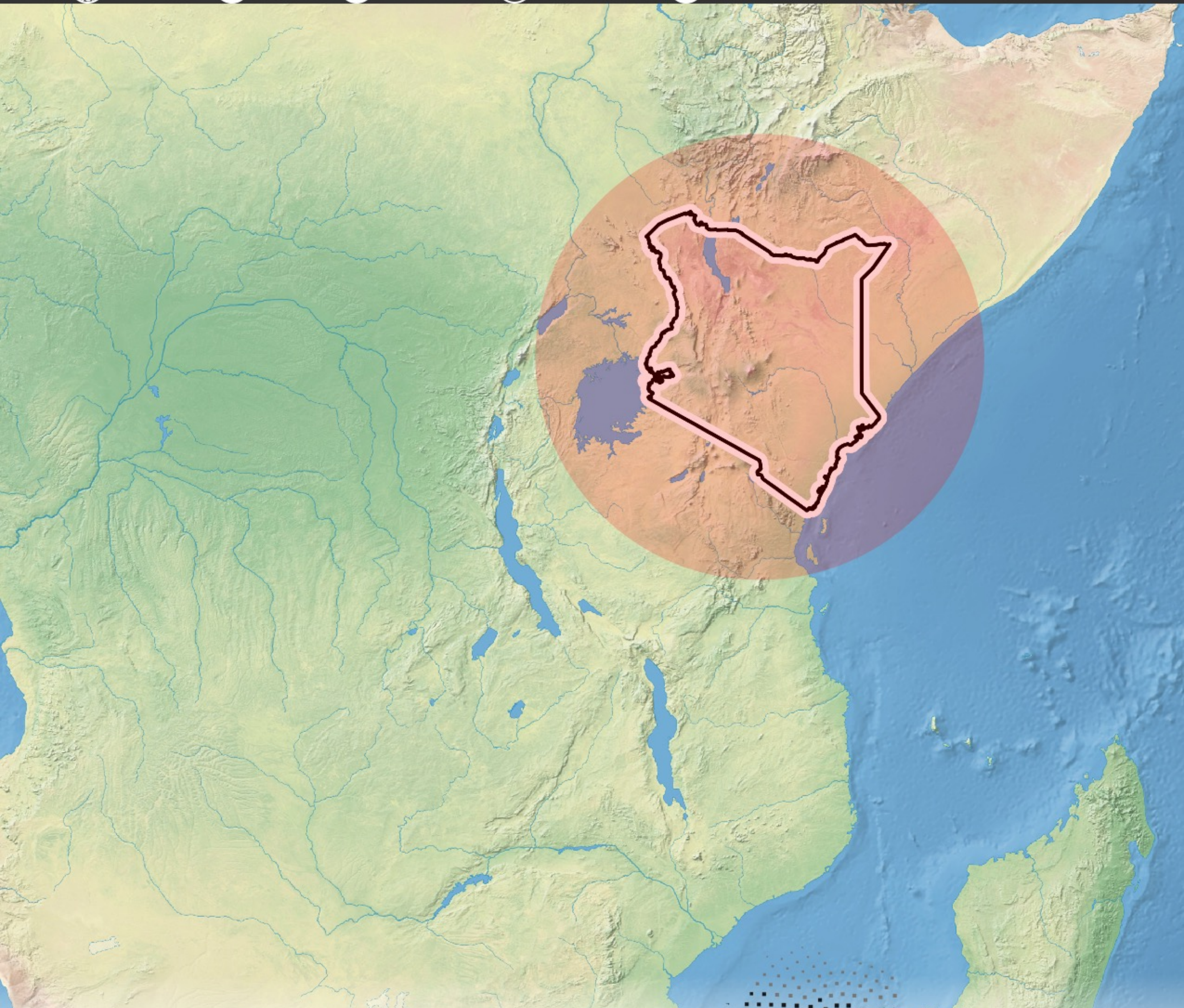
DISASTER RISK PROFILE

Kenya

Drought Flood Landslide Earthquake Volcano



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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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.

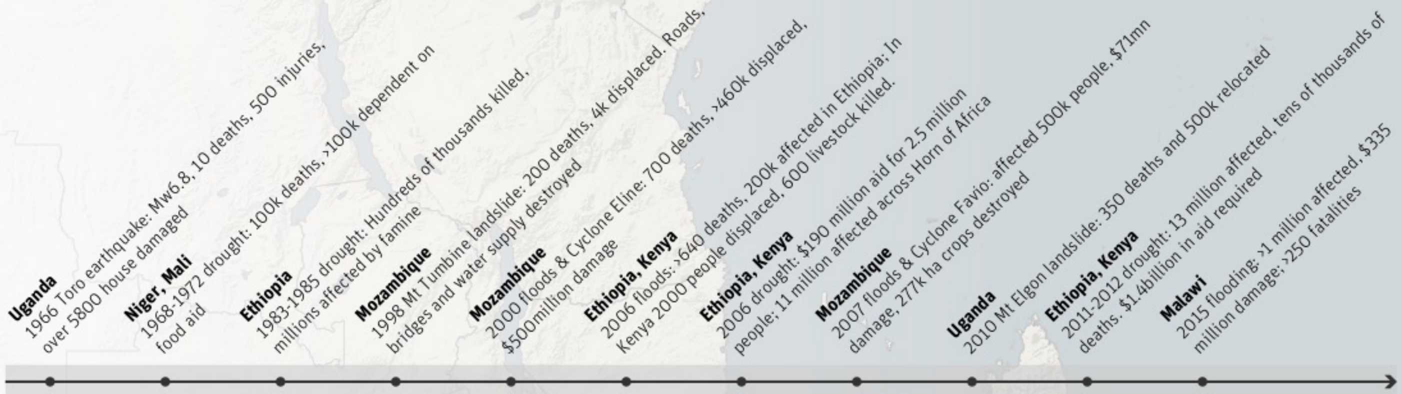
National Risk Profiles

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	✓	✓	✓	✓	✓	



DISASTER RISK PROFILES

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.

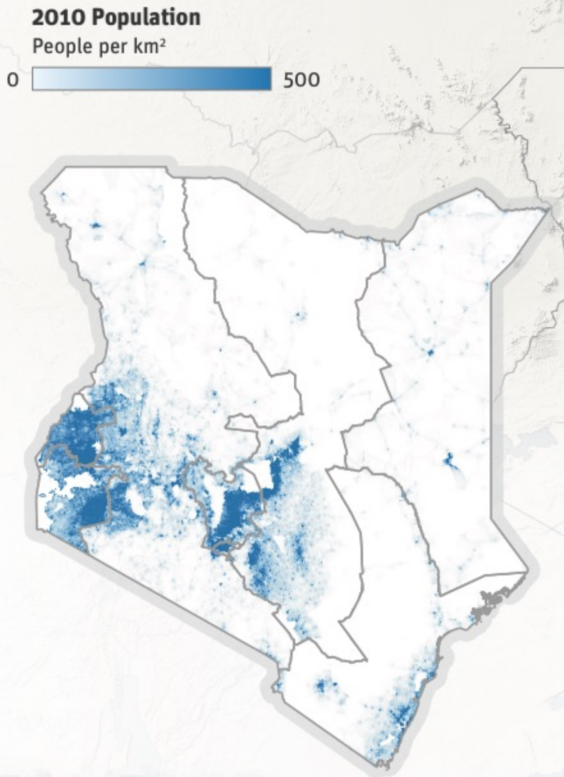
KENYA

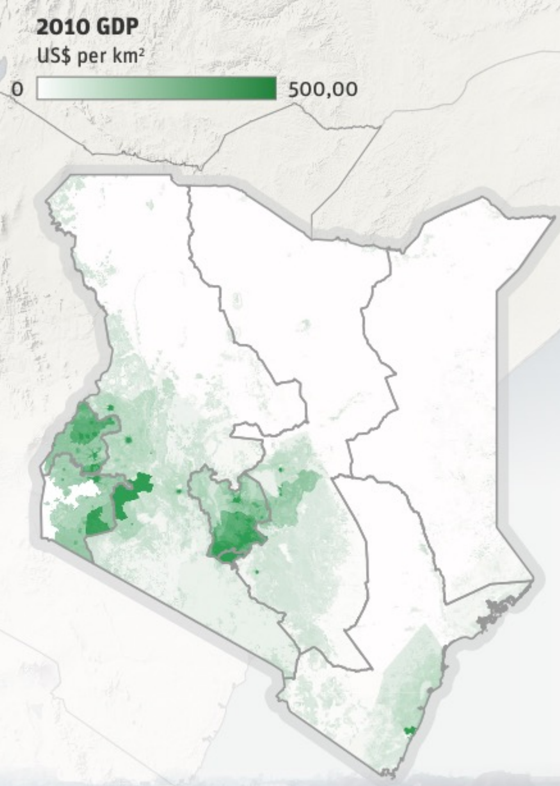
GDP $64 billion* Population 47 million* *2015 estimates

In 2015 Kenya had a population of 47 million and the population growth rates was at 1.8%[1]. An estimated 43% of the population lives below the poverty line[2]. The country Human Development Index is 0.548[3].

Kenya's agricultural sector accounts for 25% of GDP and 75% of overall employment. Most people employed in agriculture are subsistence farmers. The services sector makes up over 50% of GDP.

Vast areas of Kenya are prone to drought which has a serious impact on the welfare of the large farming population and contributes to food insecurity. Kenya's vulnerability to food insecurity is highest among the pastoralists and small-scale agriculturalists in the arid and semiarid lands of the country.





Housing on the slopes of Kibera, a division of Kenya's capital city Nairobi.

All $ amounts are in USD

Drought | Flood | Landslide | Earthquake | Volcano

Droughts and floods pose the most significant and recurring risk to Kenya, and the western and eastern regions of the country are most susceptible to the impacts of these hazards.

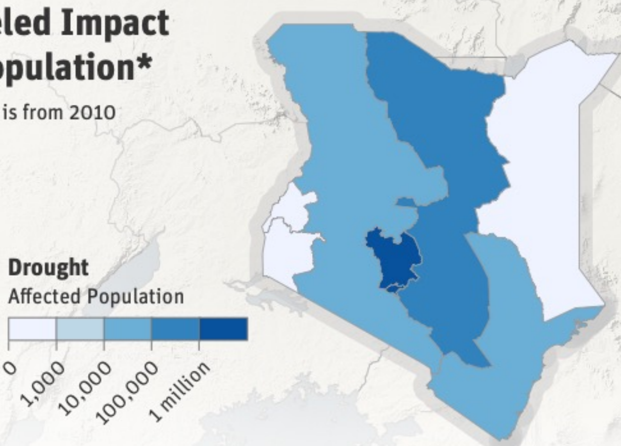
Droughts affect most people due to Kenya's climate and uneven distribution of water resources. On average, 5 million people are affected by drought every year, but this number can be substantially higher in dry years.

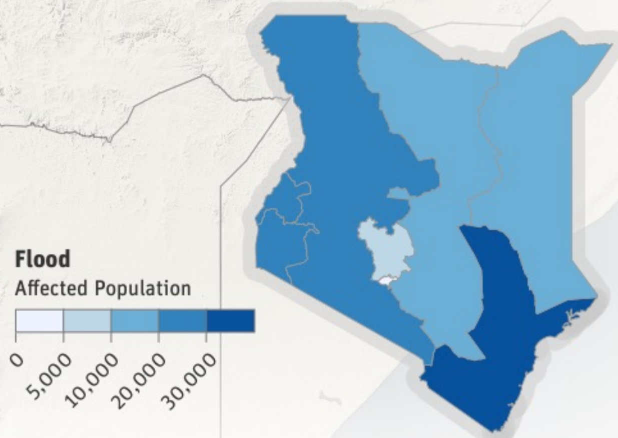
Flooding poses a threat to lowland, highland, and urban areas, with 150,000 people affected by floods each year, on average. A much smaller number of people are at risk from **earthquakes, landslides and volcanoes.**

Future changes in Ethiopia'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*

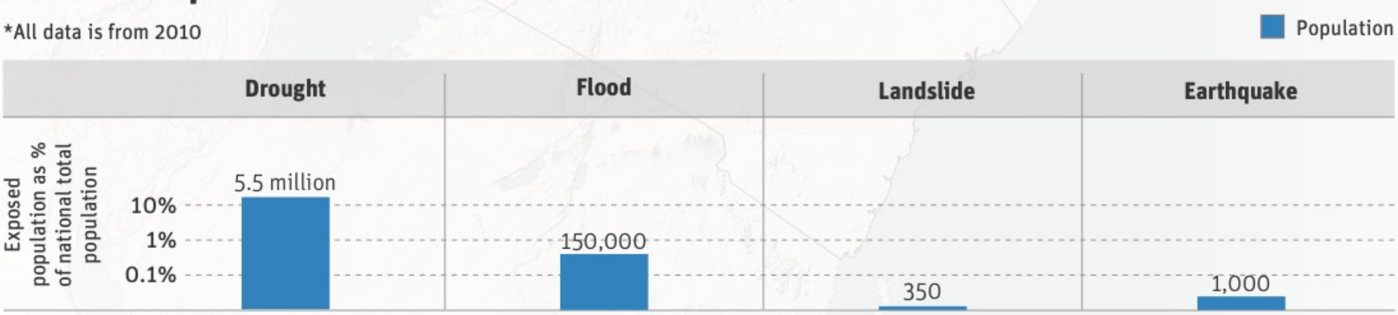
*All data is from 2010





Modeled Impact*

*All data is from 2010



Hazard Summary Table

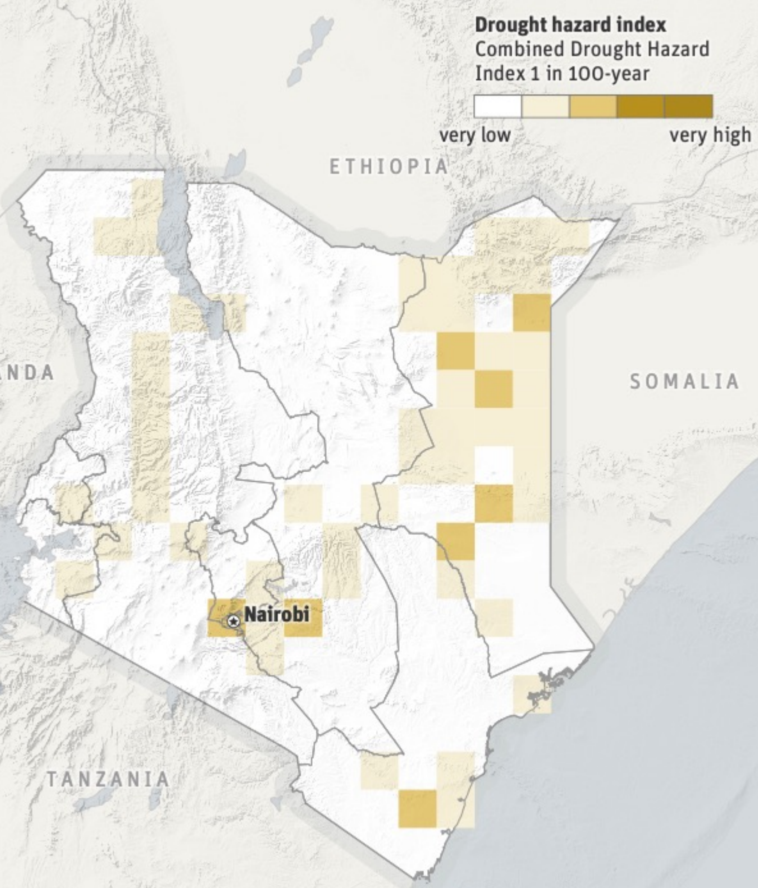
HAZARD	IMPACT
Drought	On average, around 5.5 million people are affected by water scarcity each year, mainly in central regions of Kenya.
Flood	On average, each year 150,000 people and around 200 education and healthcare facilities nationally are affected by river flooding.
Landslide	Landslide is a very localized hazard, but could cause up to $1.5 million of damage to building stock and put over 350 people at risk per year, on average.
Earthquake	Damaging earthquakes are infrequent, but it is estimated that around 90,000 people could experience at least light ground shaking at least once every 50 years.
Volcano	Kenya has many volcanoes in the heavily populated Rift Valley; around 1.3 million people are potentially exposed to volcanic ashfall around Menengai volcano alone.

DROUGHT
KENYA

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

This risk profile assesses **hydrological drought** impacts on population, and the effects of agricultural drought on crop income. Hydrological drought is characterized by estimating the potential deficit of water availability in rivers and reservoirs. The greatest deficits occur in the northeastern region of Kenya but also other areas experience significant deficits (see main map). **Agricultural drought** is assessed by estimating the potential for lack of rainfall and its impact on rainfed agriculture.

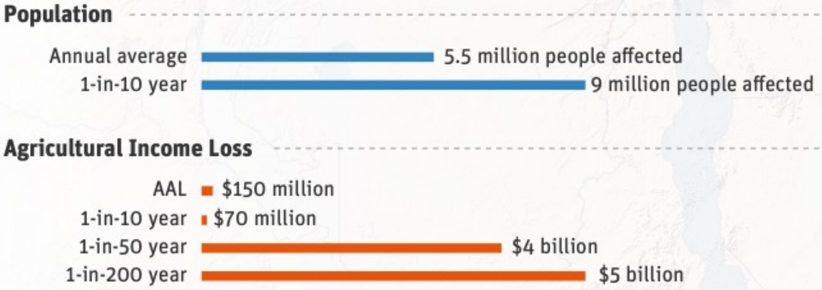
The bars below indicate the number of people located in areas affected by a lack of water availability. Agricultural income loss refers to the value of crops lost due to agricultural drought. These are modeled estimates and are inherently uncertain. Based on the historical numbers recorded from previous droughts, the modeled numbers for affected population are probably conservative estimates. In part, this could be the result of not taking into account emergency measures in reality which reduce the impact.



Key Facts

- Kenya and the Horn of Africa region experience droughts very frequently. On average, a major drought occurs every decade and a minor ones every three to four years. Recent droughts took place in 1991, 1994, 1997, 1999, 2004, 2005, 2008 and 2010-2011 and most recently in 2016-2017.
- The 2011 drought left more than 3.75 million people in need of food assistance, and in 2017 around 3 million people required emergency food assistance.
- Livestock are an important component of the agricultural economy of Kenya, and livestock are adversely effected during droughts. However, this analysis does not account for impacts on livestock.

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-200 to 0.4% annual probability.

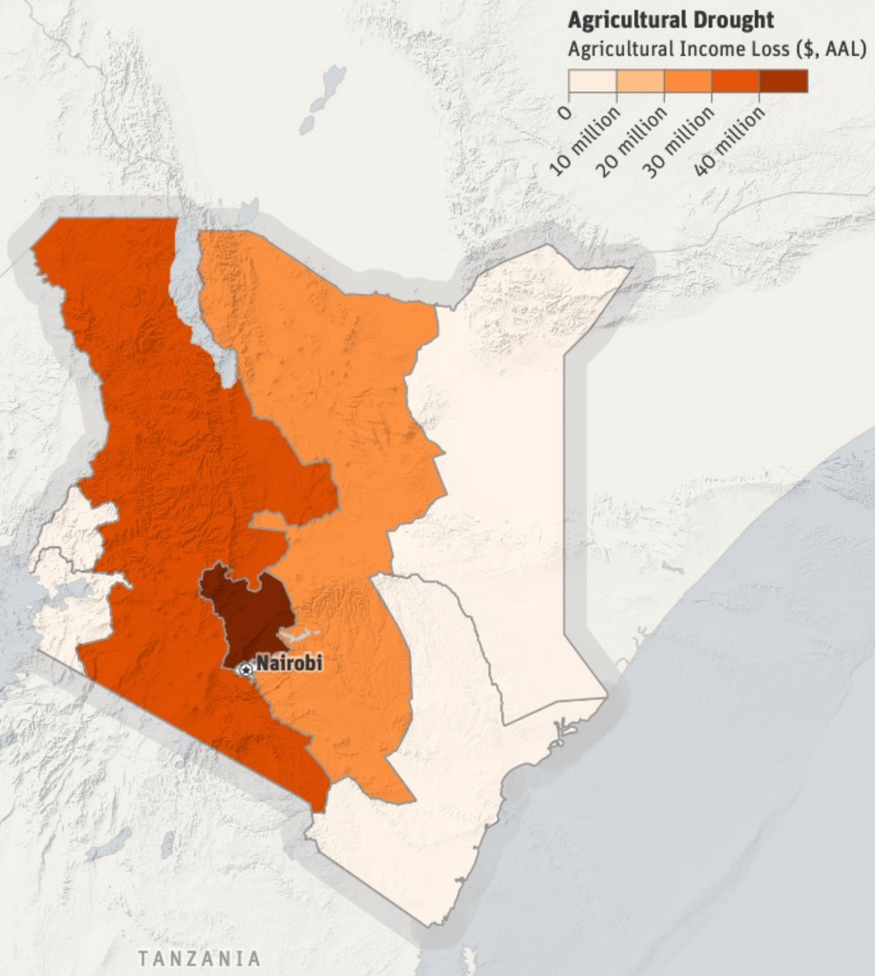
The distribution of drought risk is determined by the occurrence of drought hazard/events, the location where assets intersect with this hazard, and the vulnerability of those assets. For more detail, see the Methodology section.

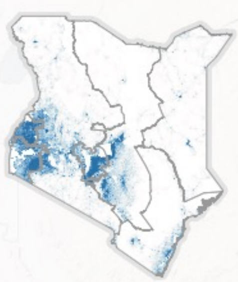
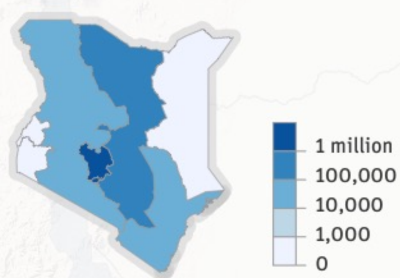
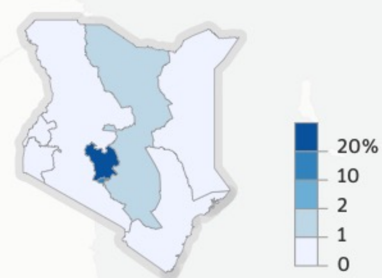
DROUGHT

KENYA

Hydrological drought risk is greatest in the central and Nairobi regions. In the Central region, more than 3 million people live in areas expected to suffer water scarcity each year, with a further 1.8 million people in Nairobi. Despite the relatively high hazard in northeastern region, there is sparse population in this region.

On average, once every 10 years a loss of at least $70 million in agricultural income will occur in Kenya based on the modeling results. The Central, Eastern and Rift Valley regions provide the greatest contribution to national crop losses. For more extreme events, the agricultural loss may be very significant resulting in multiple billions US$ of agricultural loss according to the modeling results. Due to these high losses for extreme events, the annual average loss estimates are relatively high compared to the relative frequent drought events. Overall, these loss estimate numbers have to be interpreted with care due to very limited validation data.



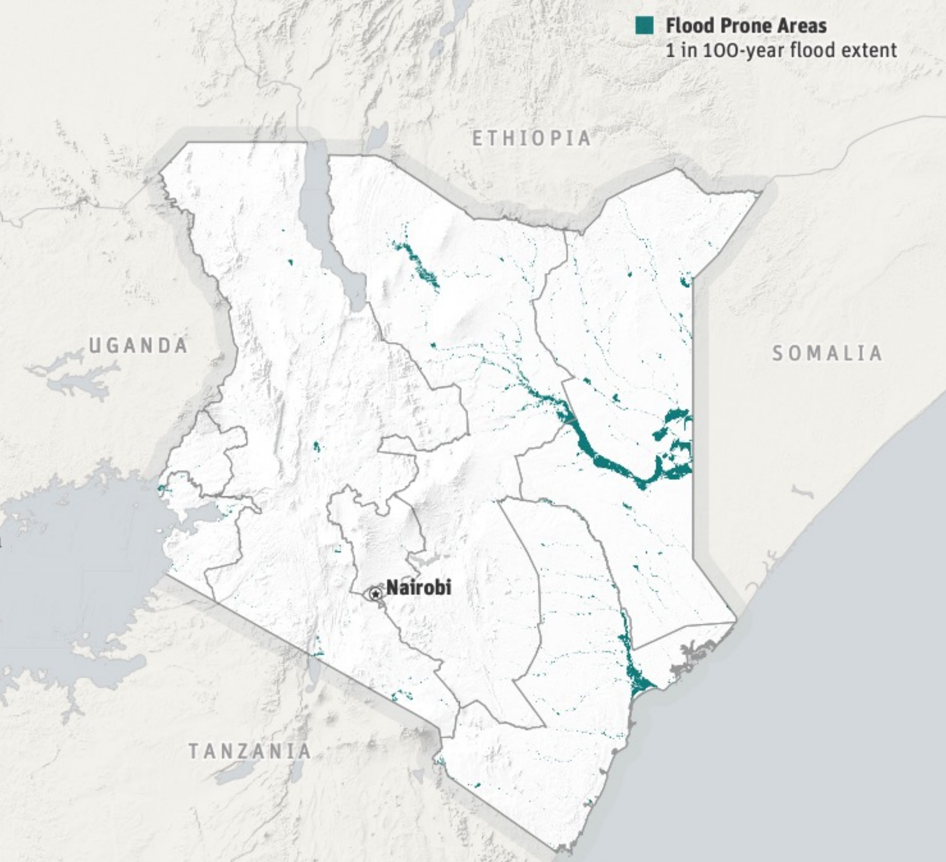
	Asset Distribution	Average annual affected (water scarcity) Per region	Average Annual Loss Contribution to national average loss
Population Pop. exposed to water scarcity			

FLOOD

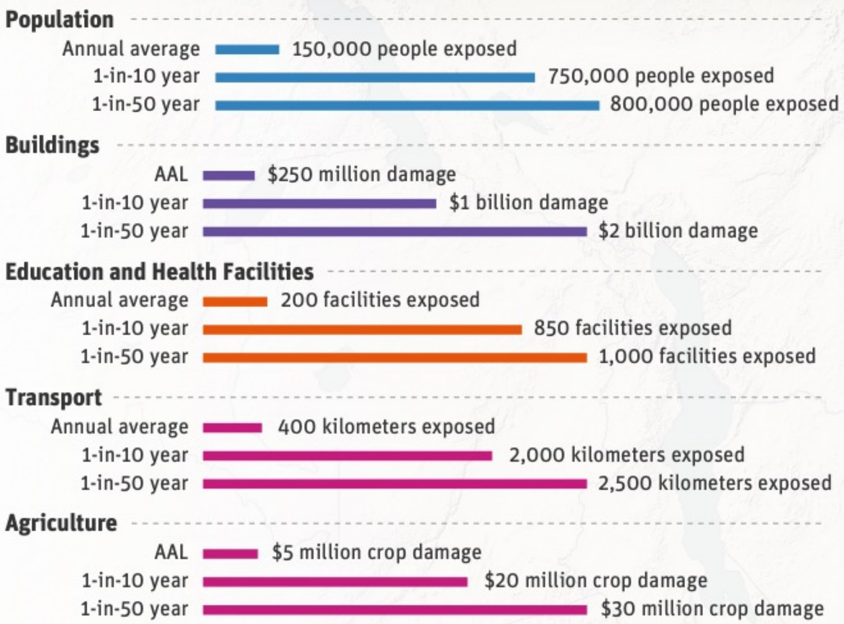
KENYA

Seasonal river floods affect various parts of Kenya, especially along the floodplains in the Lake Victoria basin and the Tana River. The most severe flooding generally occurs in the Kano Plains (Nyando district), along the Nzoia River and the lower parts of the Tana River in Nyatike (Migori County) in Nyanza Province , and in Budalangi in Western Province. Urban areas in Kenya also experience flooding from local rainfall events. 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.

Here, the flood potential in Kenya can be seen in the main map. The flood hazard is high in the eastern parts of Kenya. The downstream part of the Tana River near the coast is a flood-prone area. Also, the area around Lak Bor and Lak Dera in the eastern part of Kenya are susceptible to flooding. Although less visible, the Kano Plains and the Nzoia River also show susceptibility to flooding.



Modeled Impact



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

Key Facts

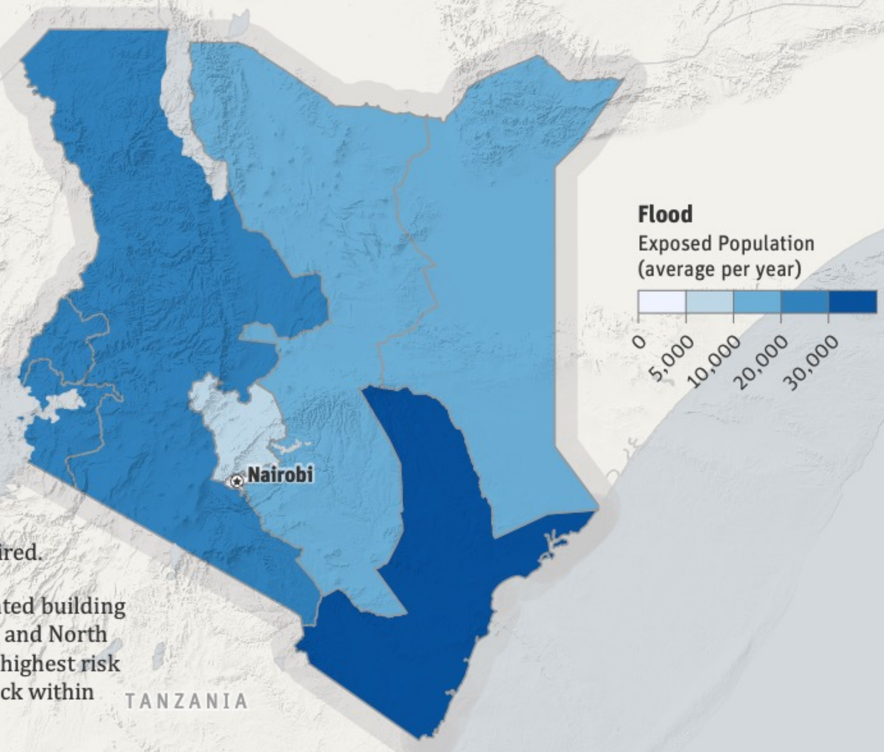
- Since 1900, flooding has killed over 1,000 people in Kenya and affected over 3 million. The large flood in 2018 killed more than 100 people in Kenya and hundreds of thousands of people were affected.
- According to available disaster databases, there have been 50,000-150,000 people affected each year by floods in the past decade.

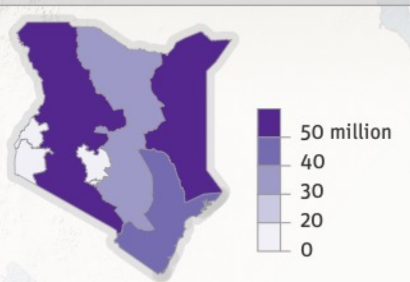
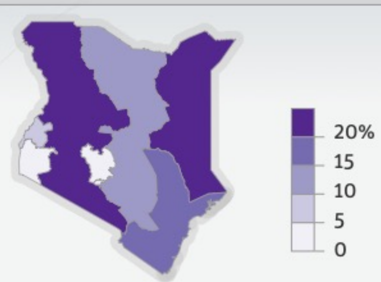
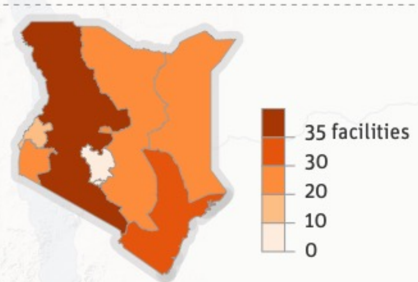
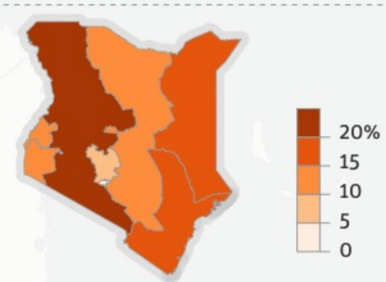
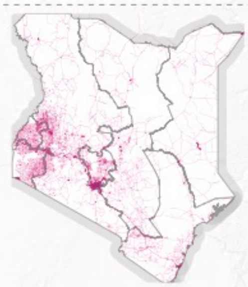
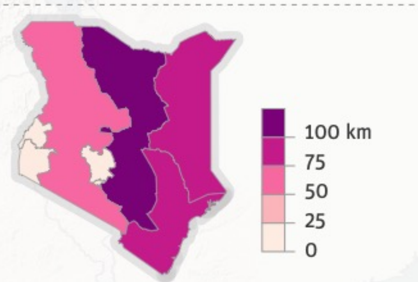
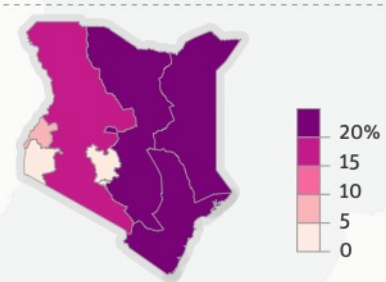
The distribution of flood risk is determined by the occurrence of flood events, the location where assets intersect with these hazards, and the vulnerability of those assets. For more detail, see the Methodology section.

Various regions in Kenya are prone to flooding. Damage of over $30 million to crops and $1.8 billion of damage to the building stock may occur in at least one flood in a person's lifetime. It is expected that on average each year, 150,000 people will be affected by flooding.

On average, each year flooding is expected to cause substantial damage to buildings, and result in 200 education and health facilities, and 400 kilometers of the transport network being exposed to flooding. It is noted that the estimated building damage is relatively high compared to (limited) historical records. Uncertainties in the modeling of loss estimates, but also under-recording of historical event impacts may explain this. Further analysis of flood risk in Kenya is required.

The areas contributing most to the national estimated building damage and affected population are the Rift Valley and North Eastern Region. The North Eastern Region has the highest risk relative to the population and value of building stock within the region.



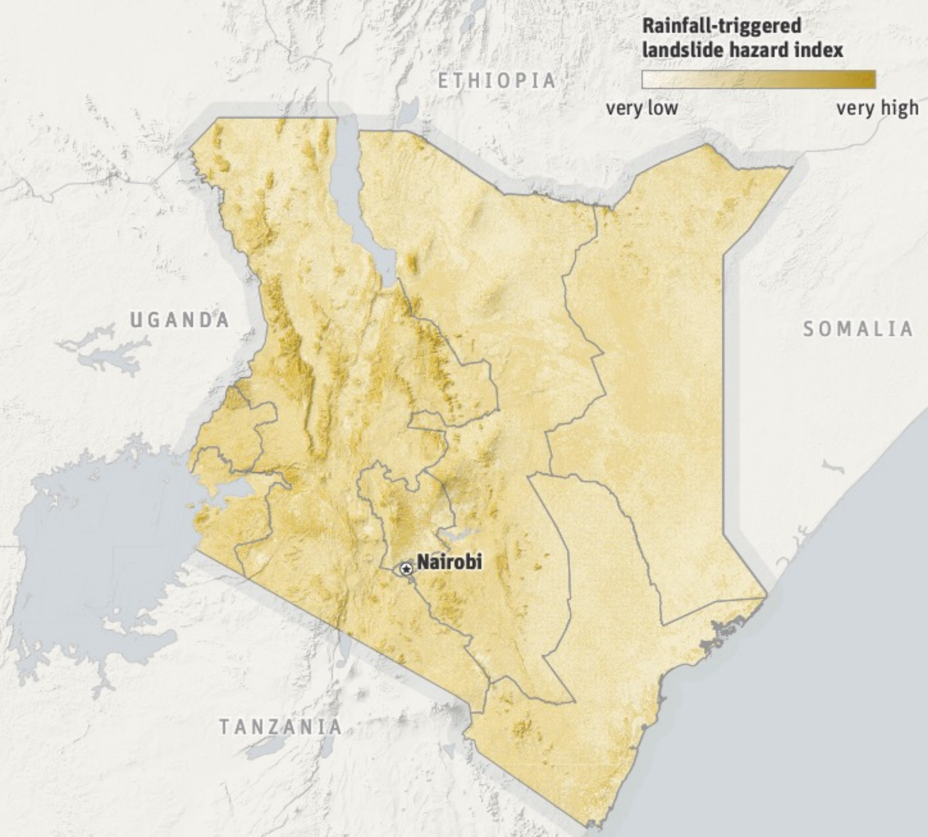
	Asset Distribution	Average Annual Loss Per Province	Average Annual Loss per Province Relative to national total
Buildings $ Damage			
Education and Health Facilities Facilities exposed			
Transport Km exposed			

KENYA

The Eastern parts of Kenya are low-lying with low landslide hazard, while the western half of Kenya has high hazard in the Rift Valley Province, southern parts of Eastern Province, as well as Nyanza and Western Provinces. Areas particularly susceptible to landslides include Mount Elgon, the Rift Valley Escarpment, and many other mountainous areas.

The highlands are susceptible to various types and sizes of landslide due to their variable topography and geology, high annual rainfall, and human development of slopes. Single landslides can move thousands of cubic meters of material, destroying land and causing huge damage and loss of life. Deforestation and unsustainable land use practices have been linked to increased landslide activity in many of the highland areas.

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.



Key Facts

- Long rainy seasons can results in increased landslide activity. Such events occurred previously in 1978, 1981 and 1986. Under future climate conditions, landslide activity could increase due to more sustained and/or more intense rainfall.
- A devastating landslide on the slopes of Mount Elgon in 2010 demonstrates the scale of landslide hazard in these mountainous areas: that single event killed over 350 people in Uganda, and prompted calls for relocation of up to 500,000 people.

Modeled Impact

Population
Annual average — 350 people exposed

Buildings
AAL — $1.5 million damage

Education
AAL — $350,000 damage

Health
AAL — $65,000 damage

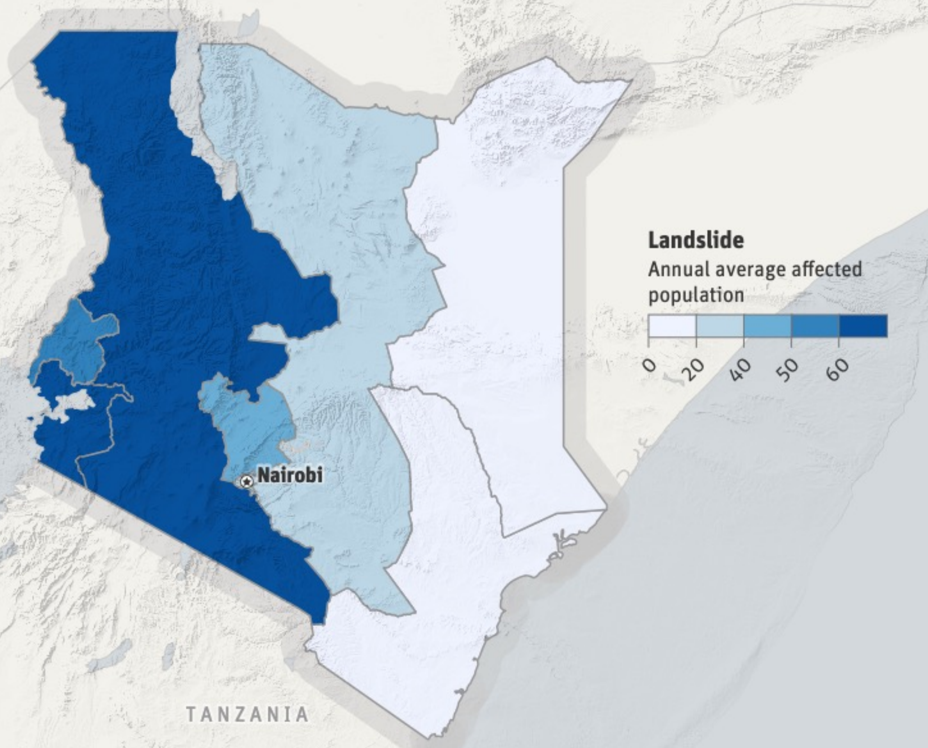
Transport
AAL — $150,000 damage

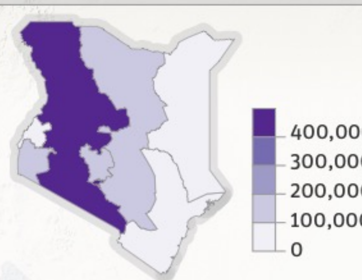
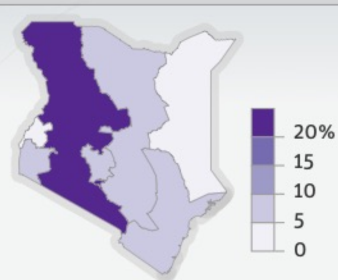
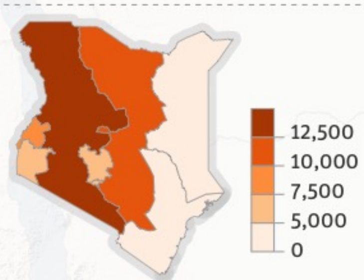
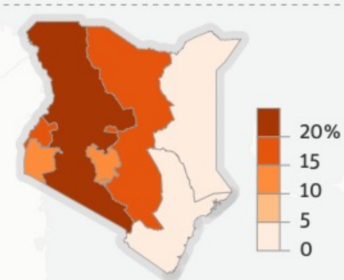
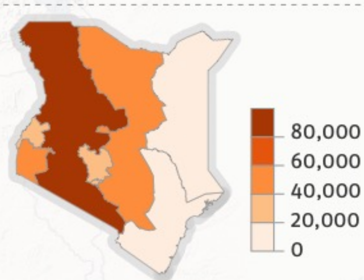
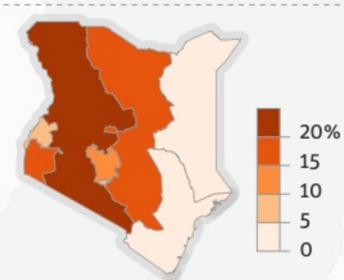
Landslide risk is a function of population and assets being located in areas susceptible to landslides (based on slope angle, vegetation cover and soil type), and the potential for earthquakes and rainfall to trigger landslides there. For more detail, see the Methodology section.

KENYA

On average, each year 300 people are at risk of being affected by landslides, with 10% of that number being killed. With projected population growth, this figure could double to around 600 by 2050. The annual average damage to building stock is expected to be over $1.5 million, and up to $3 million of GDP could be affected in any given year. This analysis also suggests that combined damage cost to energy generation, education and health facilities would be limited to around $500,000 per year on average, due to few of these facilities being located in landslide-prone areas.

Nyanza, Western, and Rift Valley Provinces contribute the greatest number of population affected (60-70 people per year in each province), while Nairobi ($400,000 per year) and Rift Valley Province ($730,000) contribute the greatest damage cost to buildings.

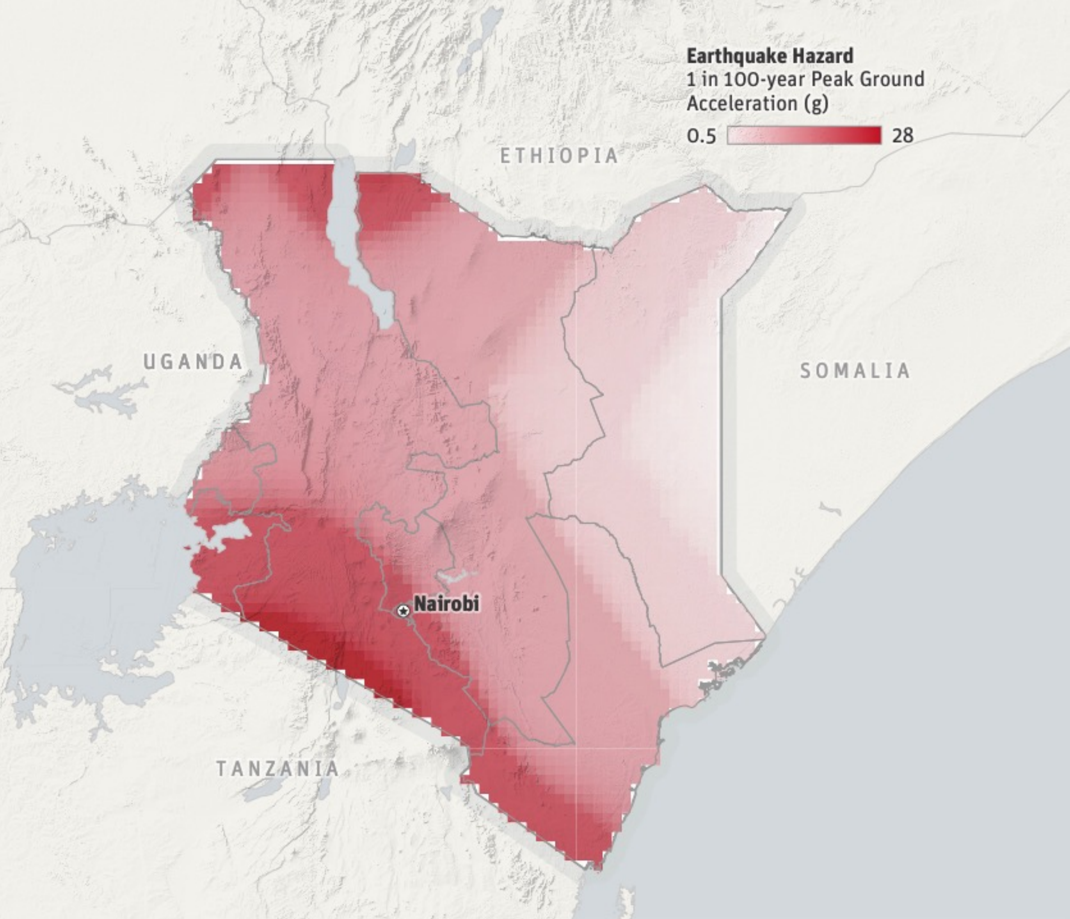


	Asset Distribution	Average Annual Loss Per Province	Average Annual Loss per Province Relative to national total
Buildings $ Damage			
Health Facilities $ Damage			
Education Facilities $ Damage			

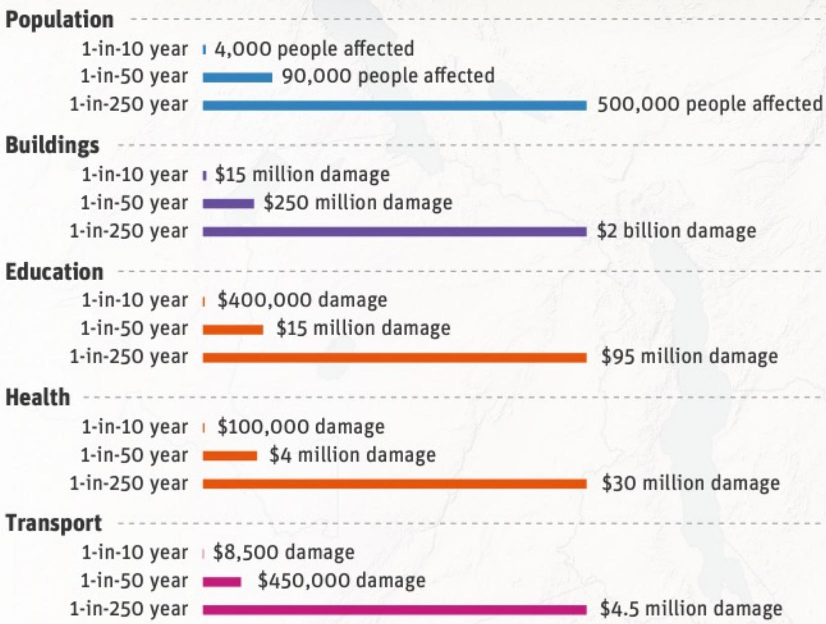
KENYA

Kenya has moderate earthquake hazard, due to the East African Rift running through the west of the country. The areas of highest hazards are in the northwest and along the southern border with Tanzania.

Earthquakes pose the threat of building damage and collapse, particularly where seismic-resistant design of buildings is not generally applied, as in Kenya. 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).



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

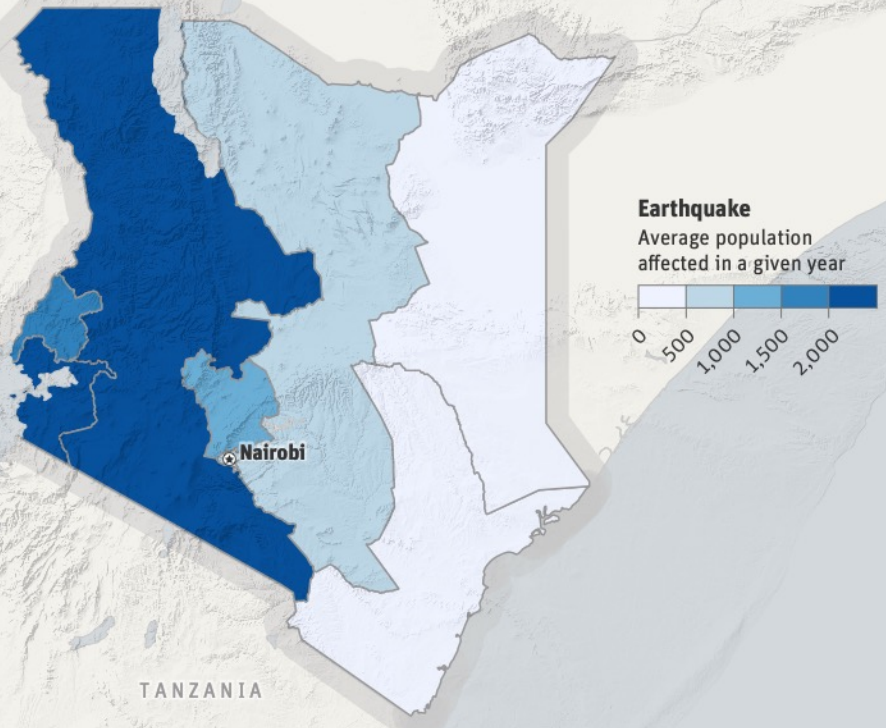
- Most known earthquakes in Kenya have been shallow (<25km deep). These can cause significant damage even with moderate magnitudes of 5-6, especially if they occur beneath or close to major urban areas.
- Earthquake hazard in Kenya is lower than that of Ethiopia and Uganda

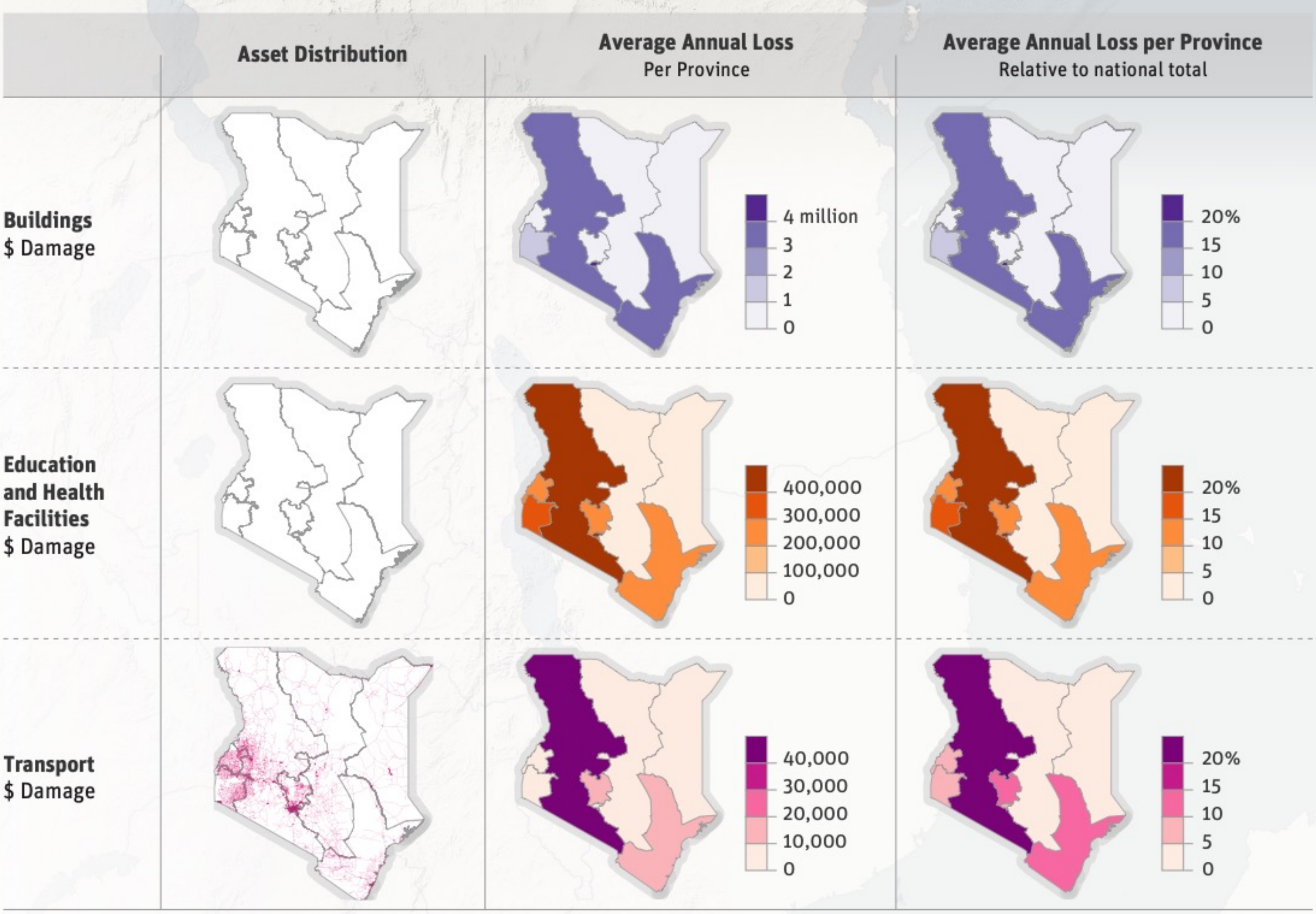
i The distribution of earthquake risk is determined by modeled earthquake hazard events, the location where assets intersect with these hazards, and the vulnerability of those assets. For more detail, see the Methodology section.

KENYA

Earthquake risk is consistently greatest in the Western, Nyanza, and Coast provinces of Kenya. The Rift Valley province has high risk owing to the high hazard in its northern and southern areas.

It is possible that, at least once in a person's lifetime, an earthquake could occur that affects almost 90,000 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 $250 million, with potential for $15 million of damage to education and health facilities.



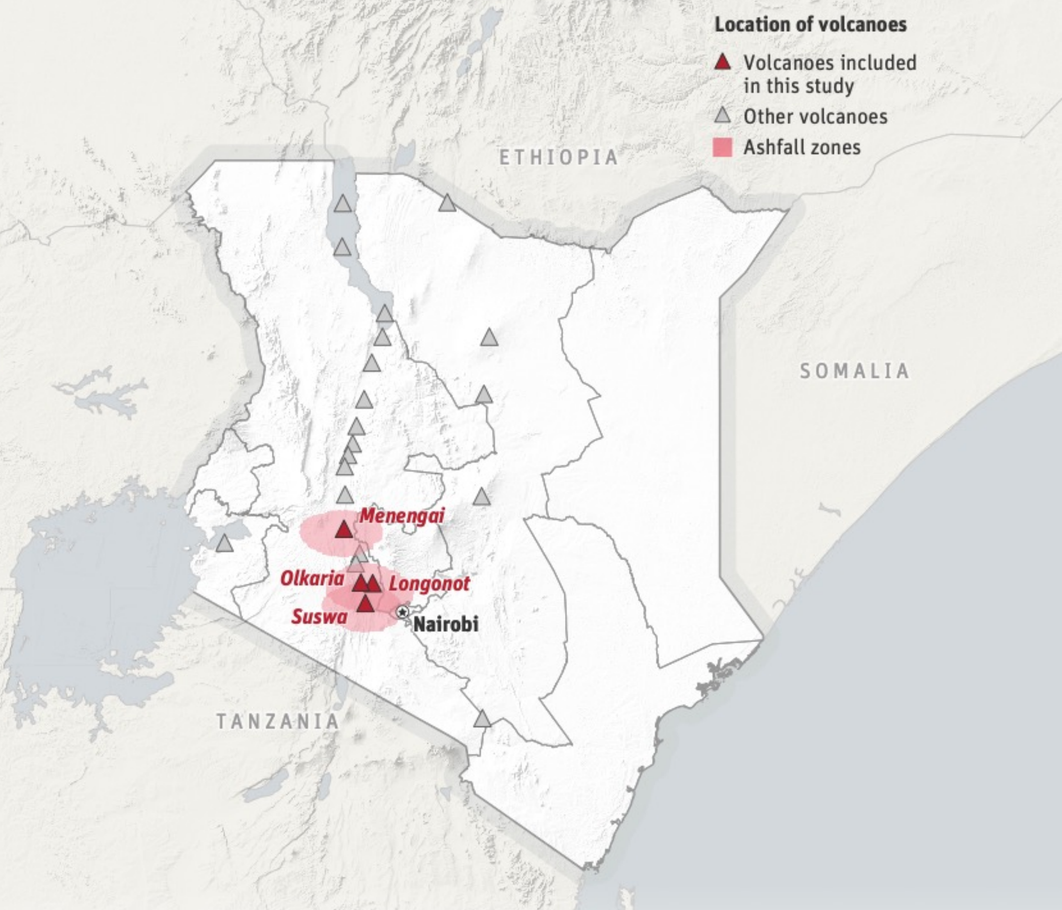


VOLCANO
KENYA

Most volcanoes in Kenya form a chain along the East African Rift in a north to south direction. There are several shield volcanoes, with a well-defined vent location and there are five volcanic fields. The extent of the volcanic fields are not well defined, but generally they are extensive areas containing tens to hundreds of volcanic vents at which eruptions could occur.

Selected volcanoes were analyzed for this risk profile, prioritized by local experts' perception of risk to population: Menengai, Longonot, and Suswa volcanoes, and the Olkaria volcanic field – all located northwest of Nairobi (see main map). There is evidence of eruption within the last 200 years at both Olkaria and Longonot.

Ashfall potential was analyzed for the three volcanoes, and a topographic analysis was conducted for all four sites, to define areas that could be affected by highly destructive pyroclastic flows (of superheated gases and volcanic debris) and lahars (volcanic mud flows). This analysis did not include additional volcanic hazards such as lava flow, explosive fire fountaining (ballistic impact close to a vent), ground fissuring, or volcanic gases (which affect people, livestock and crops).



Key Facts

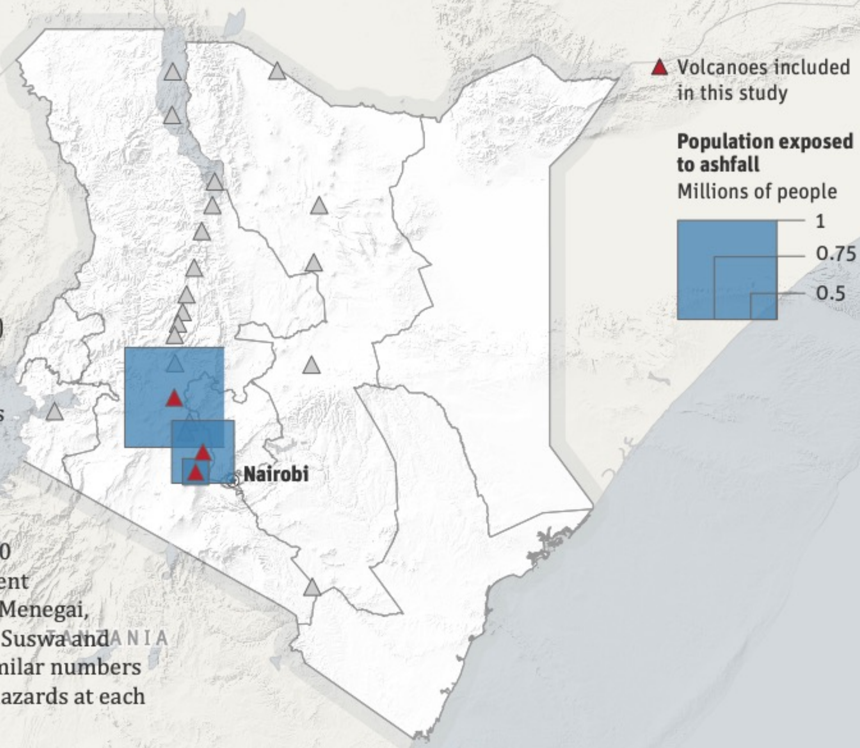
- The area around Menengai volcano is densely populated, with Kenya's fourth-largest city, Nakuru, lying to the south. Menengai poses the most frequent ashfall of the volcanoes analyzed. Menengai could be expected to experience a smaller explosive eruption (VEI 3 or lower) with significant ashfall and local hazards at least every 350 years.
- In an eruption of Suswa or Longonot the predominant wind direction is likely to carry ashfall west, away from Nairobi, but if wind blew eastward during an eruption there could be significant ashfall in the capital city. Similar volcanoes to Suswa and Longonot are considered to produce large explosive eruptions (VEI 4 or greater) more frequently than Menengai.

Modeled Exposure

The distribution of volcano exposure is determined by analyzing the intersection of volcanic hazard with location of assets. For more detail, see the Methodology section.

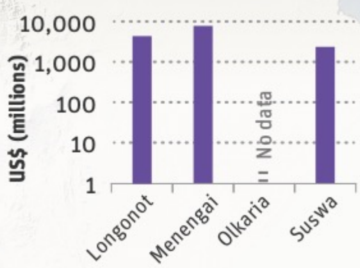
Volcano risk is presented as population or value of assets exposed to volcanic hazards (flow hazards within 100km of a volcano, and ashfall at greater distances for selected eruption scenarios) at the volcanoes analyzed, and are intended to be indicative of the volcanic risk. Due to a present lack of information around eruption frequency and eruption style (more dangerous explosive eruption, or lava-dominated effusive eruptions) of these volcanoes, and vulnerability of asset types to volcanic hazards, it is not possible to estimate the likelihood and magnitude of losses with a reasonable degree of confidence.

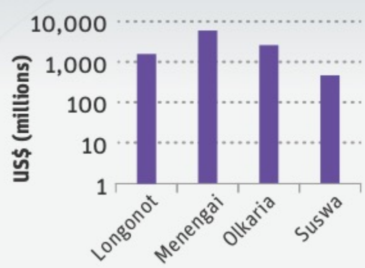
Population exposed to potential ashfall from Menegai volcano exceeds 1.3 million, with exposure to Longonot ashfall exceeding 800,000 people. Over 200,000 buildings, with replacement cost of $7.3 billion, are exposed to ashfall from Menegai, with another 100,000 ($2.3 billion) exposed to Suswa and 180,000 ($4.1 billion) exposed to Longonot. Similar numbers of populations and assets are exposed to flow hazards at each volcano and Olkaria volcanic field.



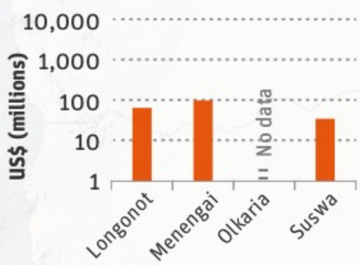
	Asset Distribution	Ashfall Exposure (Millions US$)	Flow Hazard Exposure (Millions US$)

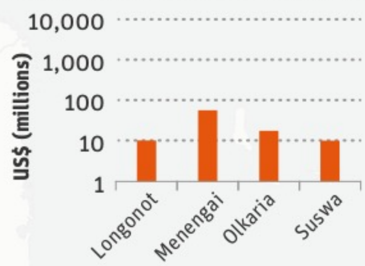
Buildings
$ Exposed Value



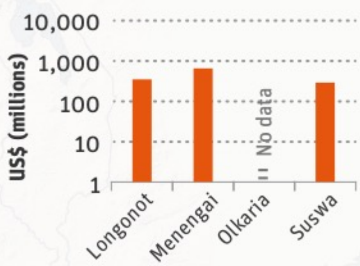


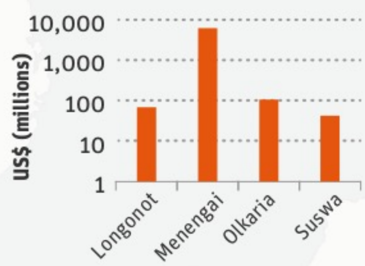
Health Facilities
$ Exposed Value





Education Facilities
$ Exposed Value





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-worldfactbook/.

[2] Ibid.

[3] 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.

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