaches, combining all the elements of city development and management. As yet, Mozambique has neither developed the appropriate policies and strategies nor the associated capacities and systems required. Moreover, while public authorities are now more aware and sensitive to DRR, the same cannot be said for private contractors and construction companies. Local contractors are still lacking the know-how and expertise to ensure resilient construction designs and execution.

Technical Recommendations

Immediate post-emergency needs assessments can be carried out by trained community members. However, school reconstruction and rehabilitation assessments are the territory of experienced professionals. It is important to provide training to ensure that proper assessment results are obtained and effectively used for planning and guideline development. A training package for school assessments exists but is not systematically being used.

To ensure adequate construction commissioning and supervision, it is recommended that third-party and/or independent companies are engaged. Eligible certified companies must have received training in resilient construction techniques and principles. These companies must accept no compromises from contractors regarding the quality of construction.

The government should allocate funds to cater not only for school equipment (e.g. pens, books, furniture etc.) but also for periodic checks, preventive maintenance and repairs. To this end, maintenance schedules should be mainstreamed into construction standards and policies.

More efforts to raise awareness of hazardous events together with the need for spreading a culture of resilience should be carried out. Private contractors should be targeted with training to enhance their knowledge of resilient construction techniques and encourage respect for quality standards.

Colours, finishings, murals, trees/greenery, playgrounds, furniture and other aesthetic components not only enhance schools' beauty but also improve children's states of mind. These elements can further contribute to nurturing communities' ownership whilst encouraging them to send their kids to school. These aspects should be taken into consideration when preparing construction designs and related bills of quantities.

School assessments should not only be limited to the number of operational classrooms; they should also include energy supply and international standards for hygiene, water and sanitation facilities. With Covid-19 (and possible other future pandemics) it is now crucial to ensure adequate access to water, sanitation and good overall hygienic conditions for all pupils. Integrating these aspects will obviously increase the costs and that is why integrated planning is important.

More rural and peri-urban communities now build schools with conventional materials (bricks, cement, corrugated iron sheeting etc.) instead of traditional local materials. Unfortunately, this shift in construction can generate new and additional risks for school users. Poor construction quality combined with increased building mass and weight increases the risk of collapse and serious injury during disasters. Awareness campaigns and training through training-of-trainers should be scaled-up to make communities aware of the risks and dangers associated with non-traditional materials if combined with inadequate construction techniques.

Complete Primary School in Mecutusse reconstructed with mixed materials under the ERRP Project | Source: UN-Habitat

The way forward

After almost 20 years of supporting a multi-level resilient construction approach in Mozambique, applying community participation, innovation, funds mobilization and normative work, the Safer Schools Initiative was ready for scaling up. The Initiative has subsequently been extended to hospitals, housing, water, sanitation provision, and waste management. The key factors to facilitate progression to the next level are:

1. Integration of soft and hard component

It is fundamental to mainstream building safety within an all-encompassing disaster risk management strategy at the school level, notably, for scaling-up the Basic Emergency School Plan approach.

In line with the Comprehensive School Safety Framework and its three pillars , durability is not only about the structure withstanding the impacts of hazardous events but also about the community's capacity to take measures before, during and after emergencies. Therefore, it is crucial for childrens' safety that the hard components (building robustness) and soft components (training, prevention, mitigation and readiness) are integrated.

2. Integrated territorial approaches with basic and social services

In isolation, a focus on basic resilient infrastructures does not build community resilience. Rather, this requires an integrated territorial approach that connects a network of basic and social services, regulations and capacity-building. Only an area-wide approach will sufficiently strengthen a community's resilience. For larger territories, like a system of urban settlements, resilience would require s establishment of interconnected support platforms. These should link settlements at risk with resettlement areas and other locations that help reduce populations' vulnerabilities.

A support platform is a public or community facility that can withstand the impacts of extreme natural events. It may include a floor slab elevated above registered flooding heights; a reinforced roof structure able to resist cyclonic winds and able to carry the weight of people escaping flooding; or a rainwater harvesting system for access to safe drinking water during droughts or after an emergency.

It is proposed that support platforms are integrated into national, provincial and local Emergency Preparedness and Contingency Plans and complemented by non-structural measures for their proper use during a disaster emergency (i.e. management structures at the community level; early warning systems; awareness-raising campaigns; and disaster preparedness training, including drills and simulation exercises).

3. Intersectoral approach and institutional capacity-building

Urban disasters are complex and require an intersectoral approach. The authorities need to provide a network of safe heavens of dual-purpose buildings, an improved drainage infrastructure, and early warning systems among others. All these need to be planned, established and managed. This requires institutional capacity among public and private actors that can be built through training, tool development and technical support. A combined (integrated) approach is essential for any successful resilience-building.

In turn, this requires an organisational structure with leadership, coordination and clear responsibility allocation. Coordination needs to be both horizontal (e.g. between the different sectors of city and district authorities) and vertical (between the different administrative or territorial levels). Currently, Mozambican municipalities are not sufficiently involved in building a culture of resilience. This can be overcome through the development of policies, regulation, tools and training that will empower them.

Replicating the safer school initiative

* **1st Recommendation:** A broad-based representative platform of stakeholders, including the end-users, needs to be established for implementing all-encompassing initiatives. The broader the partnership, the more useful, actionable and replicable the outputs and deliverables will be. This requires strong commitment by the stakeholders, including the sharing of information and the institutionalisation of procedures and approaches.

* **2nd Recommendation:** Ensure that school construction gives due consideration to non-conventional and/or community-led construction processes using both local and formal building materials and techniques. This requires increasing the monitoring and control capacity of the authorities and their ability to rapidly mobilise technical expertise to provide advice on planned and ongoing construction. Disseminating know-how through user-friendly audio-visual manuals, tools and training-of-trainers is essential for reaching the local level.

* **3rd Recommendation**: Develop multi-dimensional tools to systematically assess the quality of construction and to identify the most suitable options to build or retrofit a reinforced structure. Assessments must include the engineering and architectural designs, the institutional reforms required including capacity-building for assessments and assignment of responsibilities, and policy/legal matters such as building standards definition and enforcement.

* **4th Recommendation:** Develop and maintain a full and continuously updated database of planned and on-going public facility construction activities to create synergies, to avoid overlapping and to increase impact and efficiency. This would include integrating the Safer Schools Initiative into broader education development and increase its visibility and advocacy based on evidence, best practices and lessons learned.

* **5th Recommendation:** Good data collection and analysis will be critical for scrutinising risks, project design and outcomes. A data collection and analysis component must be included in the budget for project design, focusing on the most-recurring hazardous events and vulnerabilities. This requires special expertise that, eventually, can be found in academia and research institutions.

END

> Since 2002, UN-Habitat in Mozambique has worked on a sustainable and resilient urban future, developing and implementing a country programme based on priority areas defined by the Government of Mozambique, development partners and the main global development agendas...

With its diversified multilevel approach to natural hazard resilience of Mozambique's human settlements, UN-Habitat identified school vulnerability as a proxy to estimating the magnitude of communities' overall vulnerability. Public infrastructure buildings such as schools or health centers are often communities' only disaster-resistant structures. Access to safe schools is therefore central to community resilience and safety, notably in the remoter areas of Mozambique.

By introducing new normative and construction standards for repair and reconstruction under the Building Back Better approach, UN-Habitat's Safer Schools Initiative has proved very effective in promoting long-term changes in school construction. The Initiative has enhanced coordination among different government levels as well as with donors and other partners. It has also delivered capacity-building training to sub-contractors and communities engaged in school building. With strong central government and academia support, the Safer School Initiative has managed to achieve unprecedented impacts and became a global best practice.

For a Better Urban Future

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