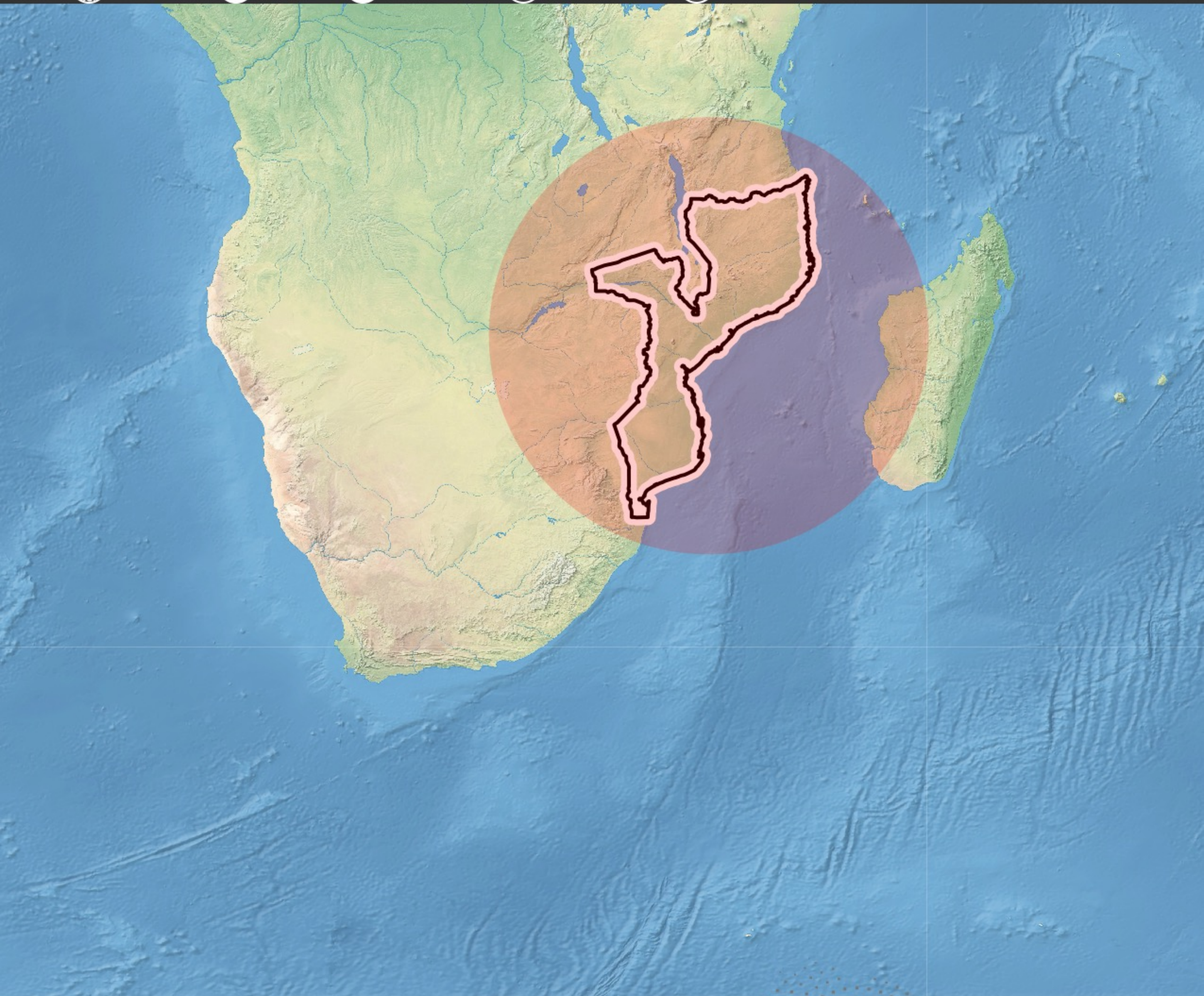
DISASTER RISK PROFILE

Mozambique

Drought Flood Landslide Earthquake Cyclone



Africa Disaster Risk Financing Initiative

Building Disaster Resilience in Sub-Saharan Africa

WORLD BANK GROUP

GFDRR
Global Facility for Disaster Reduction and Recovery

An initiative of the African, Caribbean and Pacific Group of States funded by the European Union

The International Bank for Reconstruction and Development
The World Bank Group
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Washington, D.C. 20433, USA
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DISASTER RISK PROFILES

INTRODUCTION

Overview

The Africa Disaster Risk Financing (ADRF) Initiative is one of five Result Areas of the European Union (EU) - Africa, Caribbean and Pacific (ACP) cooperation program *Building Disaster Resilience in Sub-Saharan Africa*, which is implemented by several partners, including the African Development Bank (AfDB), African Union Commission (AUC), the United Nations International Strategy for Disaster Reduction (UNISDR) and the World Bank (WB)-managed Global Facility for Disaster Reduction and Recovery (GFDRR). The Program's overall objective is to strengthen the resilience of Sub-Saharan African regions, countries and communities to the impacts of disasters, including the potential impact of climate change, to reduce poverty and promote sustainable development.

The ADRF Initiative, launched in 2015 and implemented by GFDRR and the World Bank, supports the development of risk financing strategies at regional, national and local levels to help African countries make informed decisions to improve post-disaster financial response capacity to mitigate the socio-economic, fiscal and financial impacts of disasters. One of the operational components to achieve this objective is to create an enabling data environment for risk financing. This aims to build the understanding and awareness of disaster and climate risks in Sub-Saharan Africa, providing a fundamental input to developing disaster risk financing strategy, approaches, and tools for financing risks. One of the activities is to develop national-level multiple-peril country risk profiles using globally available and readily accessible local datasets, in combination with scientifically proven methodologies. These are used to catalyze dialogue with government counterparts in the region on the primary disaster risks they face to formulate Disaster Risk Management strategies, such as financial protection and risk reduction investment programs. Furthermore, the risk profiles provide datasets that are a critical input for developing risk financing and insurance strategies.

National Risk Profiles

To create an enabling environment for dialogue on risk financing strategies and to further the understanding of disaster risk, national risk profiles have been developed for **eight countries** in the region. The risk profiles provide **visual information and data on the hazards, exposure, and risk for multiple hazards** in each country. The profiles provide an overview of which hazards, sectors and regions are most at risk of disasters, and contribute most to the national level of risk.

Specifically, the national risk profiles provide the estimated impact of disasters on population, building stock, transport networks, critical facilities, and agriculture at the national and sub-national levels. These profiles can guide initial strategic dialogue on financial protection and / or risk reduction investment opportunities to manage disaster risk, as well as help identify priorities for more detailed risk assessments if specific interventions are to be made.

Countries and Hazards

	Drought	Flood	Landslide	Earthquake	Volcano	Cyclone
Cabo Verde	●	●	●	●	●	●
Ethiopia	●	●	●	●	●	
Kenya	●	●	●	●	●	
Malawi	●	●	●	●		
Mali	●	●	●			
Mozambique	●	●	●	●		●
Niger	●	●	●			
Uganda	●	●	●	●	●	

METHODOLOGY AND LIMITATIONS

Use

These risk profiles provide a preliminary view of disaster risk at the national level, and distribution of risk across regions of the country and types of assets. They enable the identification and prioritization of risk drivers, to guide risk management activities and identify the need for further, more detailed risk assessment.

Due to limitations in the content and resolution of the publicly available global and national level exposure and hazard data used in their development, these profiles do not provide sufficient detail for taking final decisions on disaster management investments and policies, or for planning subnational and local scale mitigation projects, such as construction of flood defenses. Such decisions should be informed by a local, and possibly sector-specific disaster risk assessment, which estimates risk at a higher resolution with more locally-specific exposure, hazard, and vulnerability input data.

These risk profiles present a substantial part of the analysis results. However, it has not been possible to present all results in these documents. Full results for all asset types are available from GFDRR Innovation Lab.

Risk

Risk calculations require input data describing the hazard, assets ('exposure'), and vulnerability of those assets.

Disaster risk to structural and infrastructure assets is quantified here by estimating the cost to repair and/or replace assets damaged or destroyed in a disaster, i.e. due to ground shaking, flood depth or wind speed, over various time horizons. Assets analyzed are private and government-owned building stock, critical facilities (education and health), and transport networks (road, rail, and bridges).

Risk to population is quantified by assessing the number of people that are expected to be affected by the hazard.

For volcanoes, an indicative measure of volcano risk is given by estimating population and value of assets exposed to the volcanic hazards (no estimation of impact is made).

Losses additional to those incurred due to physical damage are not included in this analysis (e.g., business interruption due to disrupted infrastructure or supply chains).

The cost or number affected is estimated for most hazards at three time periods: a decade (this refers to the 1 in 10 year return period, or 10% chance of a loss being exceeded in any given year); a person's lifetime (1 in 50, or 2% in any year), or for an extreme event (1 in 250, or 0.4% in any year).

Hazard and Vulnerability Data

Drought hazard analysis comprises agricultural (soil moisture deficit) and hydrological (river flow) drought. Drought duration and deficit volume per year are determined by event-based modeling to estimate population affected by water scarcity. Monetary loss reflects the loss in yield and long term average price for each modelled per crop.

River flood risk (urban/surface flooding is excluded) is estimated at 1km resolution using global meteorological data, global hydrological and flood-routing models. Loss estimates are generated by simulating rainfall statistics for 10,000 years based on 40 years of previous rainfall data. Damage functions for four types of buildings, and for roads/railways, are used to estimate loss as a function of flood depth. Population are considered 'affected' if flooding of any depth occurs in the same 1km area. Agriculture loss is estimated by assuming that catastrophic flooding will result in a loss of the annual crop yield.

Earthquake hazard describes the distribution of ground shaking intensity (i.e., peak ground acceleration), based on the locations of known seismic faults and location/size of previous earthquakes. Losses are estimated using fragility and vulnerability models that translate ground shaking into the expected level of (a) damage to different types of structure, and (b) displacement of roads and rails. Based on damage to buildings, a casualty model has been used to estimate the risk of fatalities as well as the population affected by ground shaking. This study includes losses due to damage from earthquake ground shaking only. Secondary hazards (liquefaction and fire following an earthquake) are not accounted for. Landslide hazard is considered under the separate landslide section, where ground shaking is considered as a potential trigger of landslides.

Landslide susceptibility has been defined across each country using an assessment of factors that increase potential for landslides (including slope, vegetation and soil types) combined with landslide trigger events (rainfall and seismic shaking) to create landslide hazard maps. Long-term average annual cost to structures and transport networks has been estimated using vulnerability of different asset types to landslides, based on extensive literature review, empirical data, and expert judgement.

DISASTER RISK PROFILES

METHODOLOGY AND LIMITATIONS

Average annual population affected, and fatalities, are estimated.

Volcanic eruption scenarios at a small number of key volcanoes are used to estimate the population, and replacement cost of structures and infrastructure exposed to ashfall hazard (i.e. are located in an area that could receive ash in an eruption) and topographic analysis is used to determine the assets and population exposed to flow hazards. Full quantification of risk at all volcanoes is not possible due to limited information on potential frequency and eruption style at many volcanoes in Sub-Saharan Africa.

Cyclone and storm surge hazards are assessed using a record of historical cyclone tracks and wind field modelling, to determine maximum wind speeds on land and accompanying water levels along the coast. Vulnerability of structures to wind and surge is estimated based on previously observed damage sustained at different wind speeds and literature on flood depth impact of different types of structures.

Asset Database

Open and freely available national, regional, and global data sets are used to develop, for the first time, a database of population and multiple built asset types for risk analysis. This is used to inform this risk assessment, in a region where there is significant variability in the availability and content of inventories describing building stock and infrastructure.

Population density is described using WorldPop data. Building stock is described using six development types: rural, residential, high-density residential, informal, urban, and industrial, based on land use data and satellite imagery. In each cell of a 0.5 km resolution grid, the number of buildings and total floor area of each development type is given. The number of buildings is further disaggregated into different construction types to account for the impact different levels of structural vulnerability in the risk analysis.

Critical facilities include education and health facilities. Where possible, the assets have been analyzed using accurate geolocation given in an available building inventory. However, many assets had no geolocation given and were distributed using building density as a proxy for their location; the proportion of geolocated assets varies by country. Education facilities (classified as primary school, secondary school, or universities) and health facilities (hospital or clinics) have been assigned an estimated construction type based on interviews with structural engineers in each country and used to approximate construction cost per square meter.

Transportation data include roads, railways, and bridges, where present. Road surface type (paved, unpaved) is also included where available. Agriculture exposure is described by crop type and subnational distribution, average annual yield, and crop price for risk calculations.

Replacement costs for building stock and critical facilities are calculated using construction cost per square meter for each building or facility type, and cost per kilometer for roads based on road type and for railway lines, based on terrain. Estimates of replacement cost were developed through interviews with local engineering and construction professionals (numbers and sources varied in each country). These were validated and adjusted where necessary using several sources, including site surveys and international literature on construction. Replacement costs used are representative of typical building infrastructure and replacement costs for the entire country. Subnational variations in costs and building distributions (due to cost of materials and labor) will vary and are not accounted for.

RISK SUMMARY

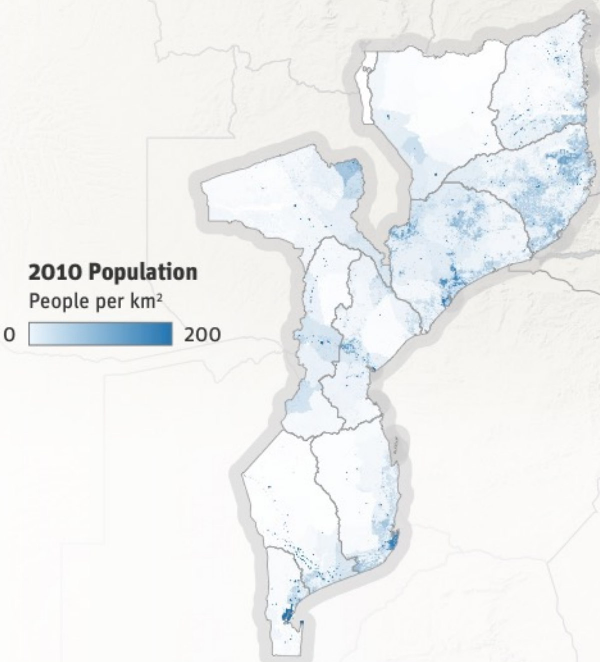
MOZAMBIQUE

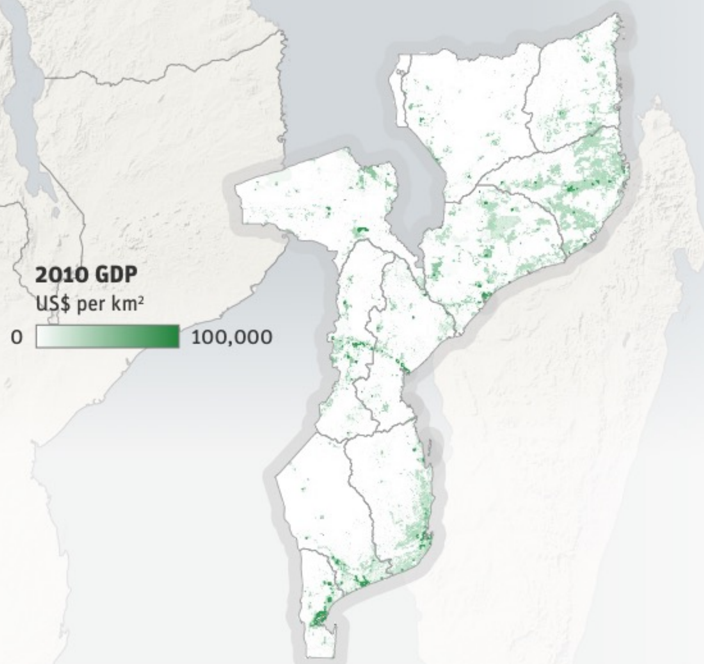
GDP $15 billion* **Population 28 million*** ***2015 estimates**

Mozambique's population stood at 28 million in 2015 but is growing at a rate of 3% each year. Approximately 67% of the population lives in rural areas[1]. The urban population is concentrated in various cities of which the capital city Maputo is the largest with 1.2 million inhabitants[1]. The country is one of the least developed countries in the world (Mozambique's Human Development Index is 0.432[2]) and 46% of the population lives below the poverty line[1].

Mozambique's agricultural sector accounts for 30% of GDP and 77% of overall employment[1]. The main agricultural products are sugar, copra, cashew nuts, tea, and tobacco. The industrial sector accounts for a further 24% of GDP with a predominance of the mining sector. The service sector contributes the remaining 46%[1].

The large majority of Mozambique's agriculture is rain-fed, with harvests vulnerable to rainfall variability. In Mozambique, chronic food insecurity is at 24 percent[3]. The food insecurity is in part caused by floods and droughts.





High-rise developments close to the coast in downtown Maputo, Mozambique.

MOZAMBIQUE

All $ amounts are in USD

Drought Flood Landslide Earthquake Cyclone

Cyclones pose the most significant and recurring risk to Mozambique, affecting 2 million people per year on average in the coastal regions.

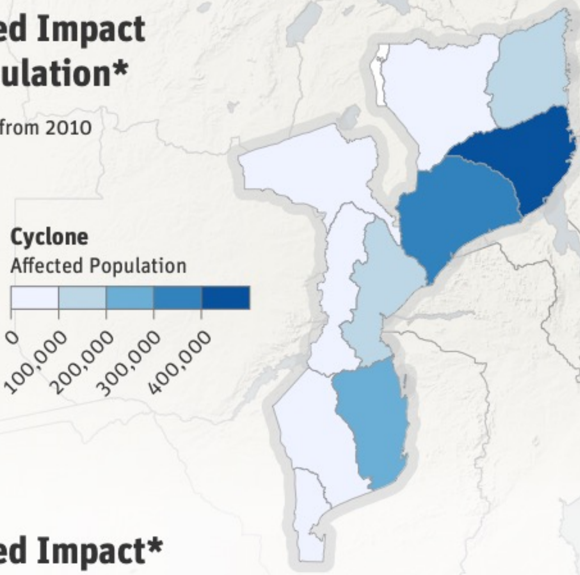
Droughts and floods also affect many people: 600,000 people are affected by drought every year, but this number can be substantially higher in dry years. Flooding poses a threat to lowland, highland, and urban areas, with 200,000 people affected by floods each year, on average.

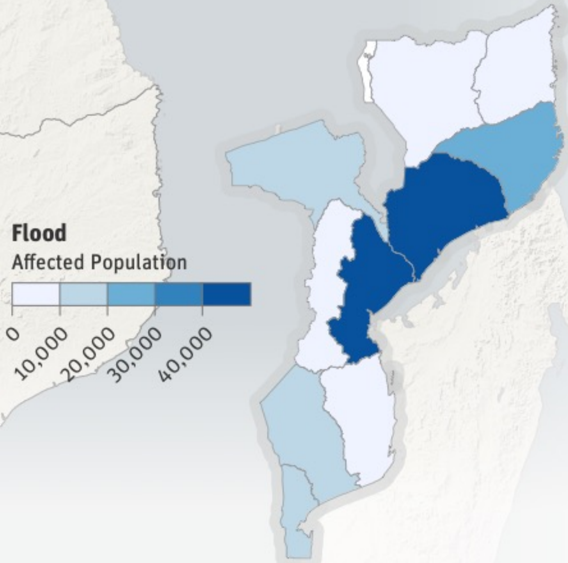
A much smaller number of people are at risk from earthquakes and landslides.

Future changes in Mozambique's population and economy, coupled with changes in climate-related hazards, are expected to increase the impacts of droughts and floods.

Modeled Impact on Population*

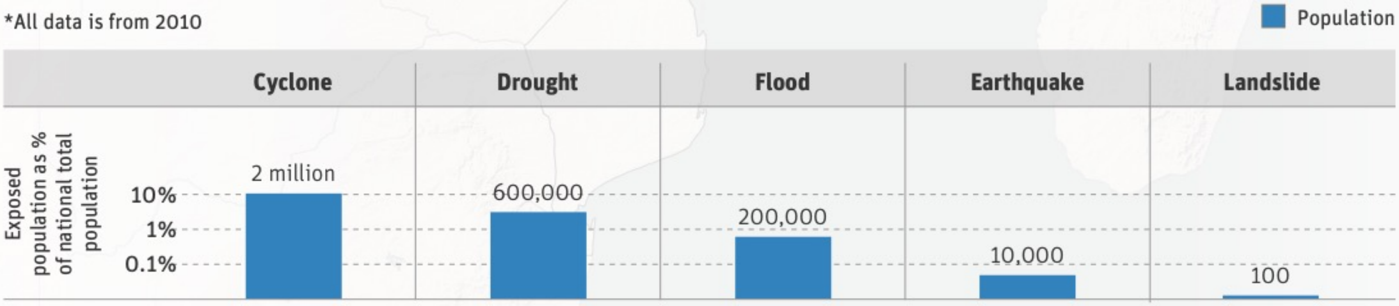
*All data is from 2010





Modeled Impact*

*All data is from 2010



Hazard Summary Table

HAZARD	IMPACT
	Agricultural income loss of $20 million per year, on average, with the greatest contribution to loss from Zambezia and Manica.
	On average, 185,000 people and around 350 education and healthcare facilities are exposed to flood each year.
	Landslide is a very localized hazard, but could cause up to $1 million of damage to building stock and put over 100 people at risk per year, on average.
	Damaging earthquakes are infrequent, but it is estimated that around 70,000 people could experience strong ground shaking at least once every 50 years.
	Around 2 million people are affected by cyclone-strength wind and associated storm surge per year, on average.

CYCLONE

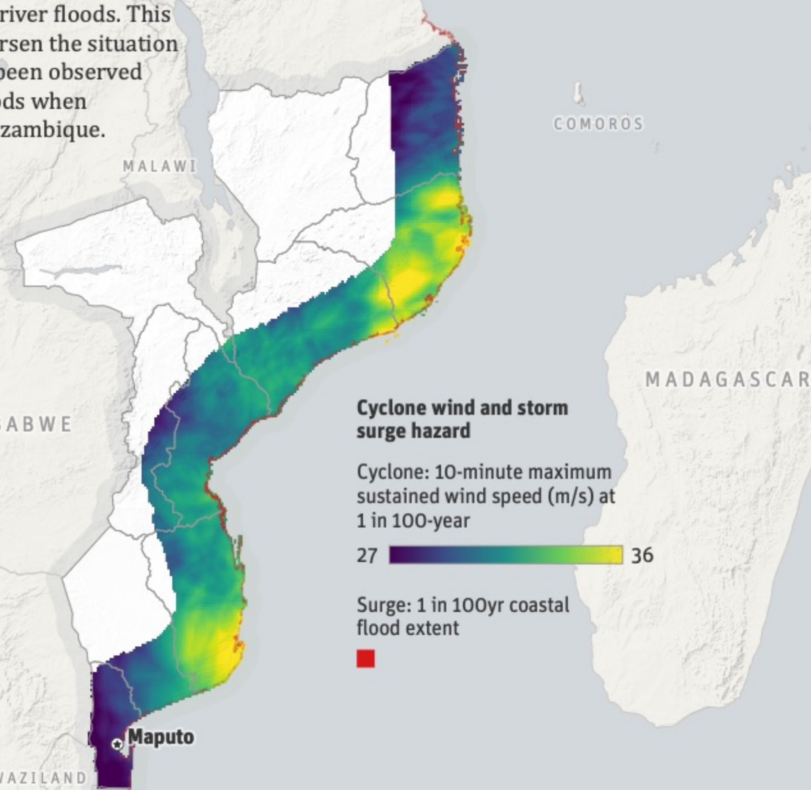
MOZAMBIQUE

The Mozambique coastline is prone to cyclones making landfall during the rainy season between October and March. It forms the western boundary of the an active cyclone belt in the south-west Indian Ocean Basin. Some cyclones originating from this belt may travel into the Mozambique Channel and can result in extreme storm surge, waves, wind and rainfall along the coast of Mozambique.

The frequency of tropical cyclones occurring across any one segment of the Mozambique coastline is about once per year. Recent events are Cyclone Bonita (1996), Eline (2000), Funso (2012) and Dineo (2017). The actual effect of each storm on coastal water levels will vary greatly depending on the local characteristics (e.g. shape and depth) of the coastline and shelf, the storm track, and the vulnerability of the affected locations.

This analysis included the effect of wind and surge damage as a result of a cyclone. Many cyclone tracks have been generated by resampling to define a reliable prediction of return periods of surge levels along the coastline.

The analysis, however, did not take into account the compounding effect of rainfall and/or high river floods. This combination can worsen the situation significantly, as has been observed during the 2000 floods when Cyclone Eline hit Mozambique.



Modeled Impact

AAL = Average Annual Loss; 1-in-10 year return period equates to a 10% annual probability; 1-in-50 to 2% annual probability; and 1-in-250 to 0.4% annual probability.

Key Facts

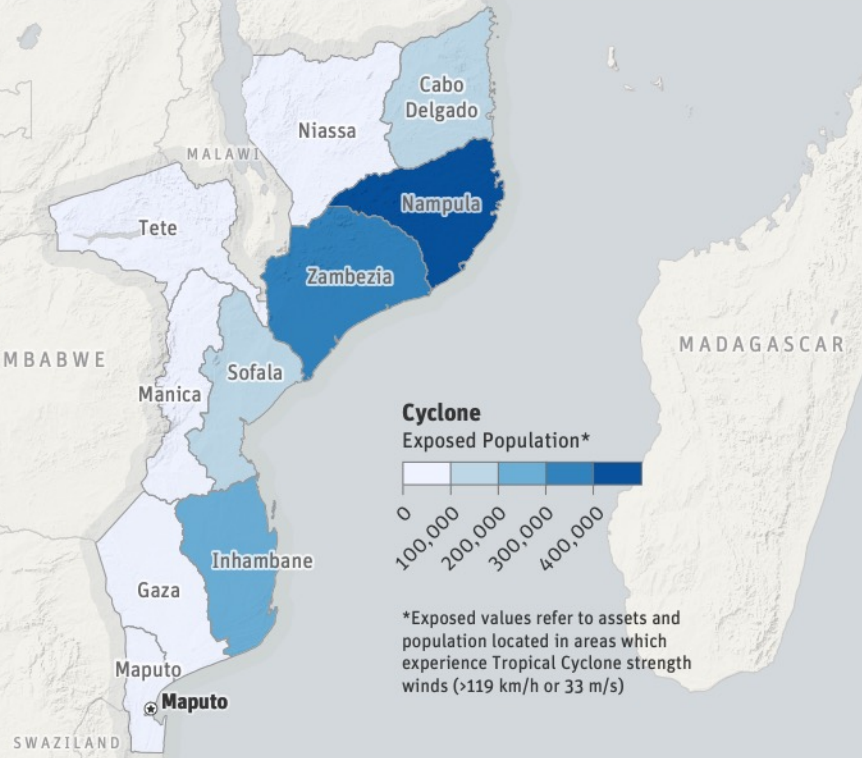
- Cyclone Leon-Eline in 2000 is one of the most damaging cyclones in Mozambique in recent history. This cyclone occurred when flooding was already widespread throughout the country. Total impact of this compounded disaster was estimated at $500 million of damage and 700 deaths.
- Cyclone Funso hit Mozambique in 2012 and affected more than 3 million people with tropical storm-force winds. The Zambezia Province was hit hard during this storm, which left more than 50,000 people homeless in Mozambique.
- Desinventar reports that about 300,000 people in Mozambique are affected by cyclones on average every year, based on the period 1994 to 2012.

The distribution of cyclone risk is determined by the occurrence of cyclone events, the location where assets intersect with these hazards, and the vulnerability of those assets. For more detail, see the Methodology section.

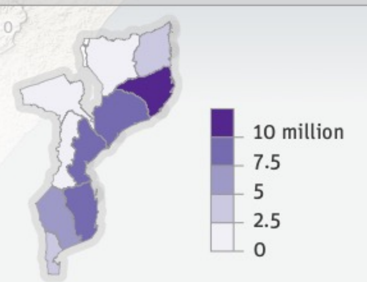
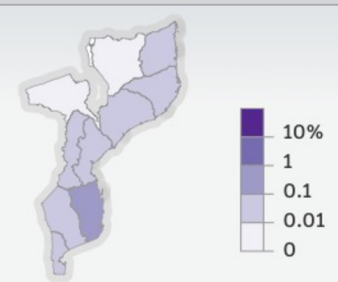
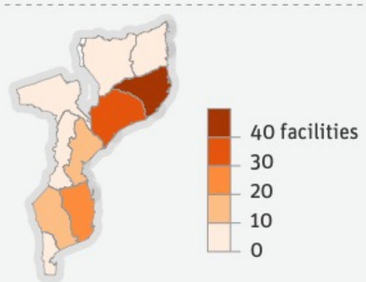
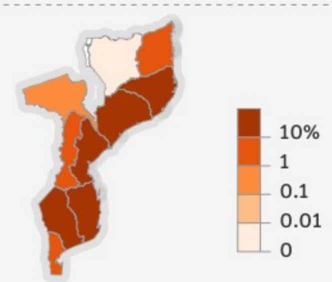
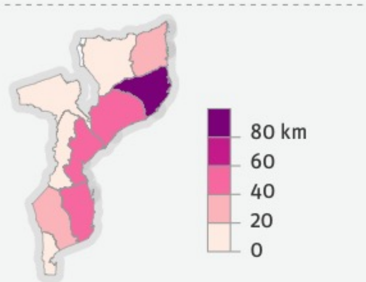
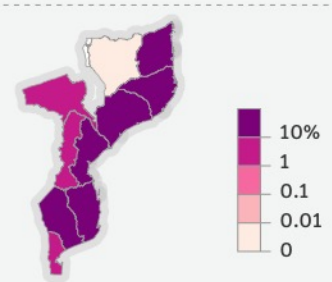
MOZAMBIQUE

Cyclone risk is presented as population exposed to cyclone wind and storm surge. These two (overlapping) effects are intended to be indicative of the cyclone risk. In addition to this, indicative estimates are provided of the likelihood and magnitude of damage to building stock due to wind and surge. Also, the total exposed value of critical facilities and transport systems are listed.

The cyclone impact in Mozambique is greatest in the coastal regions where the cyclone retains its intensity. Nampula and Inhambane show relatively high impact on population from cyclone winds, whereas Sofala, Nampula and Zambezia are most affected by storm surge. The annual expected damage to building stock is about $70 million each from wind and surge. For extreme events, the damage to building stock can go far beyond $100 million. The exposure of critical facilities such as education and healthcare facilities (see maps below) is much less. Roads and railroads are, however, exposed to cyclone winds due to the large impact area.



*Exposed values refer to assets and population located in areas which experience Tropical Cyclone strength winds (>119 km/h or 33 m/s)

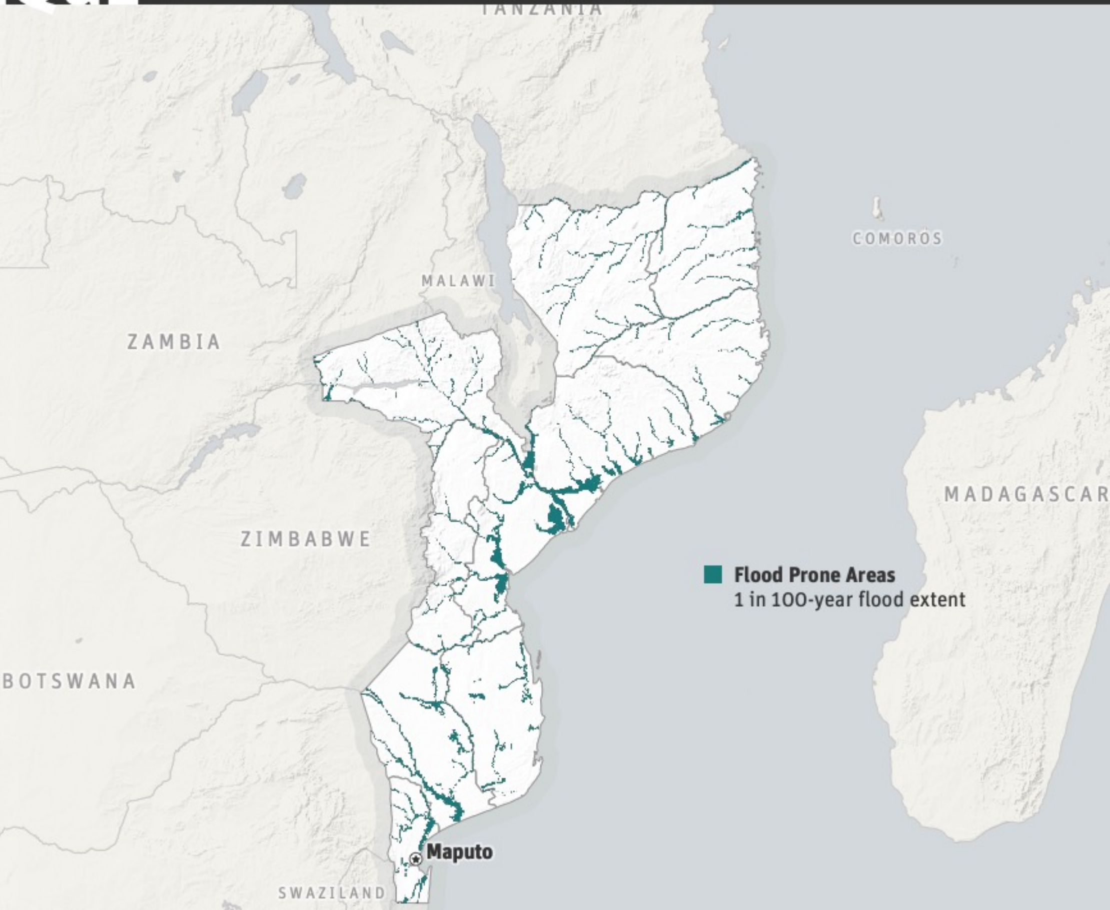
	Asset Distribution	Average Annual Loss per Province	Average Annual Loss per Province Relative to national total
Buildings $ Damage			
Education and Health Facilities Facilities exposed*			
Transport Km exposed*			

FLOOD
MOZAMBIQUE

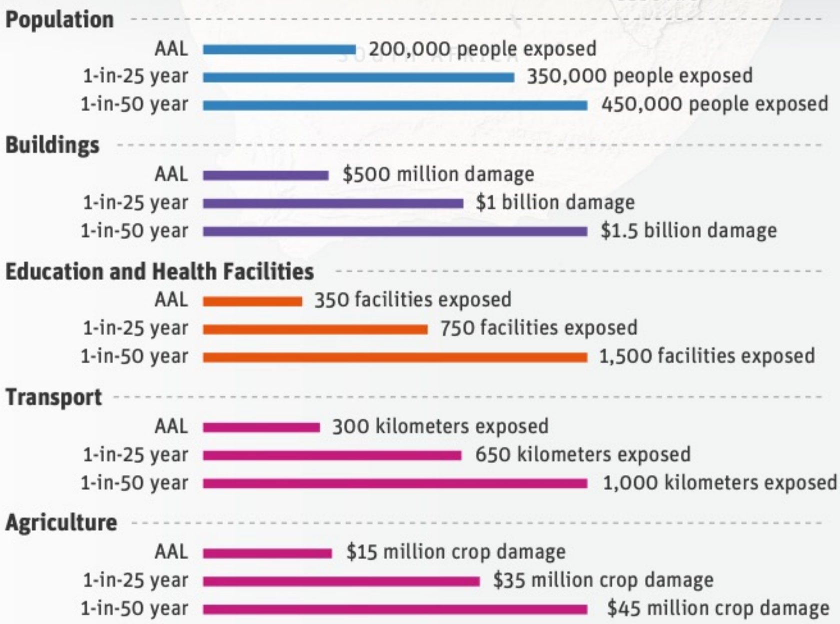
Mozambique has many rivers draining from the central African highland plateau into the Indian Ocean. Main rivers are the Zambezi in the central part and Limpopo in the southern part of Mozambique which belong to the largest rivers in Africa.

Here, the flood potential of the Limpopo and the Zambezi can be seen in the main map. Other smaller river basins in the northeastern region also result in flood hazard in the various catchments. In Mozambique, the greatest flood potential occurs during and following the November to March rainy season with peak flows in March and April. The coincidence with incoming tropical cyclones sometimes worsens the flood situation, as occurred during the 2000 floods when Cyclone Eline hit Mozambique.

The national scale of these profiles means the focus is on river flooding, and surface flooding (including urban flood) is not included in the risk estimates.



Modeled Impact



AAL = Average Annual Loss; 1-in-25 year return period equates to a 4% annual probability; 1-in-50 to 2% annual probability; and 1-in-250 to 0.4% annual probability.

Key Facts

- Flooding in 2000 killed nearly 700 people with 1400 km^2 agricultural land and 20,000 cattle lost. The property damage was estimated at $500 million (2000).
- According to the Desinventar database of disaster impacts, there have been over 11 million people affected by flooding and over 1400 people killed in Mozambique since 1990. In that time, over 180,000 Hectares of crops have been damaged and 40,000 cattle lost.

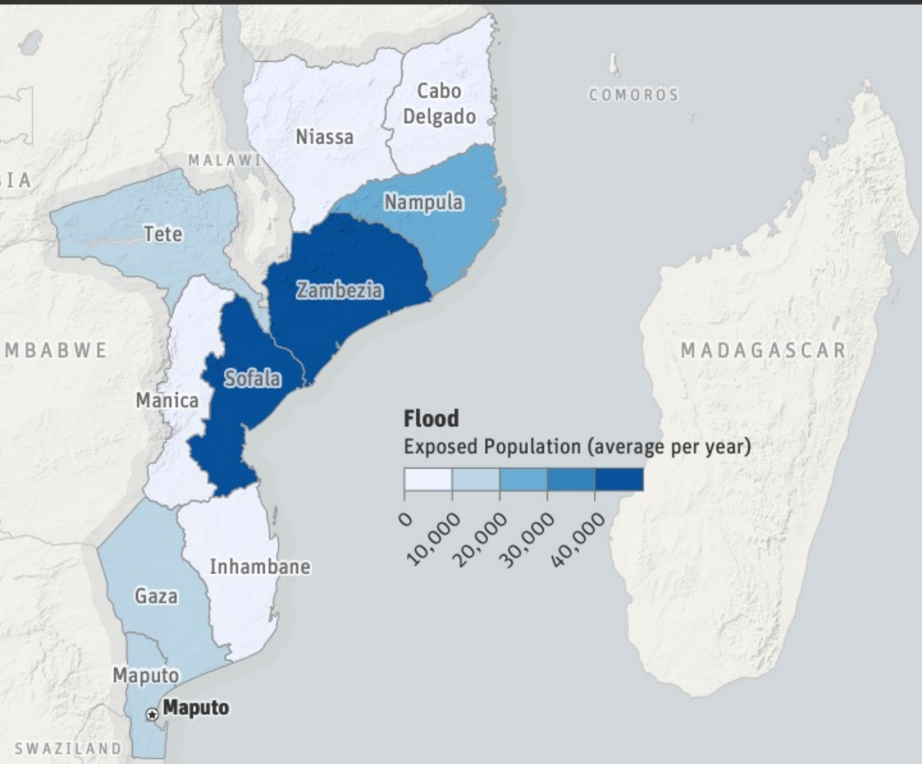
The distribution of flood risk is determined by the occurrence of flood events, the location where assets intersect with these hazards, and the vulnerability of those assets. For more detail, see the Methodology section.

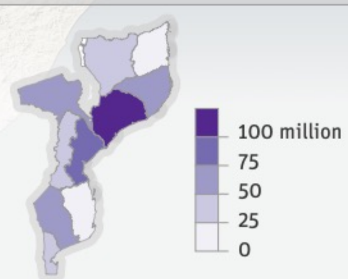
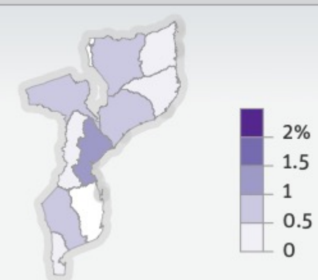
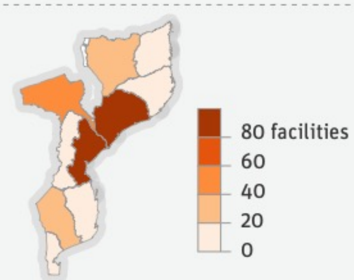
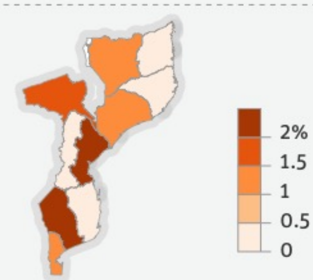
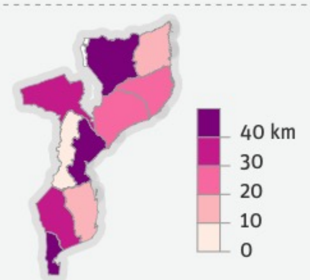
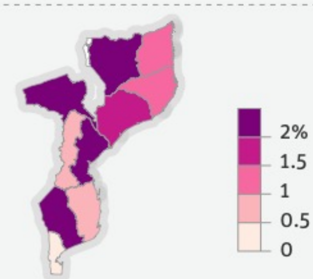
FLOOD
MOZAMBIQUE

Cyclone risk is presented as population exposed to cyclone wind and storm surge. These two (overlapping) effects are intended to be indicative of the cyclone risk. In addition to this, indicative estimates are provided of the likelihood and magnitude of damage to building stock due to wind and surge. Also, the total exposed value of critical facilities and transport systems are listed.

Over the long term, tropical cyclones are not frequently expected in Mozambique, though the changing climate could increase the frequency and severity of cyclones. About once in a person's lifetime, an event would be expected to affect about 800,000 people and 500,000 buildings with tropical cyclone strength winds (windspeeds >119km/h), resulting in damage on the order of $500 million to the national building stock.

The cyclone impact in Mozambique is greatest in the coastal regions where the cyclone retains its intensity. Nampula and Inhambane show relatively high impact on population from cyclone winds, whereas Sofala, Nampula and Zambezia are most affected by storm surge.



	Asset Distribution	Average Annual Loss Per Province	Average Annual Loss per Province Relative to national total
Buildings $ Damage			
Education and Health Facilities Facilities exposed			
Transport Km exposed			

DROUGHT

MOZAMBIQUE

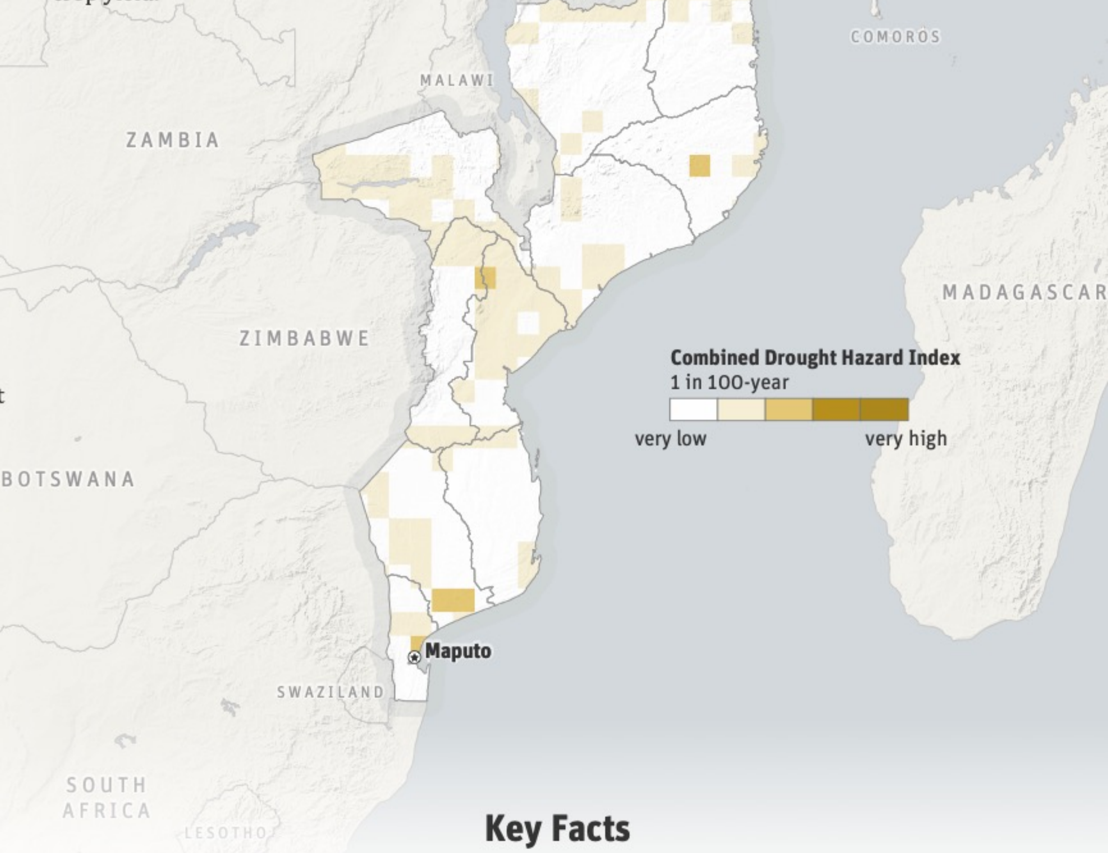
Droughts are sustained periods of below-normal water availability. Droughts occur due to natural atmospheric variability (e.g. El Niño conditions), desertification, land degradation. Increasing rainfall variability and extremes are increasing the drought hazards which is already common particularly in the Horn of Africa.

This risk profile assesses the impacts on population due to **hydrological drought** creating conditions of water scarcity, which occurs when water availability per person per year drops below a certain threshold: 1700 cubic meters per person per year. Water availability of less than 500 cubic meters per person per year is considered severe water scarcity. This analysis uses a combination of water scarcity thresholds and a measure of the volume of water flowing in rivers to assess drought risk to population, referred to here as the 'Combined Drought Hazard Index'.

Risk is considered greatest where river flows show a deficit in flow volume over a period of greater than three months, and the amount of water available for human use is below the severe water scarcity above. Shorter droughts can also result in water scarce conditions.

This profile also estimates the effects of **agricultural drought** on agricultural income from a wide variety of crops. Loss of agricultural income is assessed by estimating the impact of rainfall deficits on crop yield. The loss in yield translates to a loss of agricultural income based on crop price data.

The bars below indicate the number of people located in areas affected by water scarcity, and the loss of agricultural income due to the effects of drought on crop yield.



Key Facts

- Droughts are a recurrent hazard in Mozambique. The Desinventar database of disaster impacts reports that over 11 million people have been affected by drought since 1984.
- The worst drought in recent decades began in 1982, and by 1984 100,000 people had died and another 750,000 required food assistance. Inhambane, Gaza and Maputo were worst affected[4].

Modeled Impact

Population

Annual average	600,000 people affected
1-in-10 year	1.5 million people affected

Agricultural Income Loss

AAL	$20 million
1-in-10 year	$65 million
1-in-50 year	$200 million
1-in-200 year	$350 million

AAL = Average Annual Loss; 1-in-10 year return period equates to a 10% annual probability; 1-in-50 to 2% annual probability; and 1-in-200 to 0.4% annual probability.

The distribution of drought risk is determined by the occurrence of drought hazard/events, the location where assets intersect with this hazard, and the vulnerability of those assets. For more detail, see the Methodology section.

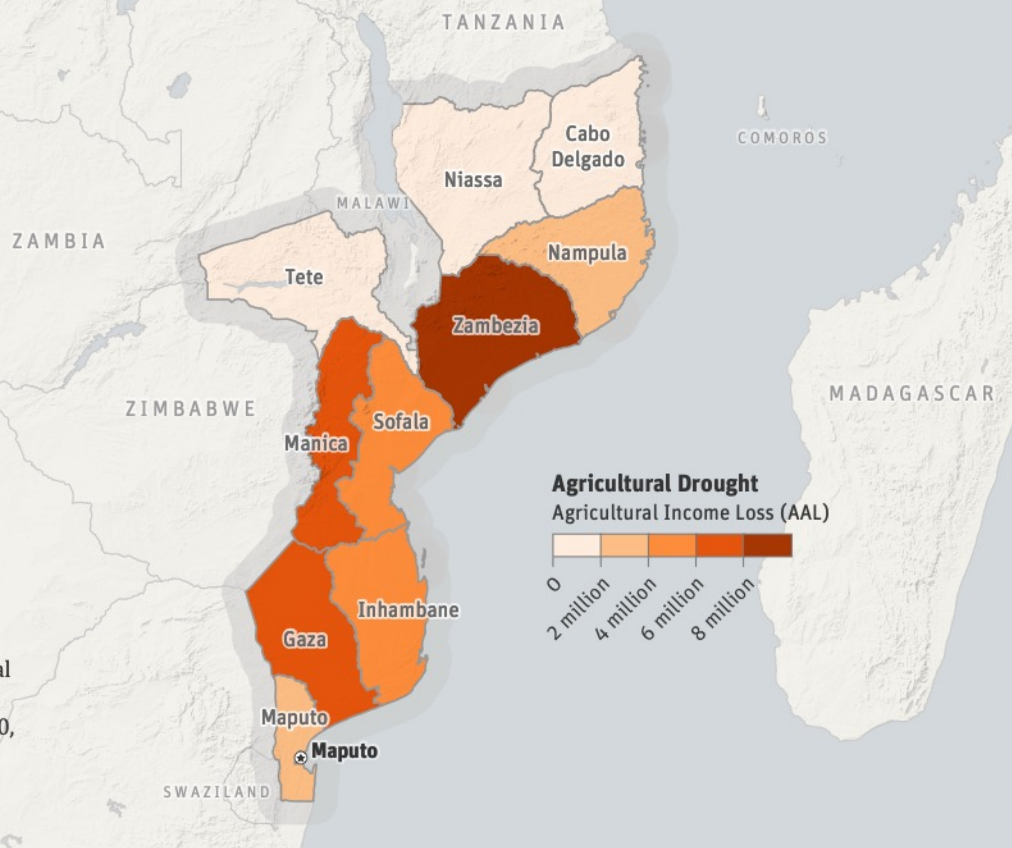
DROUGHT
MOZAMBIQUE

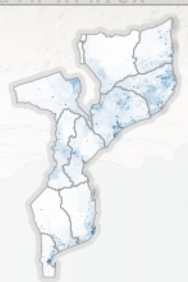
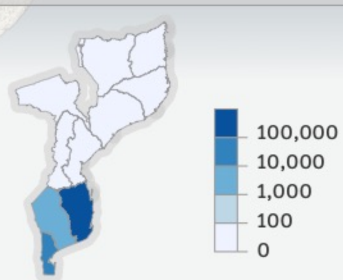
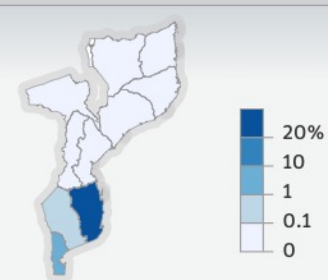
Hydrological drought risk (water scarcity) is greatest in Inhambane. In this region, more than 0.5 million people live in areas expected to suffer water scarcity each year. The selected socioeconomic and climate scenarios suggest that by 2050, the number of people affected by drought will significantly increase, both relatively and absolutely. The 2050 population is expected to increase by about 140% to around 65 million. The number of people affected by drought each year at that time is expected to be over 3 million.

The hydrological drought analysis is conducted at large scale units (water provinces), which can be larger than administrative provinces. The model assumes that water resources are redistributed via rivers within a natural 'water province', and while people in one part of the water province may experience water scarcity, those water scarce conditions may be alleviated by greater water availability in other parts of the same water province, reducing the population affected in the province as a whole.

On average, once every 10 years a loss of $65 million in agricultural income is expected to occur in Mozambique, with the equivalent of 4.5 million labor days lost. Manica, Gaza and Zambezia are the Provinces that are estimated to suffer greatest loss of crop yield and agricultural income. Agricultural income loss would be expected to be about the same by 2050, without accounting for changes in crop prices. The agricultural drought analysis does not account for the effect of water transfer within provinces, due to the prevalence of rain-fed agriculture rather than irrigation.

The different in distribution of drought risk shown in the maps, of affected population and agricultural crop loss is due to the use of hydrological drought indicators (river flow volume) for impact on population, and precipitation as the indicator of drought for rainfed agriculture, and the different distribution of these different drought types.



	Asset Distribution	Average annual affected (water scarcity) Per Province	Average Annual Loss per Province Relative to national total
Population Pop. exposed to water scarcity			

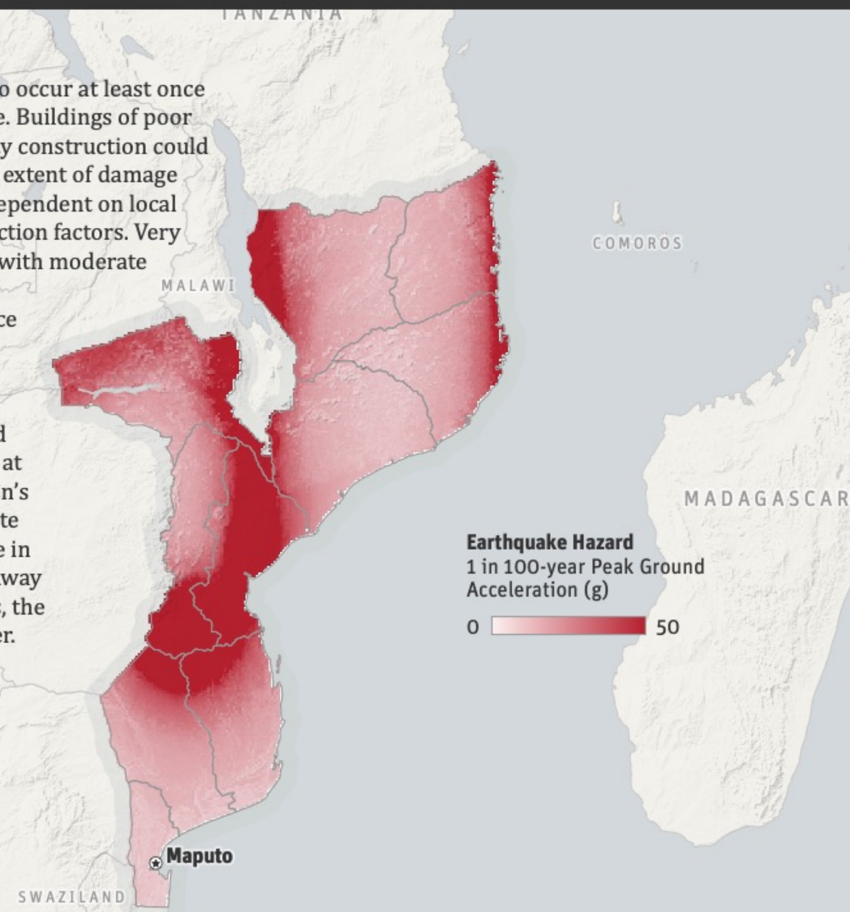
EARTHQUAKE

MOZAMBIQUE

Earthquakes pose the threat of building damage and collapse, particularly where seismic-resistant design of buildings is not generally applied, as in Mozambique. They can also cause damage and disruption to transport networks and essential services due to ground motion displacing roads, rails, bridges and other essential services. Earthquakes can cause sufficient ground shaking to trigger rockfalls and landslides in areas susceptible to such hazards (i.e. steep terrain).

Mozambique is located at the southern end of the East African Rift, and seismicity associated with this system extends from the north into central Mozambique. The main areas of seismic hazard are on the east coast (where the Eastern branch of the Rift tracks offshore), and along the Western branch of the Rift beneath and south of Lake Nyasa.

The highest hazard occurs northwest of Lichinga in Niassa Province and in Manica Province, southwest of Beira. In these areas, strong ground shaking would be expected to occur at least once in a person's lifetime. Buildings of poor and moderate quality construction could sustain damage, but extent of damage would be strongly dependent on local seismic and construction factors. Very strong earthquakes with moderate damage could be expected at least once in about 500 years. The east coast and areas north of Beira to Lake Nyassa could expect light shaking at least once in a person's lifetime and moderate shaking at least once in a 500-year period. Away from the these areas, the hazard is much lower.



BOTSWANA

SOUTH AFRICA

LESOTHO

Modeled Impact

Population

1-in-10 year	20,000 people affected
1-in-50 year	70,000 people affected
1-in-250 year	200,000 people affected

Buildings

1-in-10 year	$45 million damage
1-in-50 year	$200 million damage
1-in-250 year	$650 million damage

Education

1-in-10 year	$600,000 damage
1-in-50 year	$2.5 million damage
1-in-250 year	$8 million damage

Health

1-in-10 year	$150,000 damage
1-in-50 year	$1 million damage
1-in-250 year	$2.5 million damage

Transport

1-in-10 year	$150,000 damage
1-in-50 year	$1.5 million damage
1-in-250 year	$7.5 million damage

AAL = Average Annual Loss; 1-in-10 year return period equates to a 10% annual probability; 1-in-50 to 2% annual probability; and 1-in-250 to 0.4% annual probability.

Key Facts

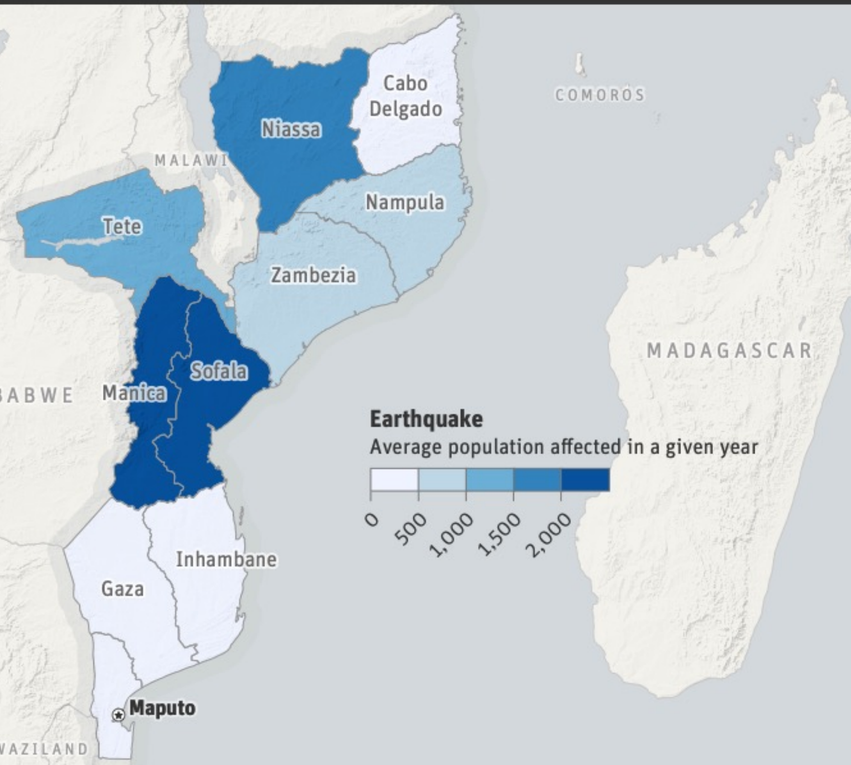
- The Mw7.0 Machaze earthquake in February 2006 was the largest earthquake in southern Africa for 100 years. The earthquake was felt widely in the region and caused 5 deaths and 40 injuries. Three hundred houses were partially damaged. Damage was limited relative to the earthquake magnitude due to the epicenter being located in a rural area and having moderate ground shaking intensity.
- This study includes losses to due to damage from earthquake ground shaking only. Secondary hazards (liquefaction and fire following an earthquake) are not accounted for. Landslide hazard is considered under the separate landslide section, where ground shaking is considered as a potential trigger of landslides.

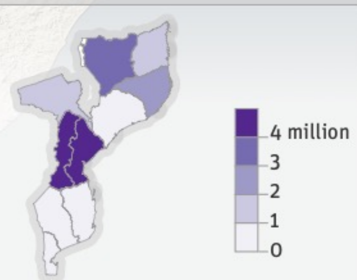
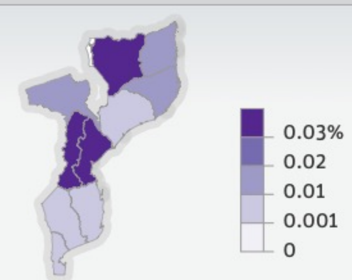
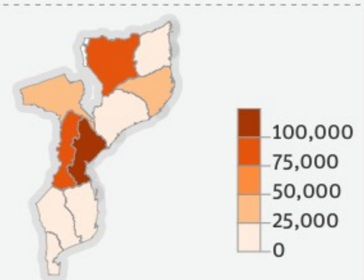
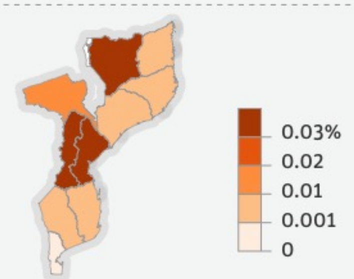
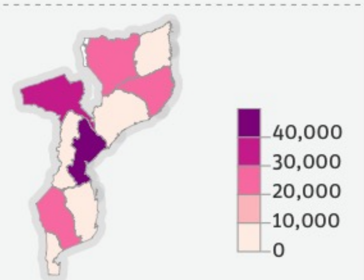
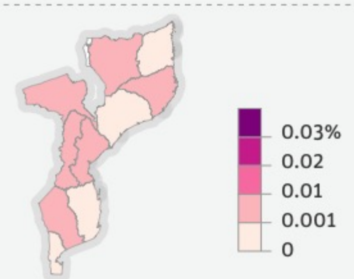
The distribution of earthquake risk is determined by modeled earthquake hazard events, the location where assets intersect with these hazards, and the vulnerability of those assets. For more detail, see the Methodology section.

MOZAMBIQUE

It is possible that, at least once in a person's lifetime, an earthquake could occur that affects 70,000 people with at least light ground shaking (see bars, opposite). In such an earthquake, there is likely to be at least light to moderate building damage in some areas. The cost of this would be approximately $200 million, with potential for $3 million of damage to education and health facilities.

Manica and Sofala provinces contribute most to the annual average affected population, followed by Niassa. Highest potential damage to building stock also occurs in these provinces. In contrast, Maputo shows much lower potential impacts from earthquakes due to low hazard in that area. In the provinces most at risk, by 2050 there could be almost twice as many people affected and 10 times the building damage costs on average each year, than in 2010.



	Asset Distribution	Average Annual Loss Per Province	Average Annual Loss per Province Relative to national total
Buildings **$ Damage**			
Education and Health Facilities **$ Damage**			
Transport **$ Damage**			

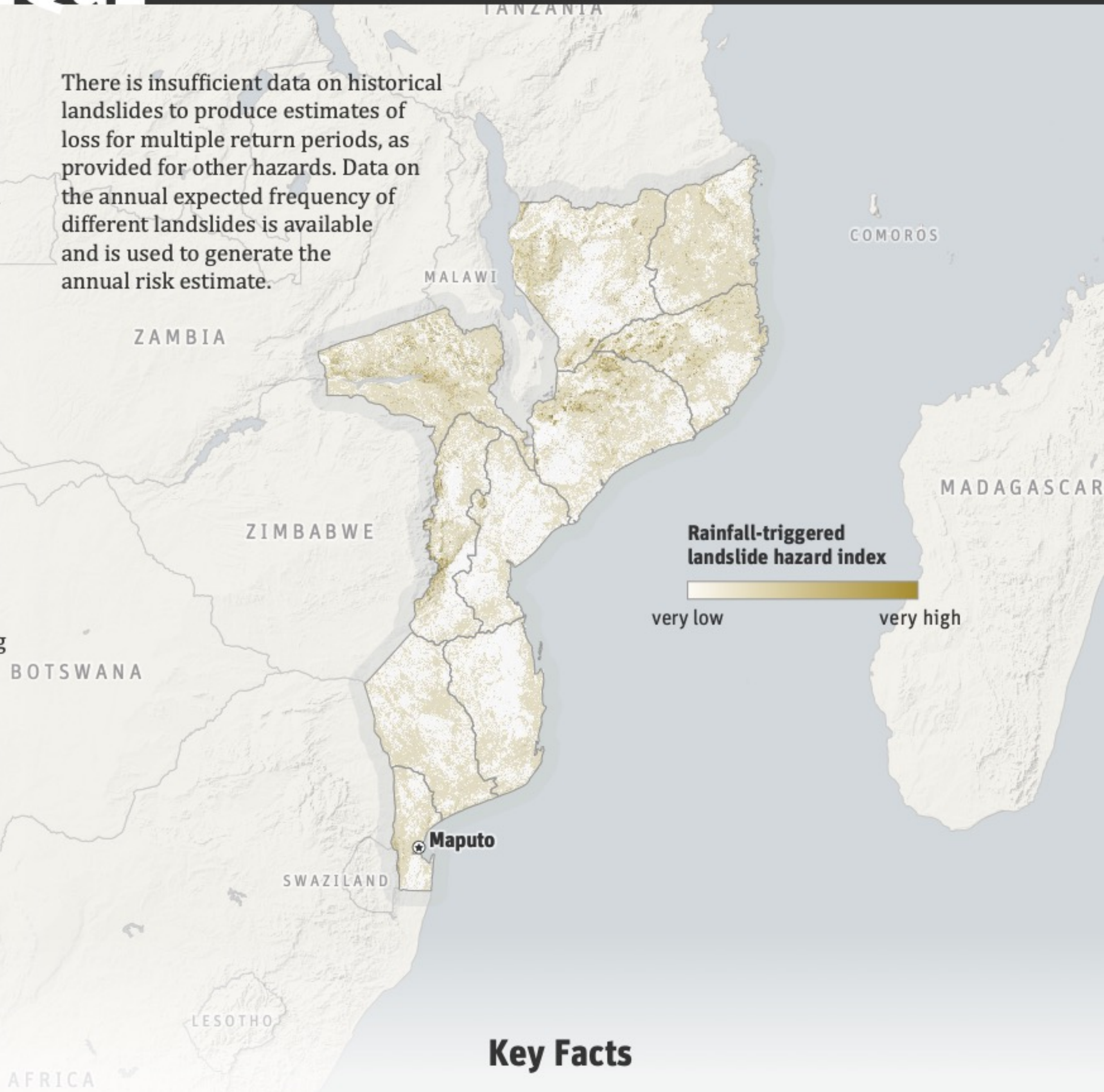
LANDSLIDE
MOZAMBIQUE

There is moderate landslide hazard in many areas of northern Mozambique and in southern areas, in the region of Maputo. High hazard is most prevalent in Nampula and Zambezia, and on the western border with Zimbabwe, in Manica Province.

In the capital city Maputo, road construction has led to steepening of slopes and increased landslide hazard. Many instances of such localized hazard are not captured well in this national-scale analysis, and require higher resolution analysis to fully describe the hazard there. Surface erosion and the formation of gullies is common during intense rainfall events in Maputo City.

Damage due to landslide has been estimated across the whole country using a novel method that enables estimation of annual average risk using landslide susceptibility factors combined with earthquake and rainfall triggers, and the potential impact of different size landslides on the population, buildings, and transport networks.

There is insufficient data on historical landslides to produce estimates of loss for multiple return periods, as provided for other hazards. Data on the annual expected frequency of different landslides is available and is used to generate the annual risk estimate.



Modeled Impact

Population
Average Annual Loss — 100 people exposed

Buildings
AAL — $1 million damage

Education
AAL — $30,000 damage

Health
AAL — $10,000 damage

Transport
AAL — $100,000 damage

Key Facts

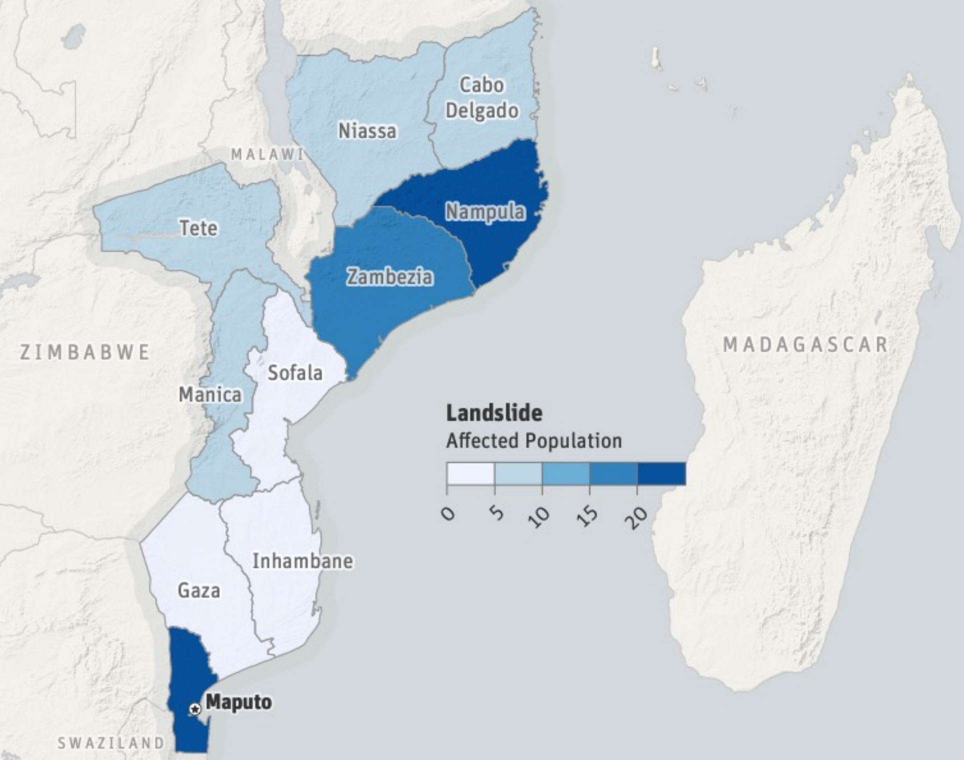
- Mount Tumbine, in Zambezia Province is prone to landslides during periods of heavy rainfall from January to March, with slope failure reported in 1949, 1958, 1968, 1993 and 1998. Reduction in surface vegetation and increased amounts of loose surface material due to deforestation contribute to slope instability here.
- In 1998, 200 people were killed and 4,000 displaced by multiple debris flows that destroyed homes, roads, bridges and water supply. One thousand hectares of crops were also destroyed.

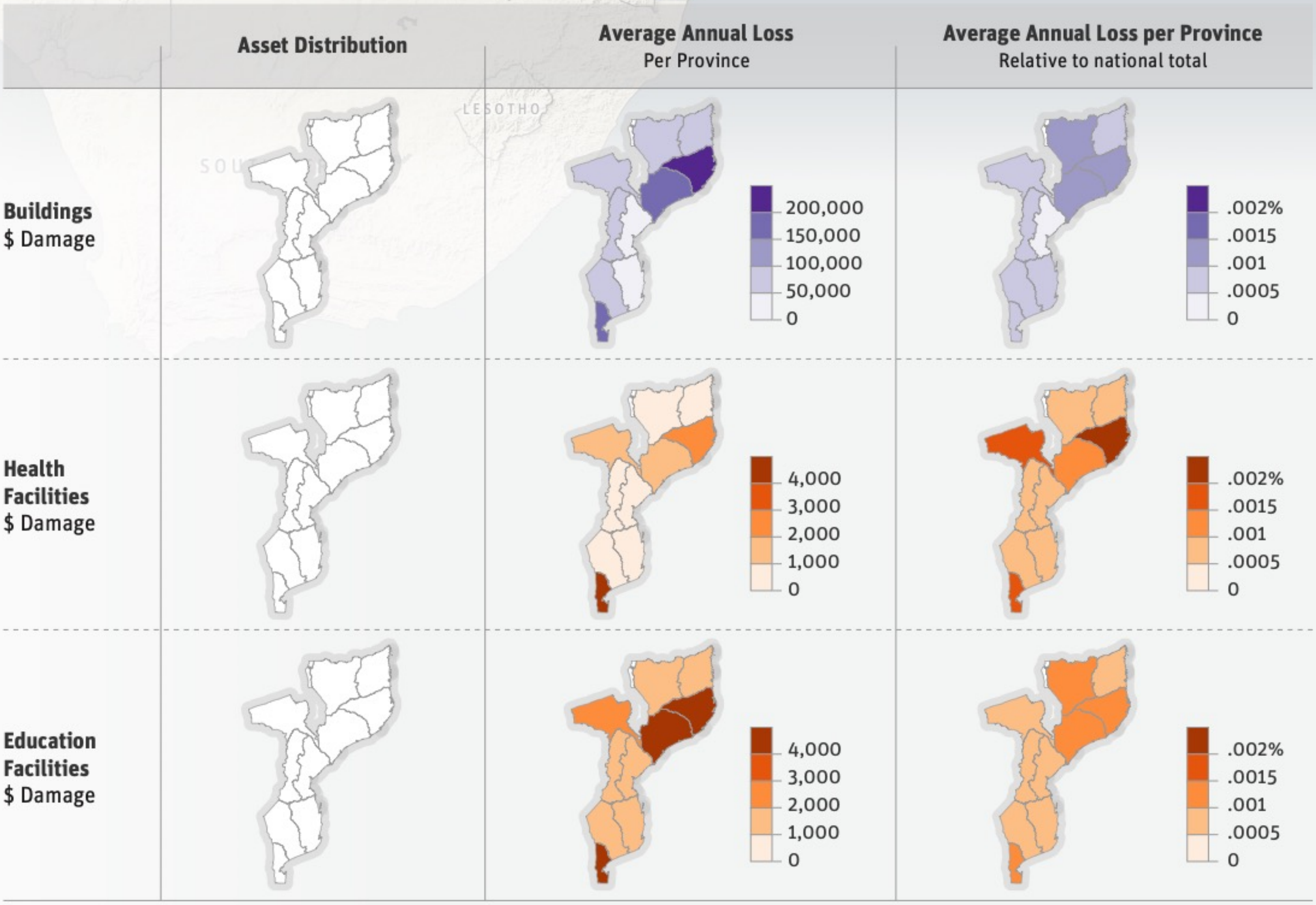
i Landslide risk is a function of population and assets being located in areas susceptible to landslides (based on slope angle, vegetation cover and soil type), and the potential for earthquakes and rainfall to trigger landslides there. For more detail, see the Methodology section.

MOZAMBIQUE

On average, each year over 100 people are at risk of being affected by landslides, with the modelling suggesting a long term average of around 10 fatalities per year nationally. The annual average cost of damage to building stock is expected to be $100,000 in any given year. This analysis also suggests transport networks could sustain damage of $100,000 per year on average. Socio-economic changes and climate change induced increases in rainfall-triggered landslides could, by 2050, double the number of people affected annually.

The most at-risk regions of Mozambique are Maputo, Nampula and Zambezia (see main map). These regions contribute the majority of losses to the national landslide risk profile.





DISASTER RISK PROFILES

GLOSSARY AND NOTES

Glossary

Average annual loss

Average annual loss (AAL) is the estimated impact (in monetary terms or number of people) that a specific hazard is likely to cause, on average, in any given year. It is calculated based on losses (including zero losses) produced by all hazard occurrences over many years.

Exposure

Exposure refers to the location, characteristics, and value of assets such as people, buildings, critical facilities, and transport networks located in an area that may be subject to a hazard event.

Hazard

Hazard refers to the damaging forces produced by a peril, such as ground shaking induced by an earthquake or water inundation associated with flooding.

Risk

Disaster risk is a function of hazard, exposure, and vulnerability. It is quantified in probabilistic terms (e.g., Average Damage Per Year, and return period losses) using the impacts of all events produced by a model.

Vulnerability

Vulnerability is the susceptibility of assets to the forces of a hazard event. For example, the seismic vulnerability of a building depends on a variety of factors, including its structural material, quality of construction, and height.

Notes

[1] Central Intelligence Agency, The World Factbook, 2015, https://www.cia.gov/library/publications/the-world-factbook/.

[2] United Nations Development Programme, Human Development Report 2015: Work for Human Development (New York: United Nations Development Programme, 2015), http://hdr.undp.org/en/data.

[3] http://www1.wfp.org/countries/mozambique.

[4] https://reliefweb.int/report/mozambique/mozambique-droughtfloods-mar-1982-undro-situation-reports-21-30.

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