DISASTER RISK PROFILE

Afghanistan

Flood Earthquake Drought Landslide Avalanche

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GFDRR
Global Facility for Disaster Reduction and Recovery

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DISCLAIMER

RIGHTS AND PERMISSIONS

INTRODUCTION

Afghanistan's rugged mountain landscape and generally arid climate make it prone to several natural hazards. The Hindu Kush Mountains divide the country into the Central Highlands that are part of the Himalayas, the Southwestern Plateau, and the country's fertile Northern Plains. The climate ranges from arid to semi-arid, with large temperature differences between altitudes and between warm and cold seasons.

Afghanistan is highly prone to intense and recurring natural hazards, including earthquakes, floods, flash floods, landslides, avalanches and droughts. Within low-income countries Afghanistan takes second-place, only surpassed by Haiti, in terms of the number of fatalities from natural disasters between 1980 and 2015. For every 1 million inhabitants 1,150 people die in Afghanistan, 50% of these fatalities from geophysical and weather related events, respectively.[1]

Climate change also poses a threat to Afghanistan's natural resources, of which the majority of Afghans depend for their livelihoods. Afghanistan faces significant impacts of climate change and disasters which will impact growth prospects. The most obvious is the impact of floods and droughts on agriculture productivity.

The country's low level of socio-economic development makes it extremely vulnerable to disasters, resulting in frequent loss of lives, livelihoods, and public and private property. Several factors have contributed to Afghanistan's vulnerability to disasters. Decades of conflict have undermined the country's coping mechanisms and protective capacity. This increases the likelihood that hazard events turn into disasters with large humanitarian and economic consequences. Disasters also have an impact on fragility and conflict. While natural hazards and disasters do not necessarily cause conflict in and of themselves, natural disasters can exacerbate the challenges people already face in fragile states, create new risks and add stress to an already weakened governance system and fuel grievances.[2]

The availability of risk information is key for effective management of disaster and climate risk. Integrating risk information into development planning, public policy and investments and assuring the resilience of new and existing reconstruction to natural hazards and climate change is critical to secure both lives and livelihoods.

With funding from the Government of Japan and the Global Facility for Disaster Reduction and Recovery (GFDRR) and in close cooperation with the Afghanistan National Disaster Management Agency, the World Bank has produced a comprehensive multi-hazard risk assessment at the national level, including in-depth assessments for selected geographic areas. The national multi-hazard risk assessment includes information on current and future risks from the following perils: fluvial floods, flash floods, drought, landslides, snow avalanches and seismic hazards in the country.

The risk profiles, included in this document, provides a summary and visualization of the national multi-hazard assessment. The information provides essential data and information for policy decision-making, development planning and infrastructure investments to ensure a more resilient future for Afghanistan.

1 The Munich Re NatCatSERVICE: Geo Risks Research, December 2016

2 International Alert, Policy Brief: Compounding Risk: Disaster, Fragility and Conflict, May 2015; ODI Briefing, K. Peters and M. Budimir: When disasters and conflict collide, May 2016

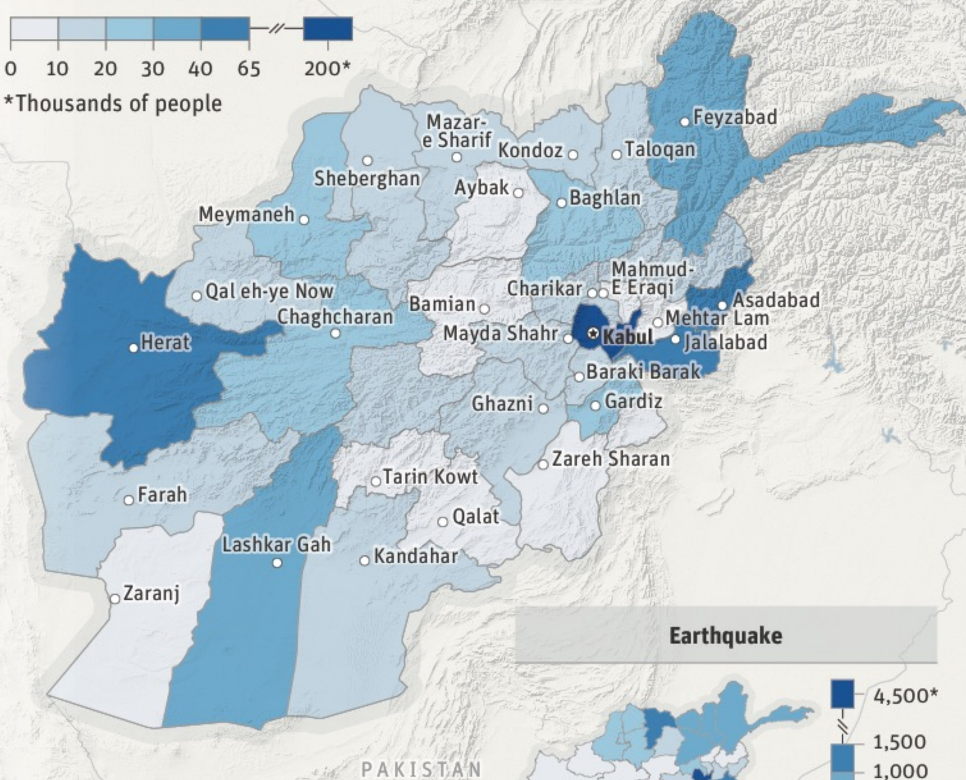
The Panj River in northern Afghanistan. Photo Credit: Brenden Jongman

AFGHANISTAN

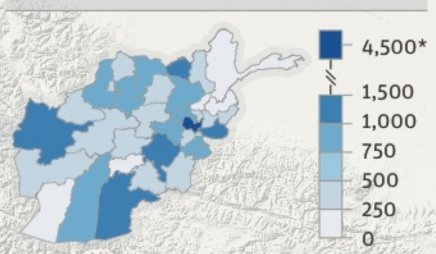
Flood | Earthquake | Drought | Landslide | Avalanche

Population Living in Hazard Area

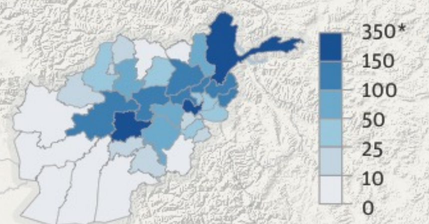
Flood



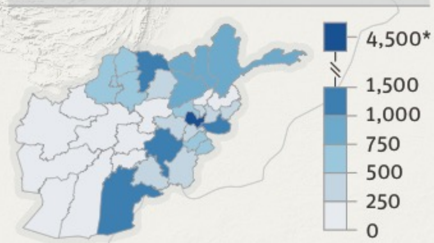
Drought



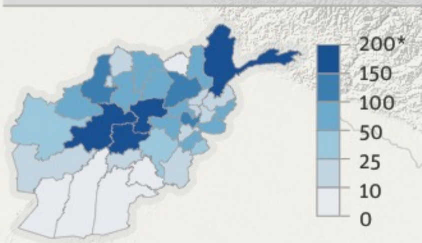
Avalanche



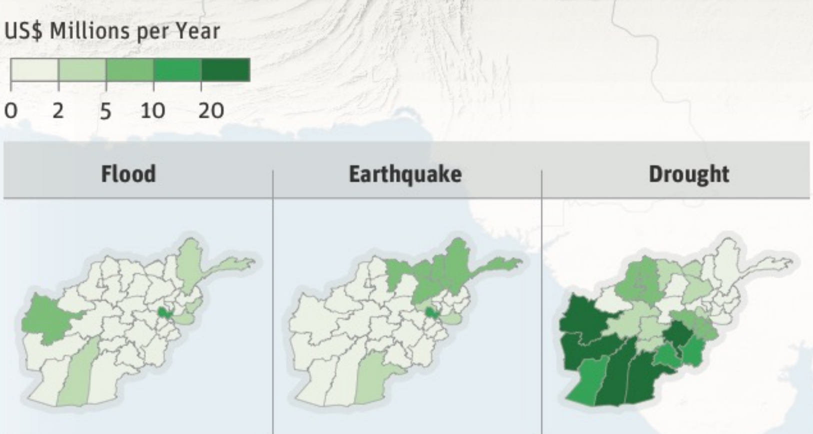
Earthquake



Landslide



Economic Damage



Hazard	Impact
Earthquake	✔ 560 fatalities on average per year
Flood	✔ Over 800,000 people exposed
Drought	✔ US$ 280 million agricultural damages per year
Landslide	✔ 130,000 private buildings exposed
Avalanche	✔ 10,000 kilometers of roads exposed

RISK SUMMARY

AFGHANISTAN

GDP $19.2 billion* Population 32.5 million* *2015

At a Glance

- Natural hazards, such as flooding, earthquakes, avalanches, landslides, and droughts, are **exacerbating vulnerability** and **poverty** in Afghanistan where the **very poorest** households experience natural hazard shocks **almost twice as frequently** as the wealthiest households.
- **Since 1980**, disasters caused by natural hazards have affected **9 million people** and caused over **20,000 fatalities** in Afghanistan.
- **Flooding** is the **most frequent** natural hazard historically, causing average annual damages of $54 million; large flood episodes can cause over **$500 million** in damages.
- **Earthquakes** caused the **most fatalities** historically; **since 1980** more than **10,000 people** have been killed due to earthquakes. [1]
- Average **yearly damages** from **earthquakes** are estimated at **$80 million.**
- **Droughts** have **affected 6.5 million people** since 2000, during four major events (2000, 2006, 2008 and 2011).[1]
- **3 million people** are exposed to very high or high **landslide** hazard.
- **2 million people** are exposed to **avalanche**.
- Due to **climate change, flood** and **drought** risk are likely to **increase** in the future.
- **Increased** frequency of **drought** conditions may **decrease hydropower** production with potential significant negative impact on power production.
- An **extreme drought** could cause an estimated **$3 billion in agricultural losses**, and lead to severe food shortages across the country.
- An estimated **10,000km of roads** (15% of all roads) are exposed to **avalanches**, including key transport routes like the Salang Pass.

1 D. Guha-Sapir, R. Below, and Ph. Hoyois, EM-DAT: International Disaster Database, Université Catholique de Louvain, Brussels, Belgium, www.emdat.be.

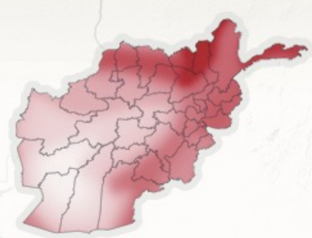
Recommendations at a glance

- To mitigate risks to development and strengthen resilience, investments in Afghanistan should incorporate information on natural hazards in planning, design and implementation.
- Strengthening dikes upstream and retrofitting houses would improve flood protection in cities; one new embankment in Kabul could reduce flood damages by $600,000 per year.
- Retrofitting schools for earthquakes throughout Afghanistan would reduce potential economic losses by 60%, and reduce fatalities by 90%.
- More effective water management could reduce water shortages due to drought; canals and irrigation systems could improve access to water for the agricultural sector; diversifying livelihoods, and improving the effectiveness of agricultural practices could increase agricultural productivity.
- Retention structures, concrete galleries over roads, and early warning systems can be effective in reducing avalanche risk.
- Reforestation and landslide retention structures such as nets can reduce the triggering of landslides during heavy rain or earthquakes.

National Hazard Maps

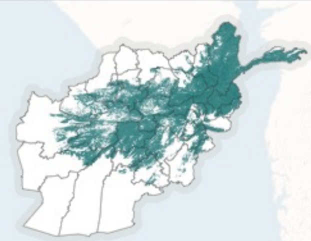
Flood

Earthquake

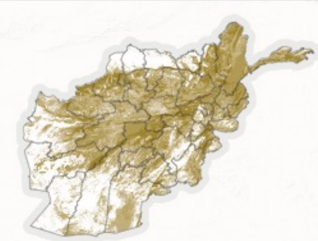


Drought

Avalanche



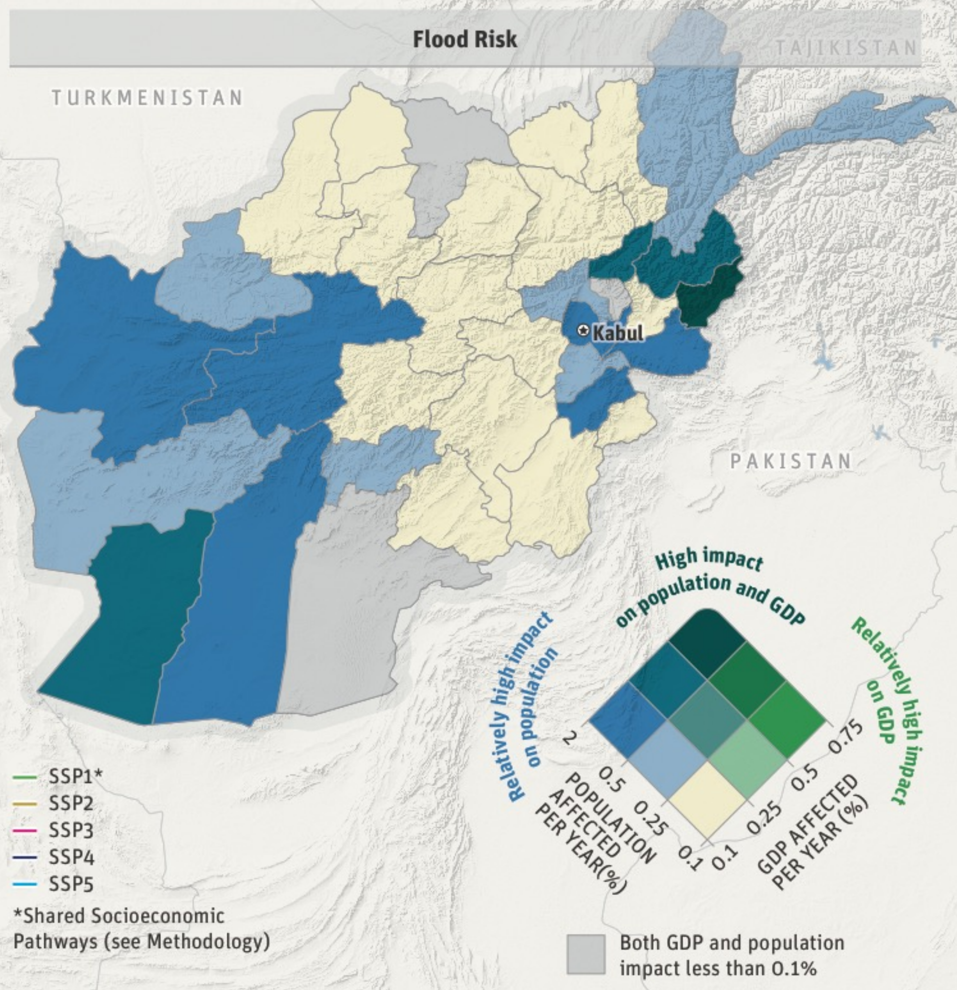
Landslide



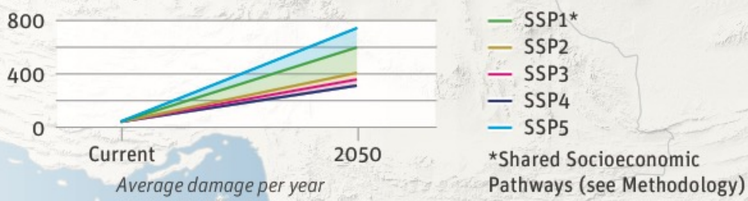
AFGHANISTAN

Flooding is the **most frequently** occurring natural hazard in Afghanistan. The country is prone to river flooding because of steep slopes in headwaters. Flooding in rivers mainly occurs as a result of **heavy rainfall** coupled with **rapid snowmelt**; the sources of most of the rivers lie in the mountains and are fed by snow and glaciers. Lack of vegetation and denudation of the mountain areas also contribute to the occurrence of flooding. **Urban flooding** is a problem in major cities, and is often caused by intense local rainfall in combination with inadequate drainage systems.

Hairatan (north) and the **Helmand** basin (west) have **high levels** of flood hazard. **Kabul** Province is **most affected**, population wise: over 2,000 people on average per year. The majority of expected flood **damages** are attributed to the **commercial** (40%) and **residential** (33%) sectors.

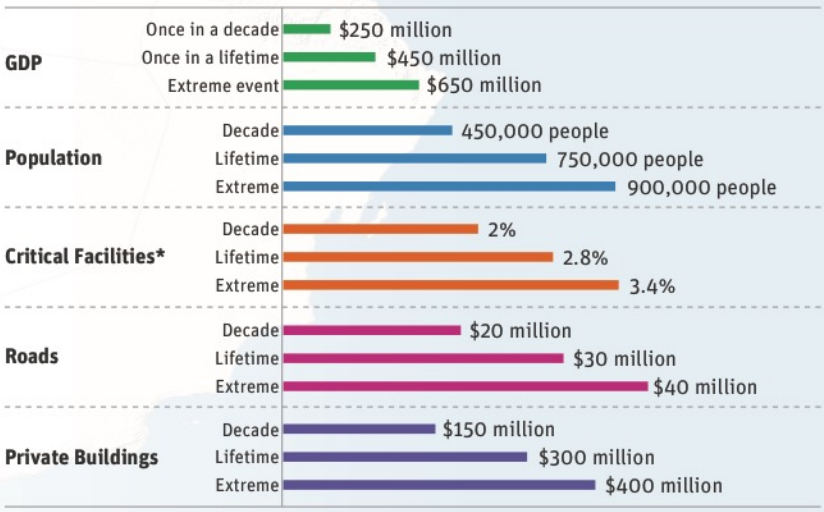


Economic Impact (Millions US$)



Modeled Flood Impacts

Reference Situation (2010)



*(Healthcare, Education and Energy)

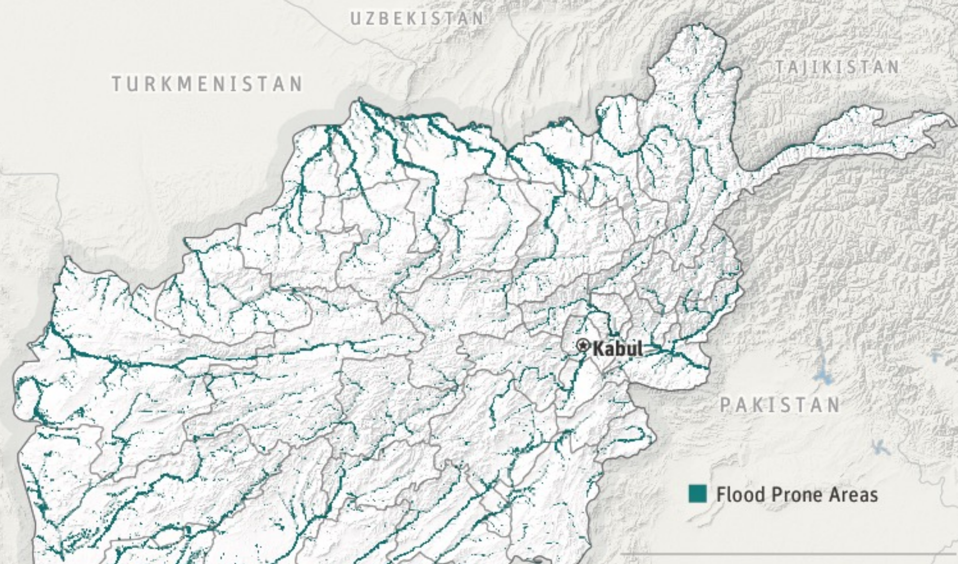
At a Glance

- Total number of **people affected each year** by flooding is approximately **100,000**.
- Extreme events from river flooding could potentially cost over **$500 million**.
- Number of people affected each year by flooding could **more than double by 2050** due to combined climate change and socioeconomic growth.
- Poorly built flood protection infrastructure, lack of early warning systems and increasing settlements in flood prone areas are **important drivers of flood risk**.
- Flooding in **May 2014** affected **90,000** people – displacing 20,000 – in 14 northern provinces, exceeding **US$100 million** in damages.

FLOOD
AFGHANISTAN

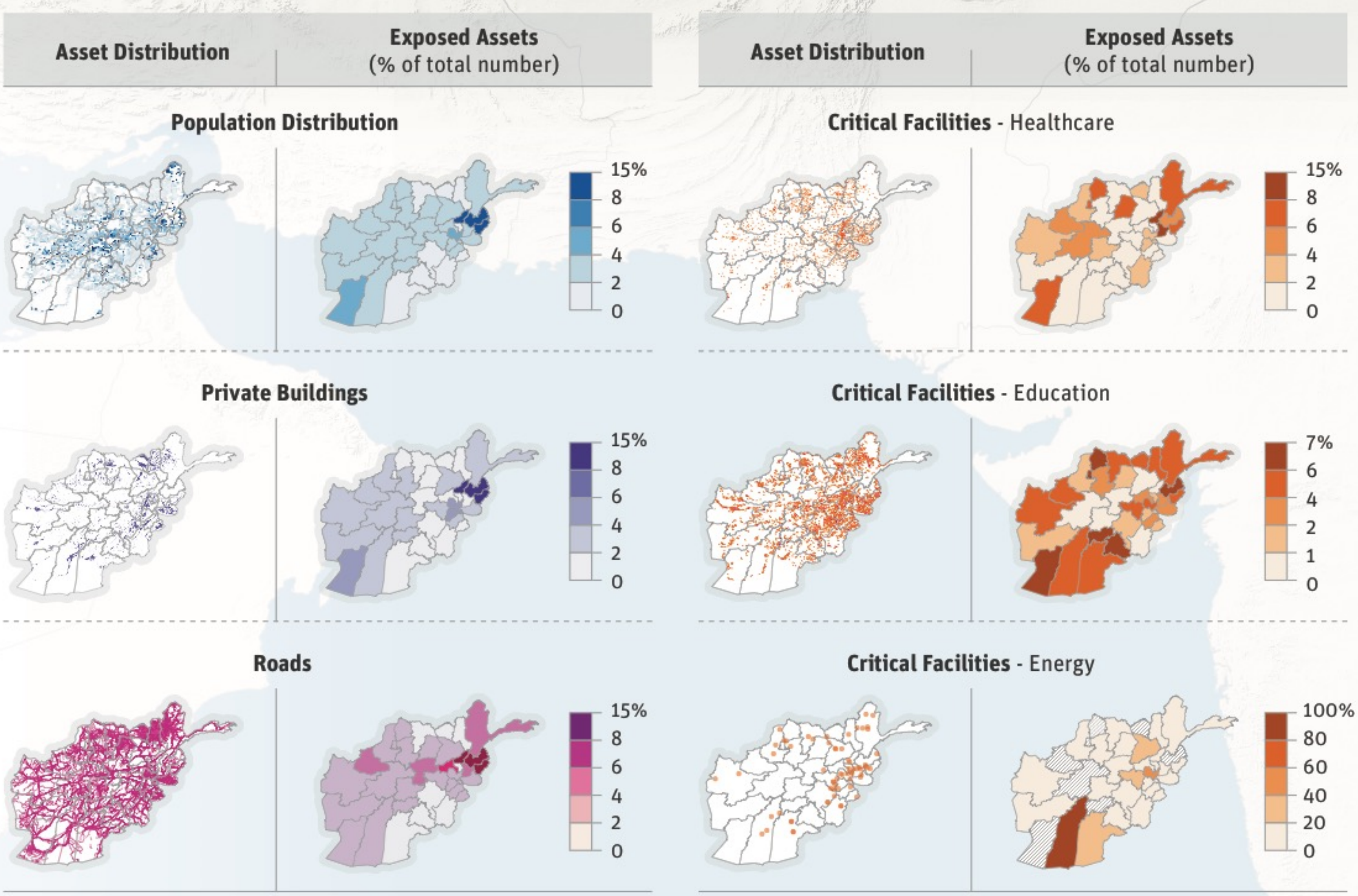
Recommendations

- **Strengthening dikes** and **retrofitting houses** would improve flood protection in cities and rural areas.
- A flood retaining wall in **Kabul** of 1m would cost approximately $180,000; the **net value** of **investing** in a flood retaining wall would be **$13.5 million.**
- One new embankment in Kabul could **reduce** flood **damages** by **$600,000 per year.**
- Building a **local earth embankment** along the river in the **Kunduz agricultural area**, in the Phuli Khumri area, and in Fayzabad could significantly reduce the risk from flooding.



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

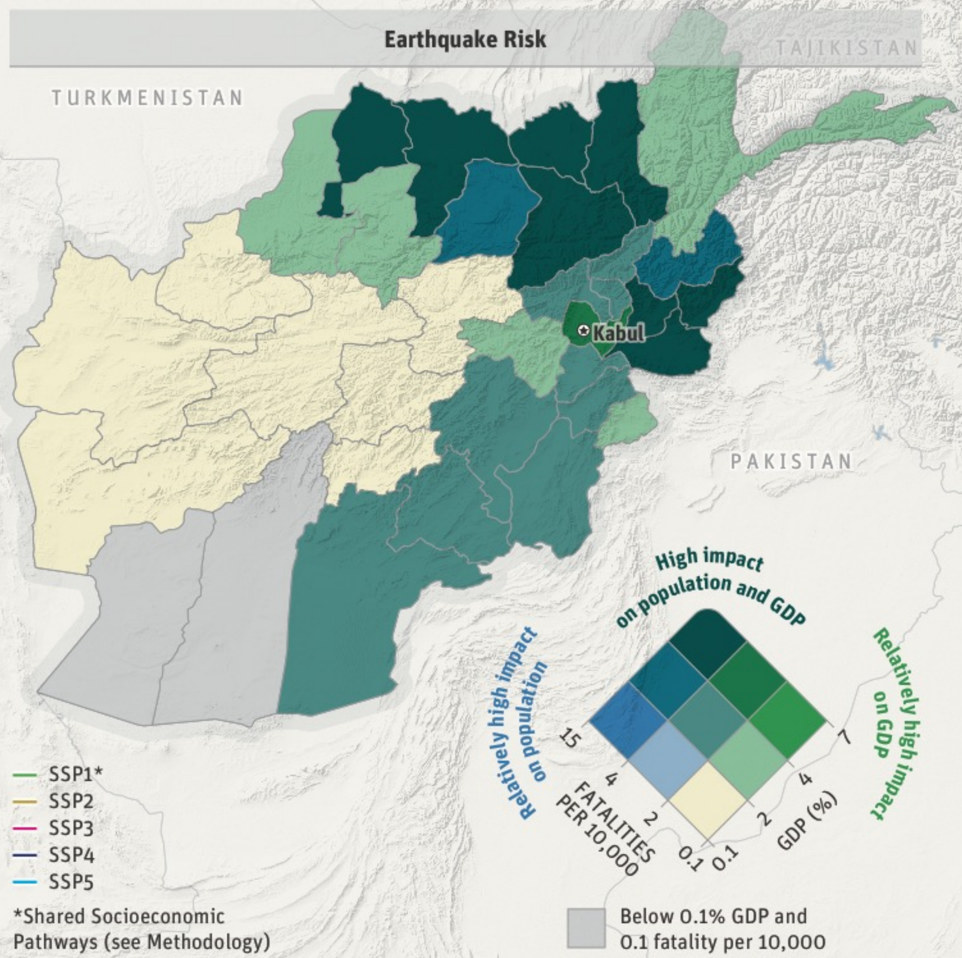
Asset Maps

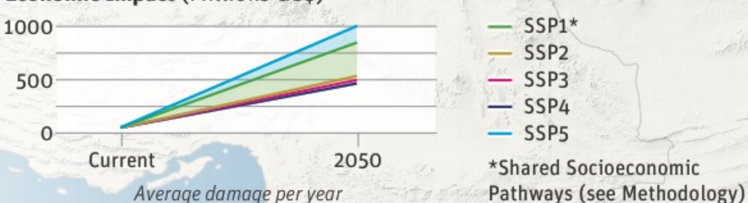


EARTHQUAKE
AFGHANISTAN

Afghanistan is located in a **tectonically active region** of the world. **Each year** Afghanistan is struck by **moderate to strong earthquakes**, causing damage or fatalities. There is high earthquake hazard towards the **north-eastern region** of Afghanistan, particularly along the borders with Uzbekistan, Tajikistan, and Pakistan. Earthquakes during the **last 30 years** have caused over **10,000 fatalities**.

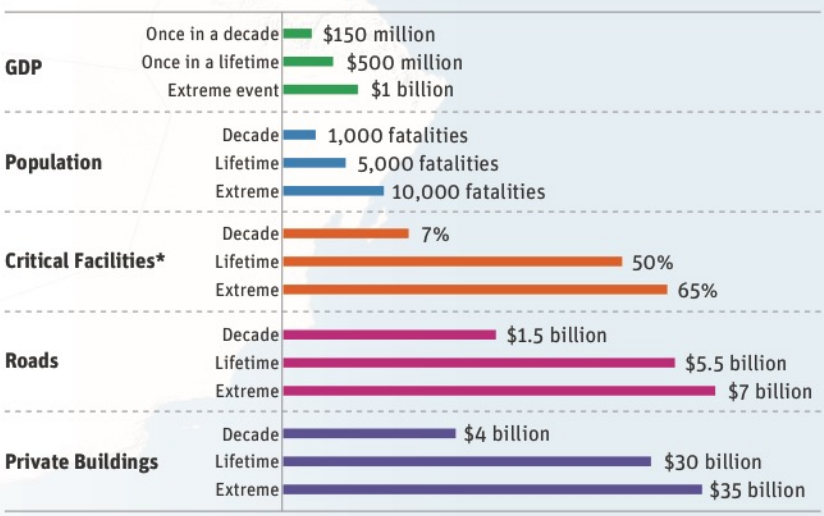
A major earthquake event in **Kabul** Province is **expected** to **cause approximately 8,500 deaths and over $500 million in damages**. **Kabul** has the **highest average estimated damage** of all regions in Afghanistan, amounting to $17 million per year, due to the concentration of assets and population located in the province. Earthquakes also frequently cause large landslides in mountainous regions.





Modeled Earthquake Impacts

Reference Situation (2010)



*(Healthcare, Education and Energy)

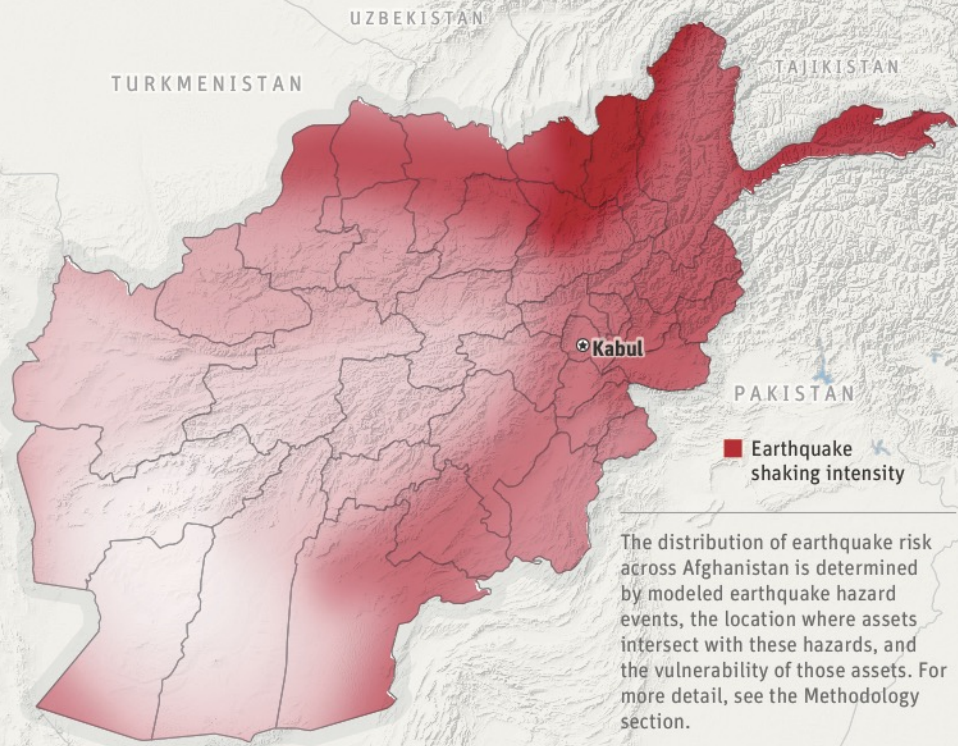
At a Glance

- Earthquakes cause the **greatest number of fatalities** due to natural hazards, with nearly 2.7 million deaths since 1900.
- Average **damages** from earthquake shaking **each year** is estimated at **$80 million**.
- **5 million students** would be exposed in school buildings if an earthquake occurred during school time.
- In just the **last 30 years**, earthquakes have caused over **10,000 fatalities** and affected over 250,000 people.
- In October **2015**, an earthquake in the Hindu Kush mountains **killed 115 people**, injured over 58,000 and made more than 35,000 homeless.
- An earthquake in March **2002** in the Hindu Kush mountains caused at least **1,200 fatalities** and **affected over 100,000** people.

EARTHQUAKE
AFGHANISTAN

Recommendations

- Constructing new structures in an earthquake-resistant way and **retrofitting existing buildings, can strongly reduce building collapse** and resulting fatalities from earthquakes.
- **Retrofitting schools** throughout Afghanistan to be earthquake resistant would **reduce potential economic losses by 60%**, and **reduce fatalities by 90%**.
- **School retrofitting** would have a **net saving** of between **$1.2 and $1.5 million** on average **each year**.
- It is more cost-effective to build new earthquake resistant roads and to keep money in reserve for damage repairs than to retrofit or reconstruct existing roads.

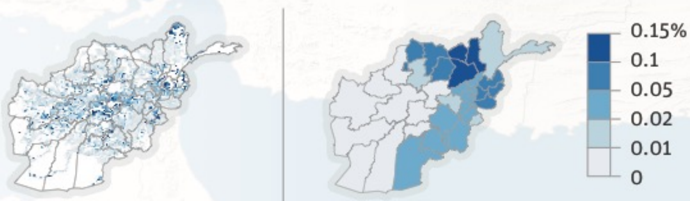


The distribution of earthquake risk across Afghanistan is determined by modeled earthquake hazard events, the location where assets intersect with these hazards, and the vulnerability of those assets. For more detail, see the Methodology section.

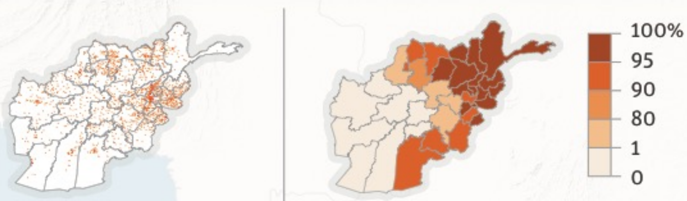
Asset Maps

Asset Distribution	Exposed Assets (% of total number)	Asset Distribution	Exposed Assets (% of total number)

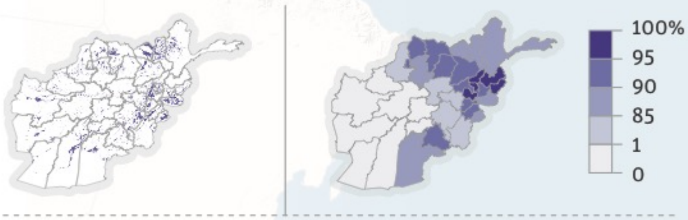
Population Distribution



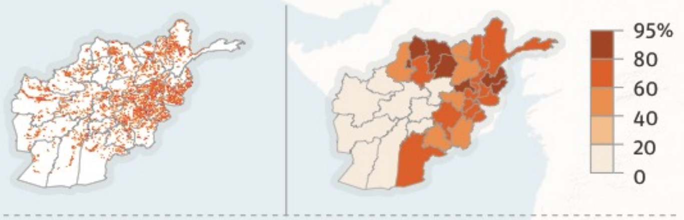
Critical Facilities - Healthcare



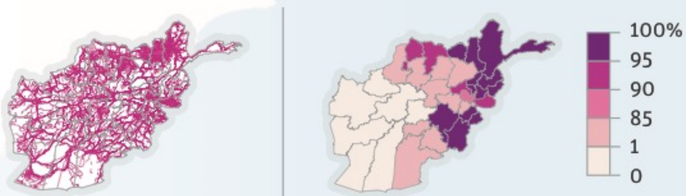
Private Buildings



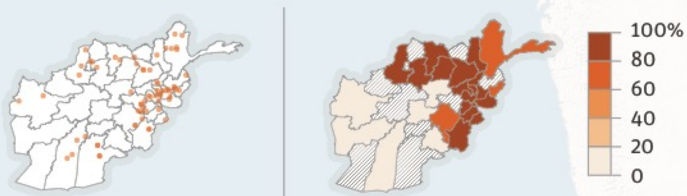
Critical Facilities - Education



Roads



Critical Facilities - Energy

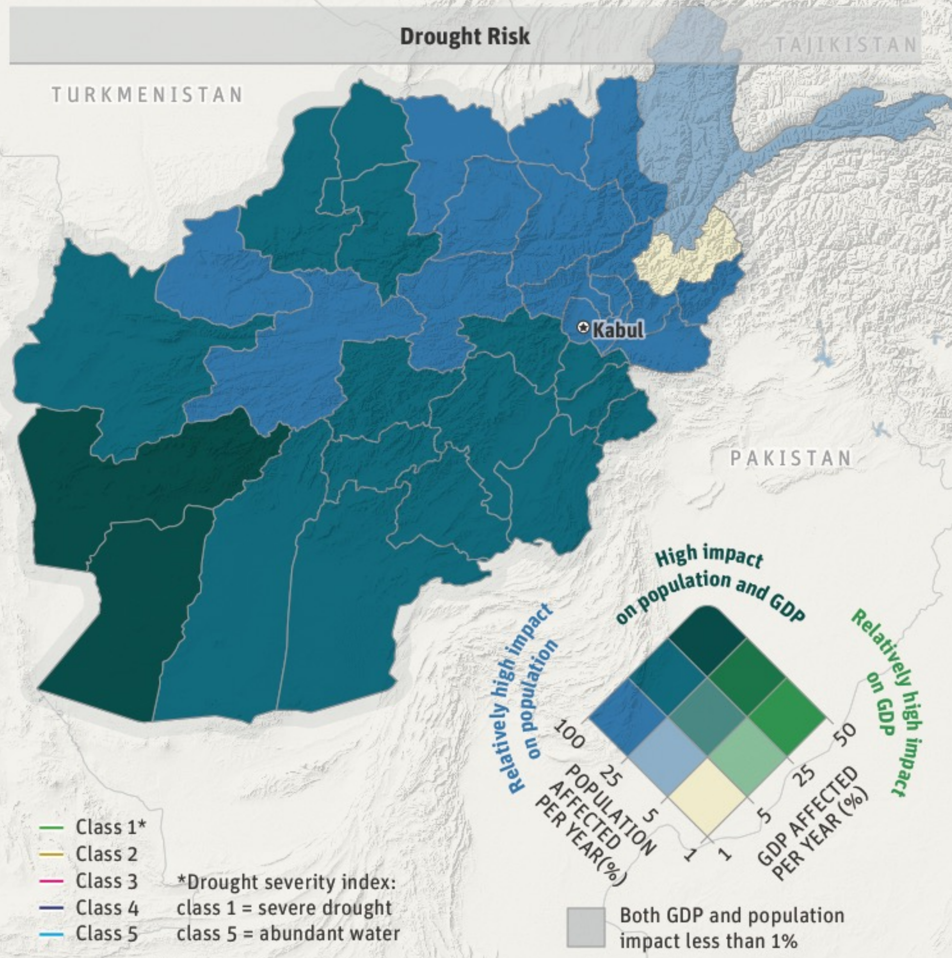


AFGHANISTAN

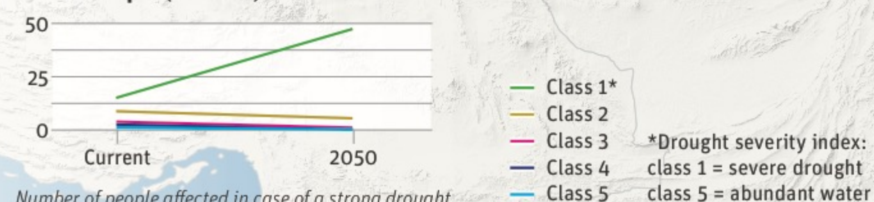
Afghanistan suffers from **recurring droughts** with varying length and severity. Droughts pose a **threat** to **livelihoods**, **income**, and **poverty reduction** efforts as over 85% of the population rely on agriculture for livelihood. Severe and prolonged droughts also have serious consequences for **food security**.

Drought risk is **highest** in the **Helmand** basin and lowest in the northeast.

In the **future**, the risk of drought is expected to **increase** due to precipitation decreases caused by climate change in most sub-basins of Afghanistan.



Affected People (Millions)



Number of people affected in case of a strong drought

Modeled Drought Impacts

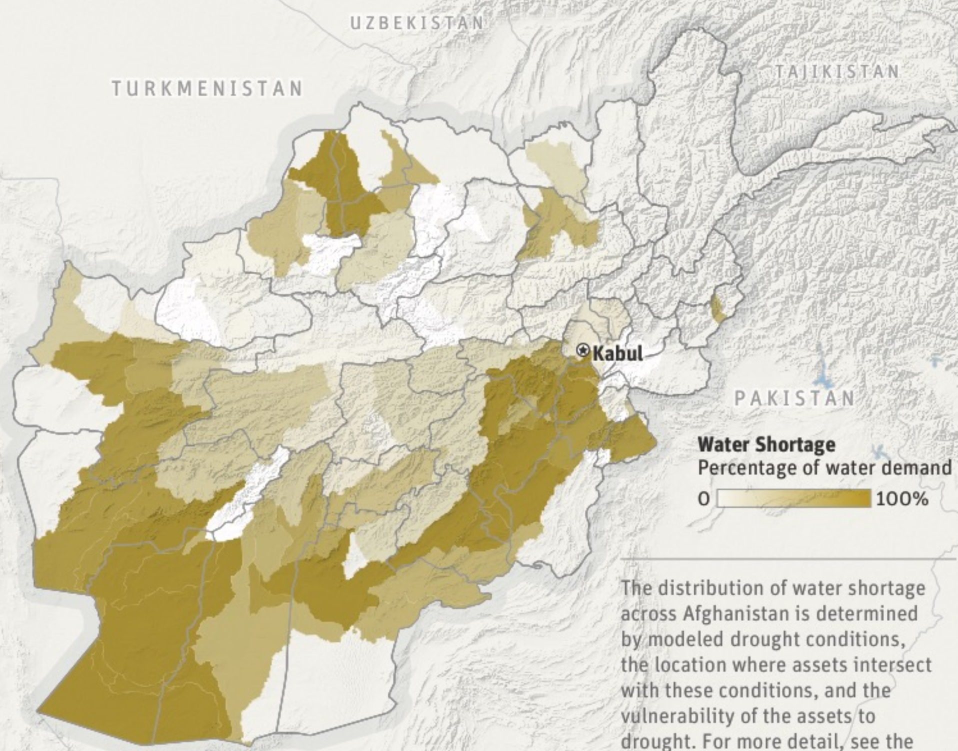
Reference Situation (2010)

At a Glance

- Droughts are a frequent occurrence in Afghanistan, **affecting millions of people** and **causing large economic damages** to agriculture, households and hydropower production.
- On average, droughts cause **$280 million** in economic **damages** to agriculture each year; extreme events could cost over **$3 billion**.
- Due to **climate change**, hydropower production is expected to have **zero production** once every 10 years in **Kajaki reservoir**, and once every 20 years in **Naghlu reservoir** by 2050.
- Droughts have **affected 6.5 million people** since 2000, during four major events (2000, 2006, 2008 and 2011).

Recommendations

- More **effective water management** could reduce water shortages during droughts.
- **Canals and irrigation systems** could improve access to water for the **agricultural sector**.
- **Diversifying livelihoods**, and improving the effectiveness of agricultural practices, for example by using crops and irrigation methods that waste less water, could **increase agricultural productivity**, reducing the reliance on water availability.

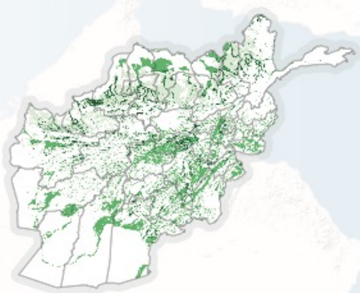


The distribution of water shortage across Afghanistan is determined by modeled drought conditions, the location where assets intersect with these conditions, and the vulnerability of the assets to drought. For more detail, see the Methodology section.

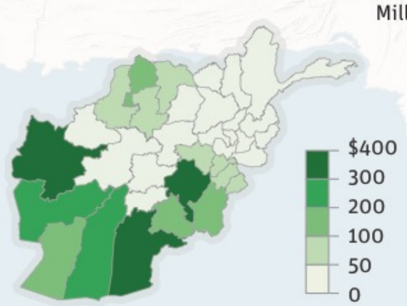
Asset Maps

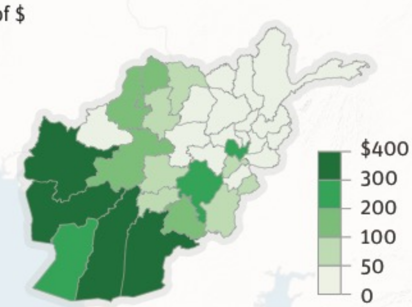
Asset Distribution	Impact – Current	Impact – 2050

Agricultural Value

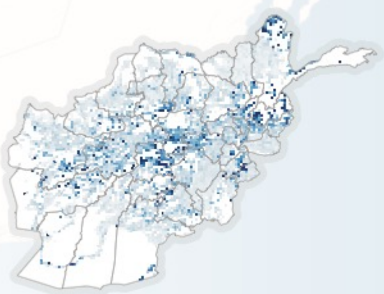


Agricultural Losses
Millions of $

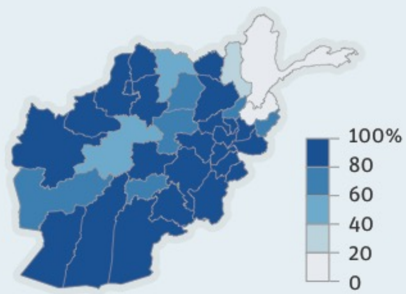


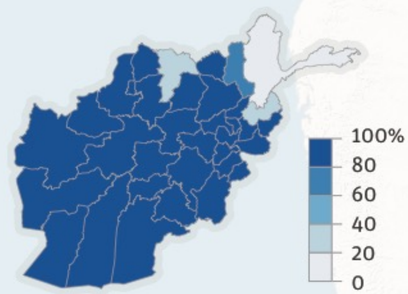


Population



Affected population (severe drought)



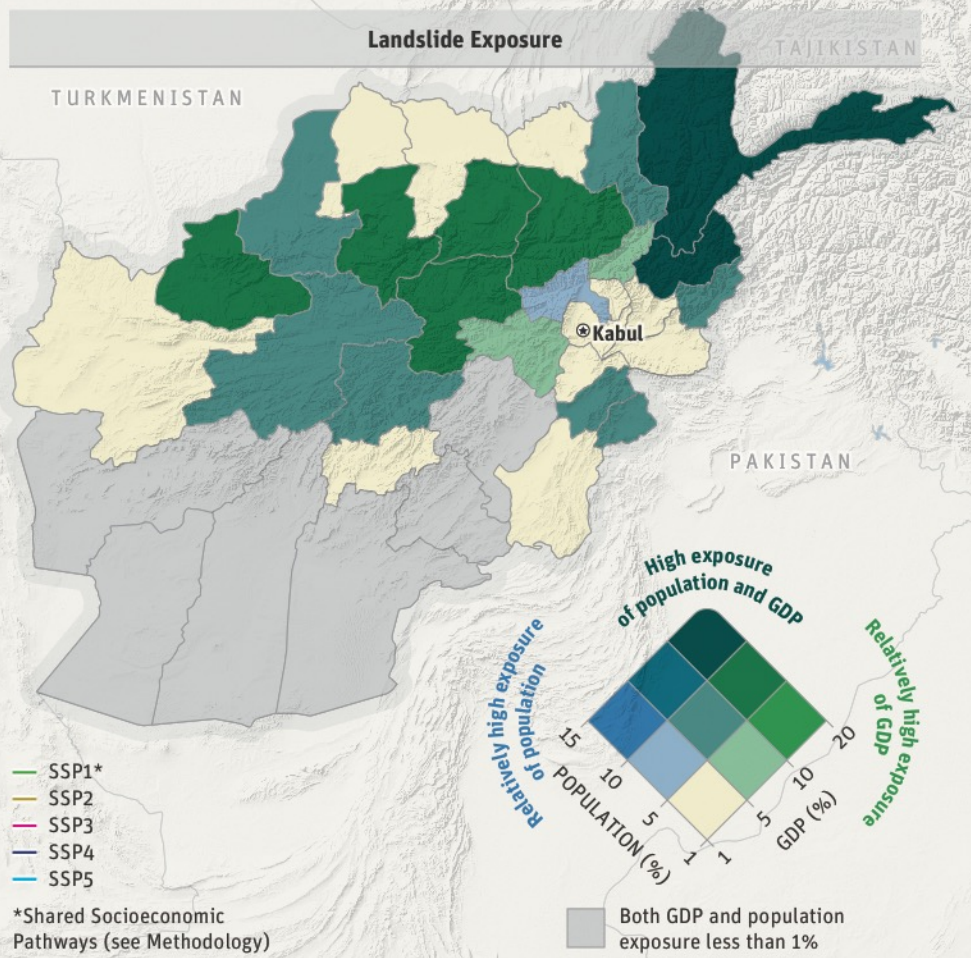


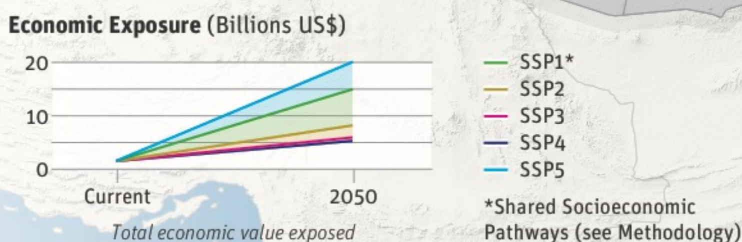
AFGHANISTAN

Landslide **susceptibility** is spread across Afghanistan's mountainous terrain that makes up **more than 60% of the country**, from the north-east to the western area. Landslides in Afghanistan are **fairly common** due to the mountainous terrain and unstable soil, and can be triggered by both **heavy rainfall** and **earthquake shaking**.

Badakhshan, **Daykundi**, and **Ghor** have the greatest **number of people** exposed to landslides. **Badakhshan**, **Takhar**, and **Ghor** have the greatest **value of assets** exposed.

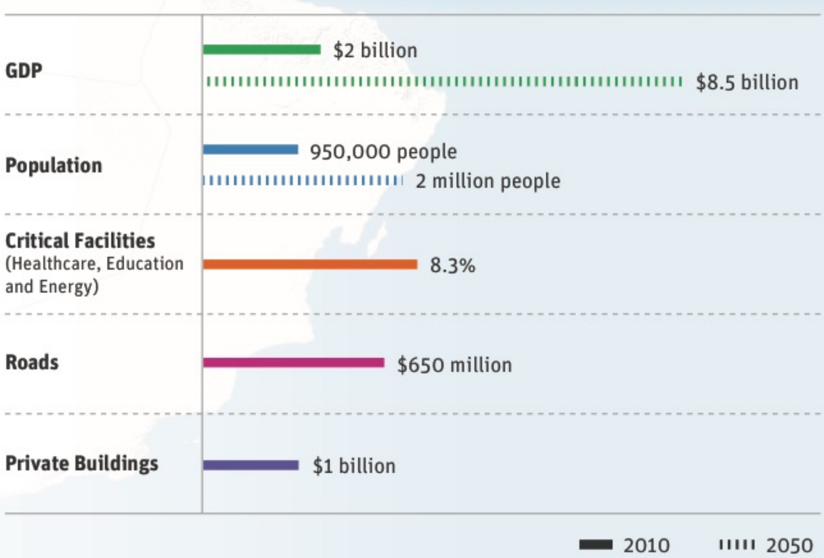
Deforestation, land-use change and increases in **heavy rainfall** can **intensify** landslide hazard to settlements and infrastructure. Landslide **mitigation options** such as nets or drainage pipes are **scarce** in Afghanistan.





Modeled Landslide Exposure

Indicates total number or value in hazard prone area

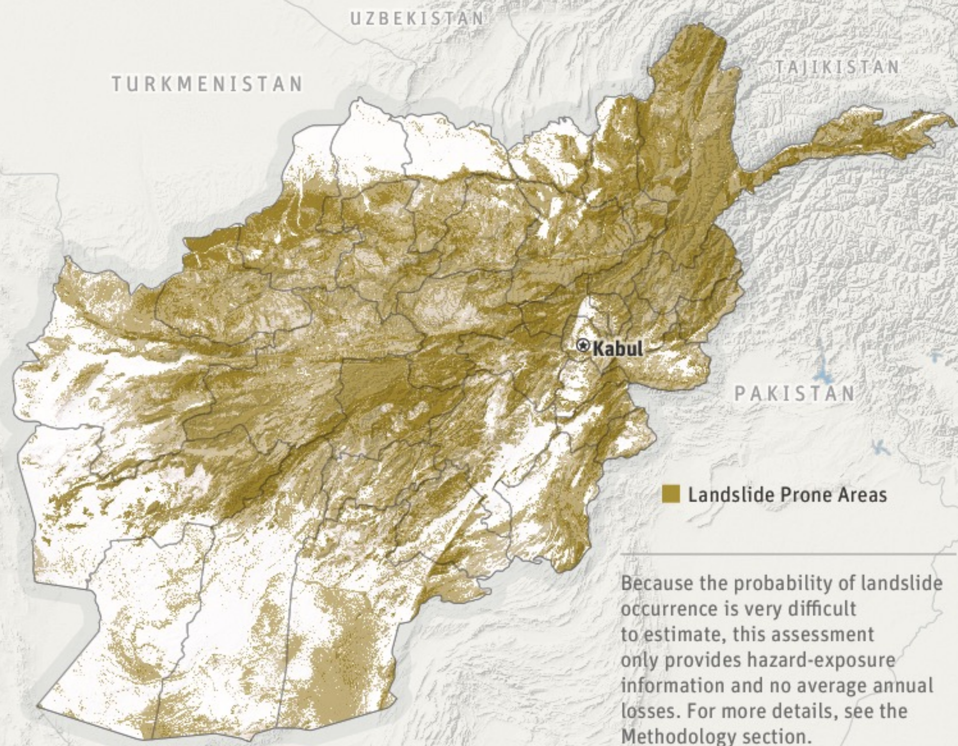


At a Glance

- Over **3 million people** are exposed to landslides in Afghanistan.
- Over **$6 billion worth of assets** are exposed to landslides, including more than 400 schools and 300 health centers.
- **Badakhshan** has over **$800 million** worth of assets and **280,000 people** exposed to landslides.
- In **2014**, a hillside saturated by heavy rains gave way above the village of Ab Barak in **north-eastern** Afghanistan, causing at least 350 and **possibly more than 2,000 deaths**.
- Due to population growth alone, the number of people affected by landslides could **double by 2050**.

Recommendations

- Landslide risk can be reduced by **avoiding construction** of buildings, transport networks or service lines **in high landslide hazard areas.**
- **Local monitoring** of slopes with high slow-moving landslide hazards can identify increased landslide hazard early.
- **Reinforcement** of landslide **susceptible slopes** can reduce the potential for landslide occurrence.
- **Passive protection measures** such as boulder-gathering trenches at the foot of the hillside, metal containment nets, and boulder barriers can **reduce** the impact of **small landslides** from reaching assets.

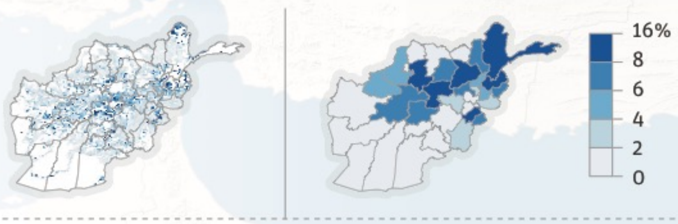


Because the probability of landslide occurrence is very difficult to estimate, this assessment only provides hazard-exposure information and no average annual losses. For more details, see the Methodology section.

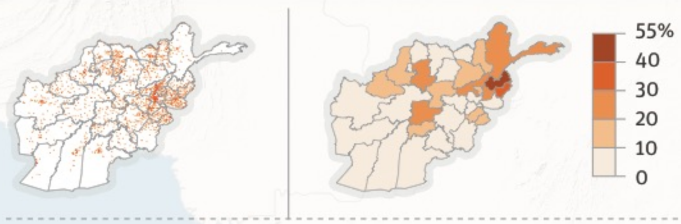
Asset Maps

Asset Distribution	Exposed Assets (% of total number)	Asset Distribution	Exposed Assets (% of total number)

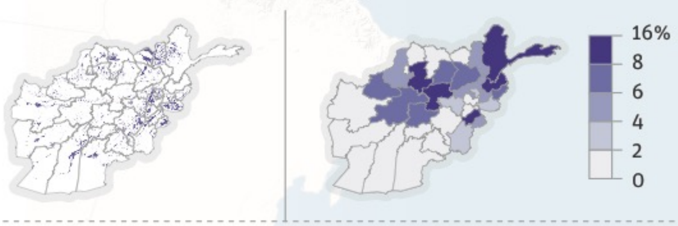
Population Distribution



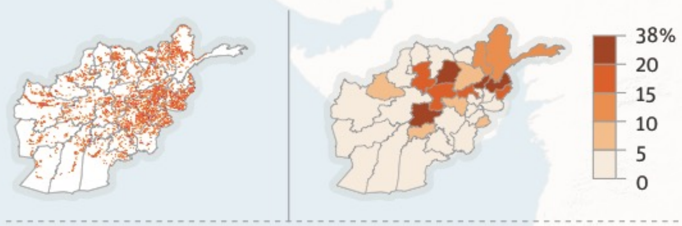
Critical Facilities - Healthcare



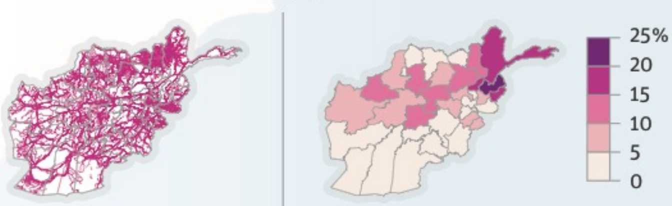
Private Buildings



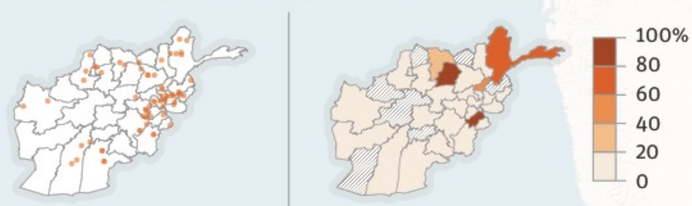
Critical Facilities - Education



Roads



Critical Facilities - Energy



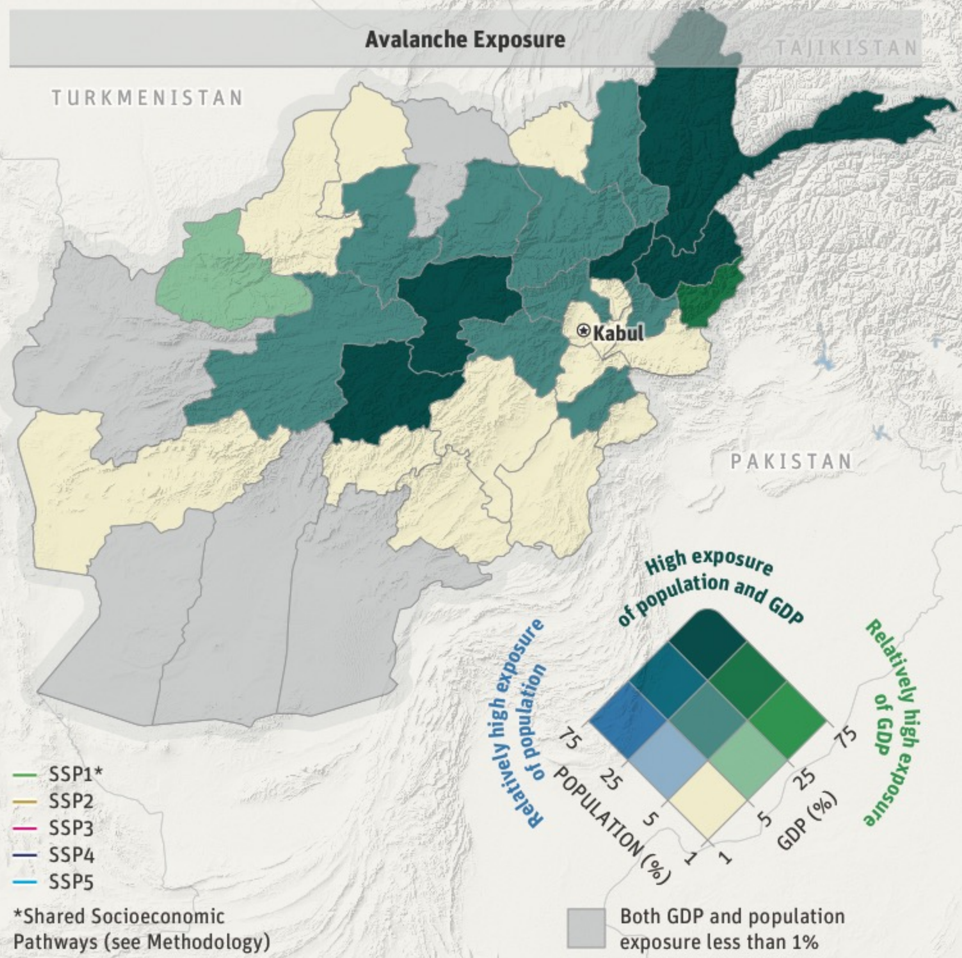
AVALANCHE

AFGHANISTAN

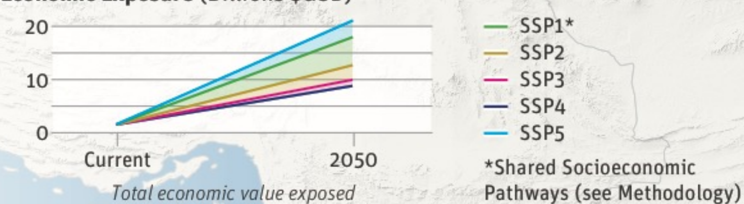
In the **Hindu Kush mountain range** of Afghanistan, snow avalanches affect people, settlements and infrastructure. Avalanche hazardous areas are driven in large part by topography and elevation and are therefore located in the mountainous regions of Afghanistan, spread from the **north-east to the western regions**.

Difficulty in **accessing** and **providing aid** to **remote populations** is a common concern with avalanche events. **Badakhshan**, **Kabul**, and **Daykundi** have the **greatest number of people** and **GDP affected** by avalanches.

Climate change may **reduce risk** from avalanches in **lower lying areas** due to rising temperatures. However higher altitude areas such as the **Salang pass** could experience **more frequent avalanches** in mid-winter due to increased snowfall.

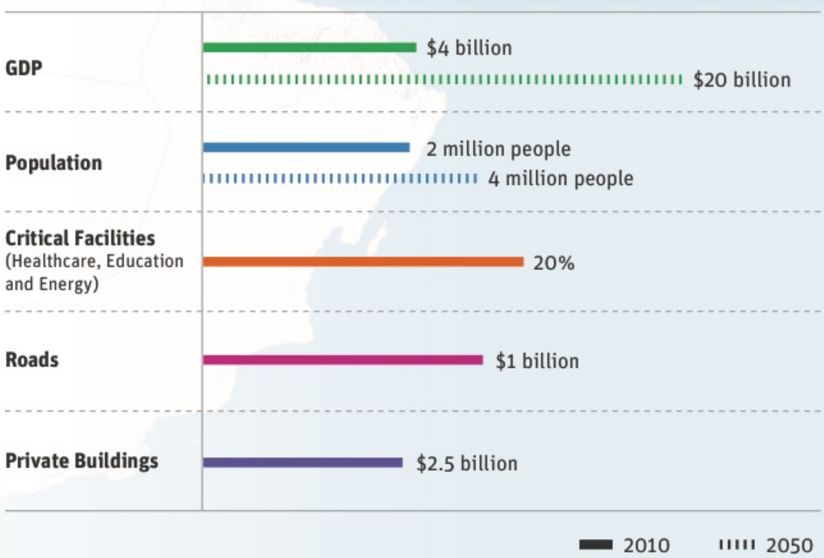


Economic Exposure (Billions $USD)



Modeled Avalanche Exposure

Indicates total number or value in hazard prone area



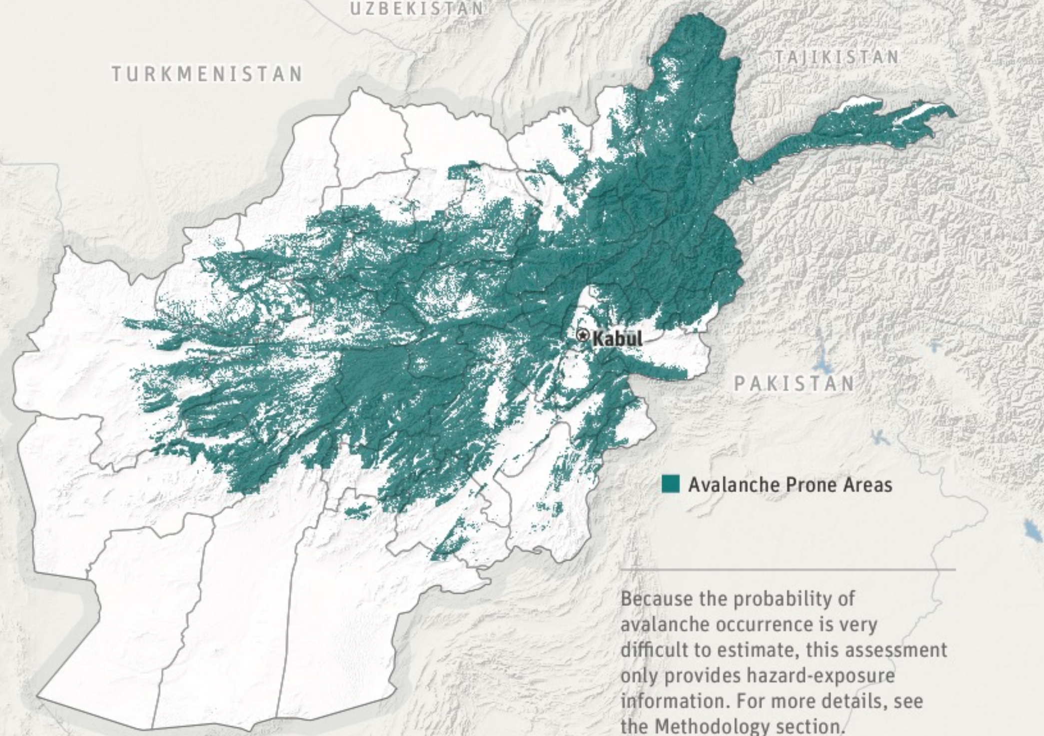
At a Glance

- **2 million people** are exposed to avalanches.
- **Over 10,000km of roads** and **$4 billion of assets** are exposed to avalanches.
- **$990 million assets** are exposed to avalanches in **Badakhshan** alone.
- In **2015**, a series of avalanches and flash floods killed **over 300 people**, the majority in Panjshir Valley.
- From **2000 to 2015**, over **153,000 people** were **affected** by avalanches.
- Avalanche **early warning systems** are being tested in the Salang Pass but are **absent elsewhere**. Avalanche **mitigation measures** for protecting infrastructure and settlements are **often missing**.

AVALANCHE
AFGHANISTAN

Recommendations

- **Retention structures** such as snow supporting structures, snow drift fences, artificial avalanche release, avalanche dams, avalanche deflection dams, and avalanche galleries or snow sheds can **reduce avalanches** from reaching potentially exposed assets.
- Buildings and structures in avalanche areas can be **reinforced** and **specifically designed** to withstand and/or deflect the impact of avalanches.

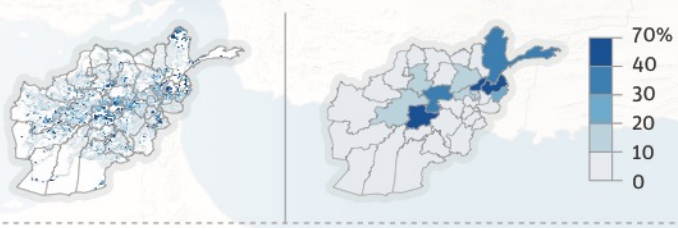


Because the probability of avalanche occurrence is very difficult to estimate, this assessment only provides hazard-exposure information. For more details, see the Methodology section.

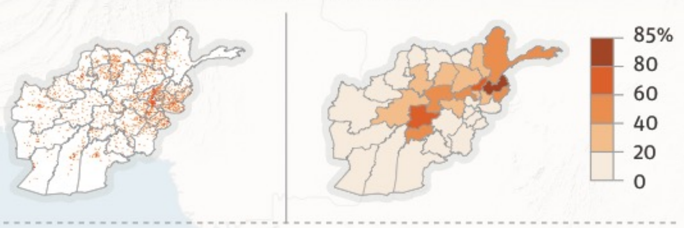
Asset Maps

Asset Distribution | Exposed Assets (% of total number)

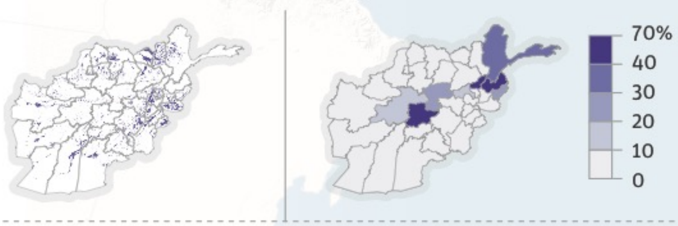
Population Distribution



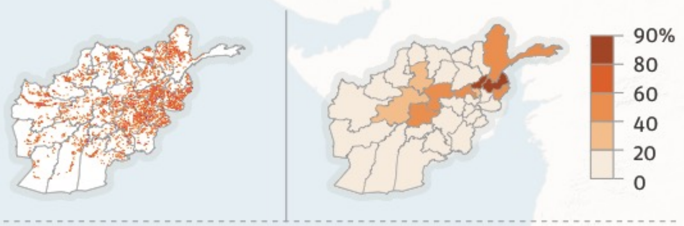
Critical Facilities - Healthcare



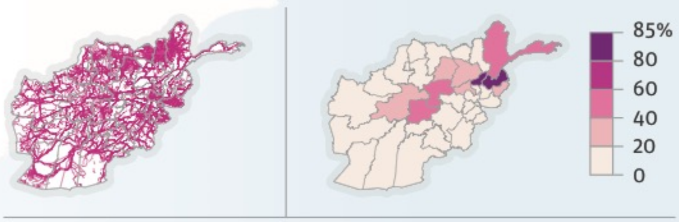
Private Buildings



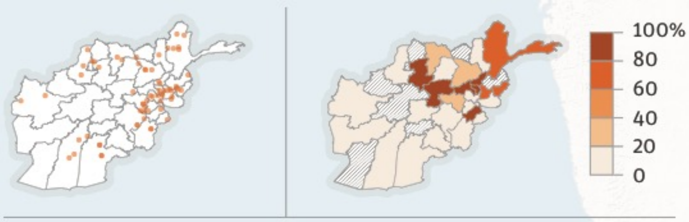
Critical Facilities - Education



Roads



Critical Facilities - Energy



METHODOLOGY

Glossary of Terms

HAZARD

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

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.

VULNERABILITY

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

RISK

Disaster risk is a function of hazard, exposure, and vulnerability. It is quantified in probabilistic terms (e.g. Average Damage Per Year) using the impacts of all events produced by a model. In this risk profile we use "once in a decade", "once in a lifetime" and "extreme event" to indicate the 1 in 10 year, 1 in 50 year and 1 in 250 year return periods, respectively.

AVERAGE DAMAGE PER YEAR

Average Damage Per Year (also 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.

SHARED SOCIOECONOMIC PATHWAYS (SSPs)

SSPs are a set of socioeconomic scenarios that are developed for the global assessments of the IPCC, and are used in this specific risk assessment to project population and economic growth between the baseline (current situation) and the future (2050).

These risk profiles have been developed from a multi-hazard assessment of exposure and risk using national level data and global hazard models. The risk modelling for all perils uses an exposure database developed specifically for this project. Brief explanation of the exposure data and risk modelling process are given below.

Asset Database

Open and freely available national, regional, and global datasets are used to develop a database of exposed assets.

Building data are based on classifying land use into four development types: urban residential, rural residential, non-residential and overlap, and infrastructure. The number of buildings and total floor area is calculated for each development type, then classified into construction classes determined through a review of available sources.

The distribution of population is based directly on global population data at 1km spatial resolution, adjusted with national data at the district level and adjusted to fit a 90m x 90m gridded cell distribution over Afghanistan. For detailed case studies of Kabul, 1m spatial resolution building data is used.

Non-residential capital stock for singular assets include schools, airports, and health facilities. The typology of the runway as well as the general infrastructure around the airport are examined and the value of the assets estimated. School facilities are obtained from a national database and contain information on number of students, number of classrooms and total value. Health facilities include hospitals and other healthcare facilities, containing information on the type of health facility and location information.

Infrastructure values for single assets include mining and oil infrastructure, roads and railways, bridges, tunnels, and ICT infrastructure. Transportation data include roads, railways, and bridges, where present. Road surface type (paved, unpaved) is also included where available.

Replacement costs for buildings, singular assets, and infrastructure are calculated as the construction cost per square meter for each building or facility type, and cost per kilometer for roads and railway lines, based on road type and terrain (for rail).

Hazard and Vulnerability

Flood

Flood hazard in the risk assessment includes river (fluvial) flooding and flash flooding, although only river flooding is included in this risk profile document. Fluvial flooding is estimated at a resolution of 90m using global meteorological datasets, a global hydrological model, a global flood-routing model, and an inundation downscaling routine. Flash flooding is estimated by deriving susceptibility indicators based on topographic and land use maps. Flood loss curves are developed to define the potential damage to the various assets based on the modelled inundation depth at each specific location.

Drought

Drought hazard is considered by its impact on water users: agriculture (water shortage for irrigation), hydropower (hydropower production losses), and Domestic, Municipal and Industrial (DMI) use (water shortage for public water supply). Drought risk is based on modelled distributed rainfall and water balance. Drought duration and drought deficit volume per year are determined by event-based modelling. Monetary loss and population affected is estimated per sector and sub-basin per year based on a deficit of water demand.

Earthquake

Earthquake hazard is based on probabilistic analysis of a stochastic hazard catalogue. The distribution of ground shaking intensity (e.g., peak ground acceleration) is produced on a gridded basis. The distribution of loss is estimated using fragility and vulnerability models developed using an analytical method.

Landslide

A spatial distribution of landslide susceptibility is defined using a GIS-based, weighted scoring of contributing factors, including slope angle, lithology, land cover, terrain curvature, distance from geological faults, and distance from roads. These source areas are combined with modelled flow (run-out) and accumulation of debris areas to create landslide hazard maps.

Avalanche

Avalanche hazard is defined by modelling avalanche susceptibility areas from the analysis of meteorological data and snow properties to determine likely starting points and snow conditions on slopes. Snow avalanche modelling is then performed to produce avalanche hazard maps delineating the likely starting and transition zones of avalanches, and in particular the runout areas of avalanche deposits.

Future Projections

Country-scale projections to 2050 are used to model future affected population and GDP. Future projections of frequency and intensity of climate hazards have been computed for flooding and drought, based on an ensemble of global climate models (GCMs) and the emission scenario RCP 6.0. Population and GDP projections for 2050 are applied to the risk assessment for all hazards, based on growth rates for the period 2010-2050 from five different IPCC SSP scenarios (see 'Glossary'), which were downscaled to high-resolution using 2010 population distributions. GDP projections to 2050 are based on the relationship between population and GDP in 2010.

All of the data used in this analysis is hosted and openly available on the Afghanistan GeoNode: http://disasterrisk.af.geonode.org/

Irrigation canals can be effective in supporting agriculture during dry spells. Photo Credit: Graham Crouch

Natural color image mosaic of Afghanistan. Credit: US Geological Survey in cooperation with US Agency for International Development.