COUNTRY RISK PROFILE
TURKMENISTAN

TA-9878 REG: Developing a Disaster Risk Transfer Facility in the Central Asia Regional Economic Cooperation Region

April 2022

CAREC
Central Asia Regional Economic Cooperation Program

About this document

TA-9878 REG: Developing a Disaster Risk Transfer Facility in the Central Asia Regional Economic Cooperation Region aims at developing regional disaster risk financing solutions for CAREC member states. It provides high-level disaster risk profiles for all CAREC member states for earthquake, flood, and infectious disease risk. The TA will then design and pilot a bespoke regional disaster risk transfer facility. This is to support CAREC member states in their management of disaster risk.

The disaster risk profiles collate information on flood, earthquake and infectious disease exposure, hazards, physical and social vulnerability, coping capacity, historical losses and impacts, and risk analysis for all CAREC member states. Much of this information is being collated on a regionally consistent basis for the first time. This includes cutting-edge flood, earthquake, and infectious disease modeling.

The profiles are logically structured:

i. **Risk analysis:** results from risk modeling;
ii. **Historical losses and impacts:** data collected from national and international databases;
iii. **Hazard:** physical processes which cause floods, earthquakes and infectious disease outbreaks;
iv. **Exposure:** characteristics of livelihoods and economic value at risk and;
v. **Vulnerability:** socio-economic vulnerability and coping capacity;

These profiles are accompanied by a separate technical note which details the data and methodologies used, and discusses appropriate limitations.

Contents

List of abbreviations

AAL	Average Annual Loss
AALR	Average Annual Loss Ratio
ADB	Asian Development Bank
ADM	Administrative Boundary
AAPA	Average Annual Number of People Affected
CAREC	Central Asia Regional Economic Cooperation
COVID-19	Coronavirus disease
CCHF	Crimean-Congo Hemorrhagic Fever
DRF	Disaster Risk Financing
EP	Exceedance Probability
EMS	Emergency Management System
GEM	Global Earthquake Model Foundation
IPCC	Intergovernmental Panel on Climate Change
IDPs	Internally displaced persons
JBA	Jeremy Benn Associates
RCP	Representative Concentration Pathway
TA	Technical Assistance

Currency

Currency Unit	United States Dollar/s ($)

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Profile summary

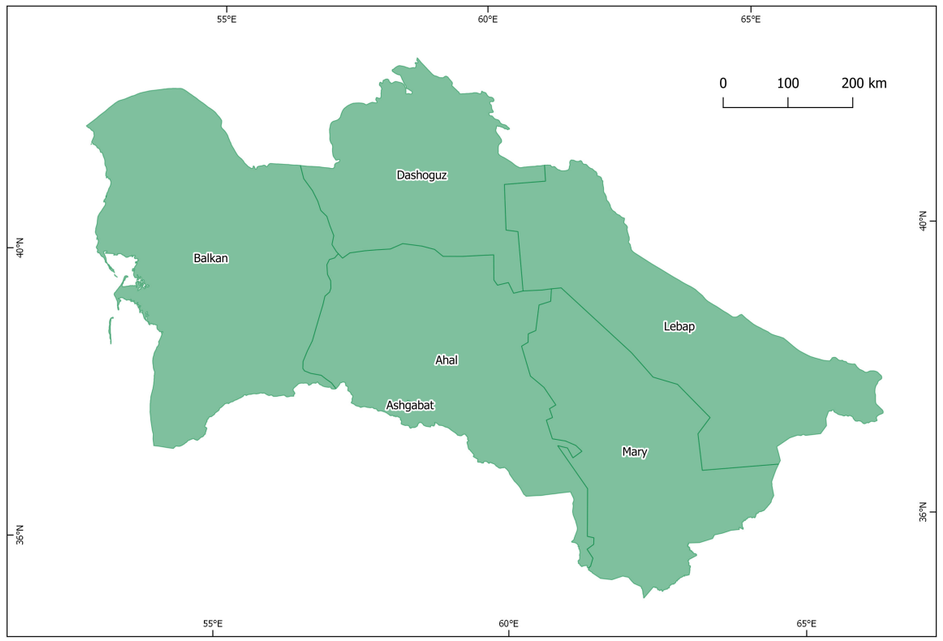
Turkmenistan is located on the south-eastern coast of the Caspian Sea and shares borders with Kazakhstan, Uzbekistan, Afghanistan, and Iran. Turkmenistan is the second largest country in Central Asia and is divided into five provinces and one capital city district as shown in Figure 1. Significant parts of the country are flat and featureless with the sandy Karakum Desert dominating large parts of its land area.

A lack of data from historical events provides unique challenges to understanding disaster event risk in Turkmenistan. Total average modelled annual loss from earthquake and flood is around $151 million which is equivalent to around 0.18% of GNI, at par with many countries across the CAREC region.

Earthquake exposure is very high with most of the country located in a seismically active zone. For events at an annual return period, flood risk is modelled to show significantly greater average annual losses ($140 million) than earthquake risks ($11 million). For the less frequent and more severe 1 in 500-year event, the predominant hazard is also flood with loss modelled around $2.4 billion.

The difference in risks between the two perils is also seen in the average annual loss of life and the average number of people expected to be severely affected. Floods are expected to lead to 173 deaths on average each year (the 5th highest among CAREC countries) and severely affect almost 69,000 people. Meanwhile, earthquakes are expected to be associated with just 7 deaths (only Mongolia has a lower average loss of life) and affect less than 10,000 people.

Figure 1: Regions of Turkmenistan



Box 1: Key facts

GDP: $40,761,000,000 (2019) **Population: 5,942,000 (2019)**

1 IN 100 YEAR FLOOD ECONOMIC LOSS
$940,000,000

1 IN 100 YEAR EARTHQUAKE LOSS
$228,400,000

AVERAGE ANNUAL LOSS FLOOD
$139,800,000

AVERAGE ANNUAL LOSS EARTHQUAKE
$11,300,000

AVERAGE ANNUAL PEOPLE AFFECTED FLOOD
69,000

AVERAGE ANNUAL PEOPLE AFFECTED EARTHQUAKE
9,454

AVERAGE ANNUAL PEOPLE AFFECTED INFECTIOUS DISEASE
43,927

EVENT FREQUENCY WHERE FLOOD LOSS EXCEEDS EXISTING COVER
N/A

EVENT FREQUENCY WHERE EARTHQUAKE LOSS EXCEEDS EXISTING COVER
N/A

Climate change scenario analysis indicates that precipitation will increase slightly across the country. The largest increases are in the Balkan province toward the Caspian Sea. On a seasonal basis, much of the increase is projected to occur in April to June with little change projected in January to March. Whilst any increases in precipitation may be offset by greater evapotranspiration as annual mean temperatures could rise approximately 1.5 to 4°C by the 2050s, potential changes in the intensities of more frequent events could increase. In Mary, what was historically the 1 in 70-year event may become the 1 in 20-year event; in Balkan and Dashoguz, what was once approximate the 1 in 200-year event could shift to the 1 in 20-year event.

Turkmenistan is exposed to respiratory outbreaks with a very low background risk to other pathogens. Respiratory pathogens (COVID-19 is an example) present the possibility of infections and deaths, a risk which applies to many countries. A 1-in-100-year respiratory disease event could see over 1.5 million people infected.

Recognising the need for interagency coordination in addressing risks and enhancing emergency prevention and response, the Government of the Republic of Turkmenistan established a National Platform for disaster risk reduction in April 2021. Disaster risk financing in Turkmenistan is sourced through ministries, agencies, organisations, national and local budgets and insurance funds. An Emergency Reserve Fund is also available to use post disaster. These funds are allocated by the State Committee on Emergency Situations of Turkmenistan under the country's president.

The absence of comprehensive, reliable data makes it difficult to provide an overall assessment of the protection gap in Turkmenistan. While reserve funds are in place, the size of these funds relative to the risks that the country faces have not been possible to assess.

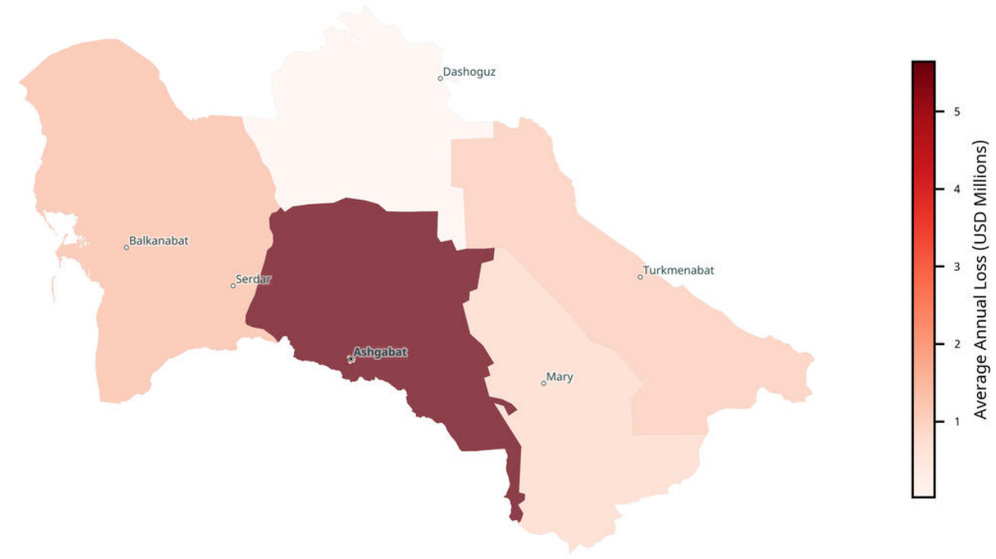
Risk analysis

The extent and geographic pattern of earthquake, flooding, and infectious disease across Turkmenistan is revealed through probabilistic modeling. Such modeling helps illustrate how natural phenomena interact with areas of high concentrations of population and assets to cause economic loss and damage.

Earthquake Risk

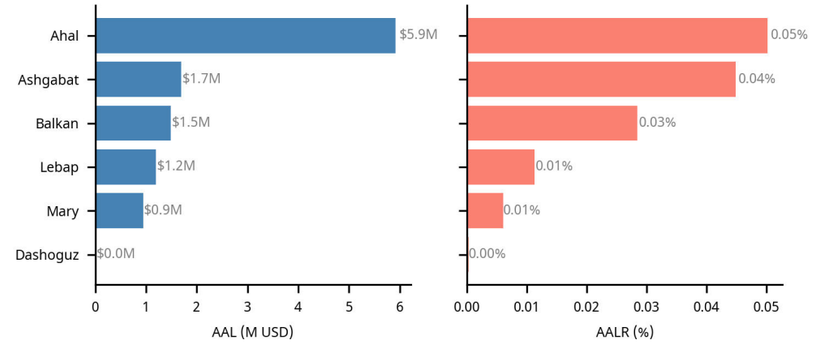
Average annual loss (AAL) due to earthquakes in Turkmenistan is estimated at $11.3 million. As shown in Figure 2, Ahal has the highest AAL in the country at $5.9 million, followed by Ashgabat and Balkan at $1.7 million and $1.5 million respectively. Dashoguz and Mary have the lowest AAL in the country.

Figure 2: Average annual loss ($ million) - earthquake



Source: Global Earthquake Model

Figure 3: Breakdown of earthquake average annual loss and loss ratio by region



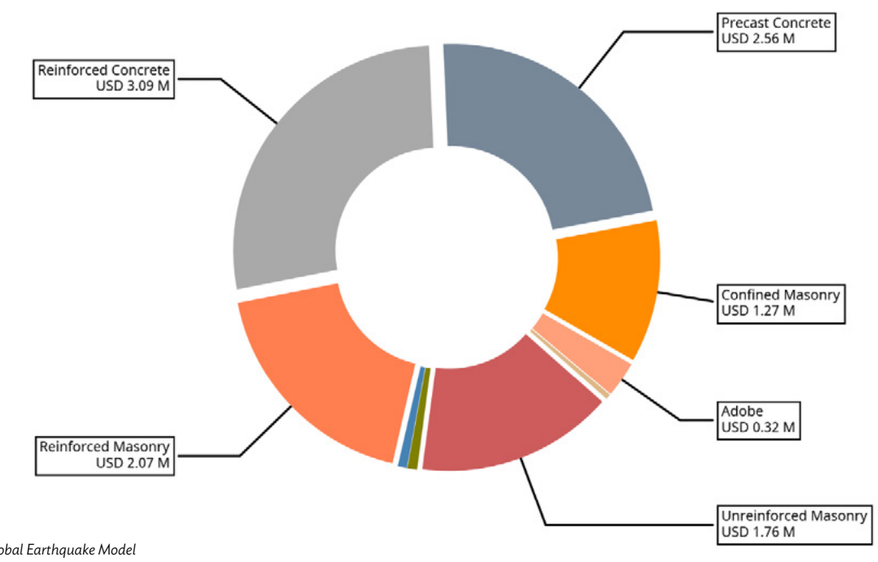
Source: Global Earthquake Model

The average annual loss ratio (AALR) in each region is the AAL for the region normalized by the total exposed value of buildings in that region. The AALR represents the proportion of the replacement value of the building stock that is expected to be lost due to damage. As a normalized risk metric, the AALR enables comparison of the relative risk across the different regions of the country.

Figure 3 compares the AAL (left) and the AALR (right) for each region of Turkmenistan expressed as a percentage of the total replacement value of buildings in the respective regions. Looking at the relative risk, Ahal is the region with the highest AALR, followed closely by Ashgabat.

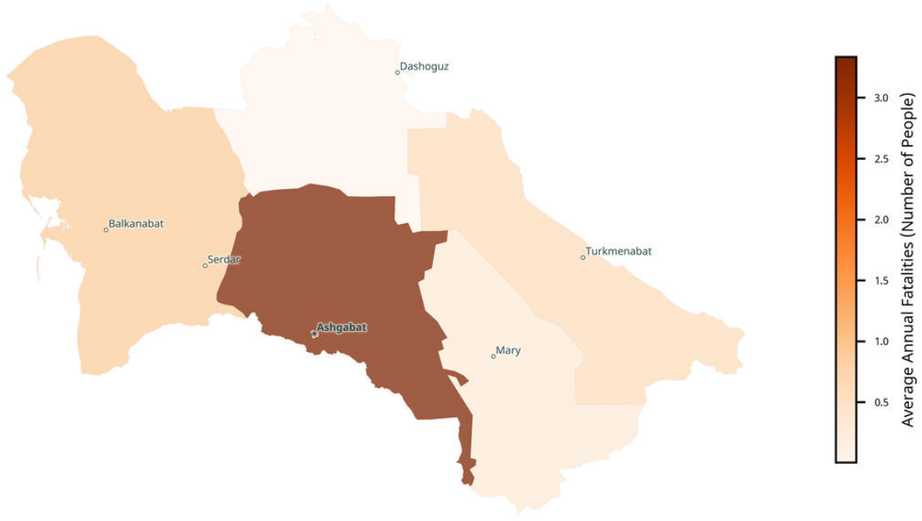
As seen in Figure 4, reinforced concrete structures contribute the most to the overall average annual loss in economic terms at $3.1 million, followed by precast concrete structures and reinforced masonry with an AAL of $2.6 million and $2.1 million respectively.

Figure 4: Average annual loss by asset types - earthquakes



Source: Global Earthquake Model

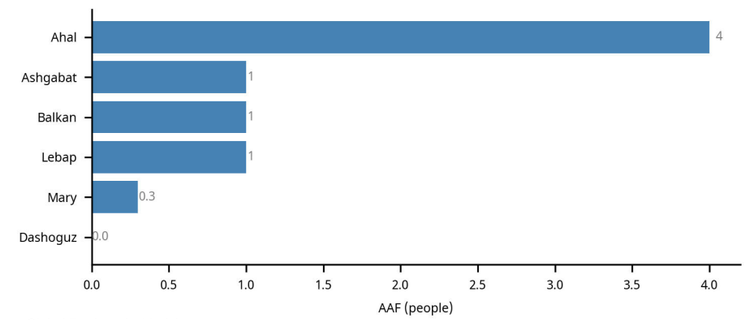
Figure 5: Average annual fatalities - earthquake



Source: Global Earthquake Model

Average annual fatalities due to earthquakes are estimated at 7 in Turkmenistan. As seen in Figure 5 and Figure 6, Ahal has the highest AAF in the country at 4, followed by Ashgabat, Lebap and Balkan with 1 fatality each.

Figure 6: Breakdown of earthquake average annual fatalities by region



Source: Global Earthquake Model

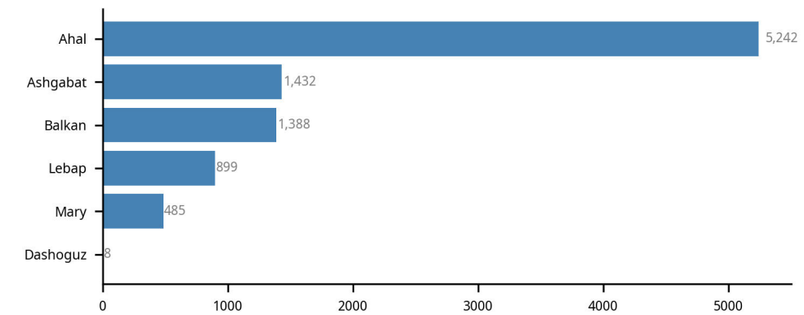
Figure 7: Average number of people affected – earthquake

Source: JBA Risk Management

For the purposes of this report, the number of people affected by earthquakes is defined as the population that can be expected to witness earthquake-caused ground shaking of Modified Mercalli Intensity (MMI) VI or higher (corresponding to strong shaking,capable of causing slight damage or higher). Figure 7 and Figure 8 show 9,454 people are estimated to be affected by earthquakes on an average annual basis in Turkmenistan. Ahal has the highest average annual number of people affected in the country at 5,242, followed by Ashgabat and Balkan at 1,432 and 1,388 respectively.

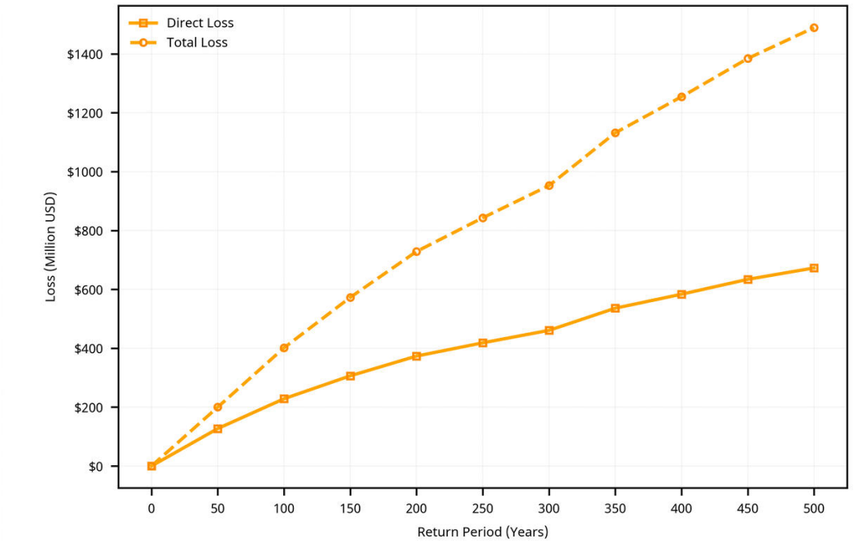
The number of people severely affected by earthquakes is the population that can be expected to witness earthquake-caused ground shaking of MMI VIII or higher (corresponding to severe ground shaking, capable of causing considerable damage including partial collapses in ordinary structures, along with slight damage to well-engineered structures). The average number of people severely affected by earthquakes every year is around 1,113 in Turkmenistan.

Figure 8: Breakdown of earthquake average annual number of people affected by region



Source: Global Earthquake Model

Figure 9: Exceedance probability curves – earthquakes



Source: Global Earthquake Model

The exceedance probability (EP) curves for earthquake for Turkmenistan are shown in Figure 9. The EP curve shows the total loss from all events in any given year. Curves are modeled for both direct and total loss. Direct loss displays the modeled loss to residential, industrial and commercial assets. Total loss accounts for secondary impacts from the onset of disaster events, accounting for the reconstruction time. Direct loss increases from $106.4 million for the 50-year return period to $753.8 million for the 500-year return period. Earthquake damage at the 100-year return period is modelled at $228.4 million. For the 100-year period, total loss exceeds $400 million and for the low frequency, high severity 500-year event, modelled losses are $1.5 billion.

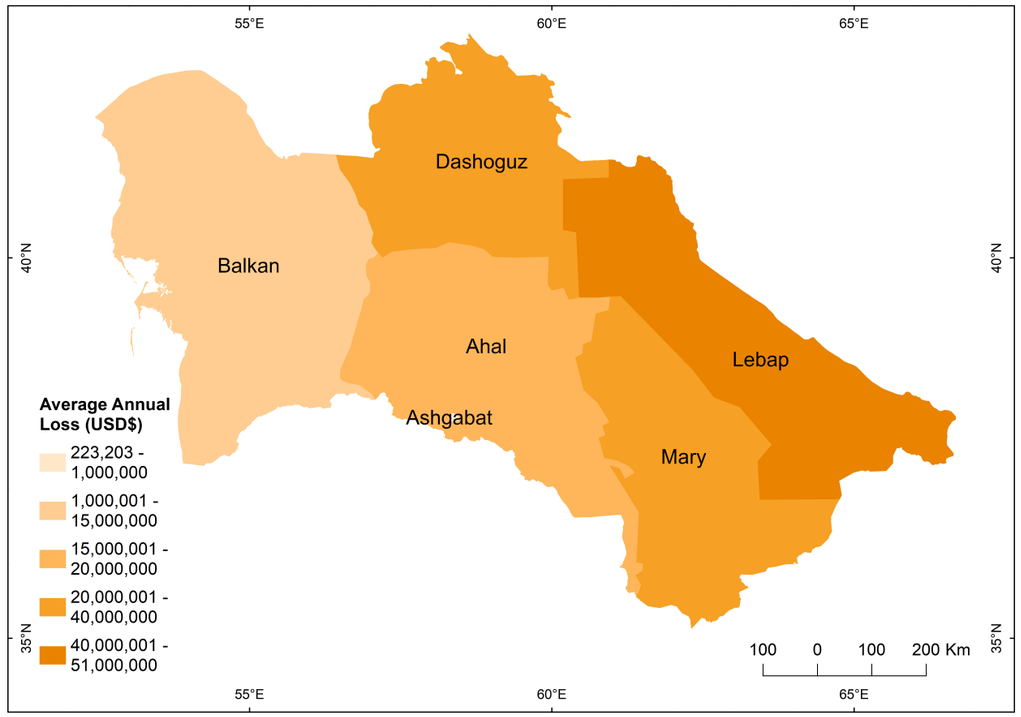
Flood Risk

Average annual loss from floods totals $139.8 million in Turkmenistan. As shown in Figure 10 and Figure 11, the greatest damage is estimated in Lebap, in the northeast of the country, at $50.3 million on average per year. The second largest damage from flooding is in Dashoguz, in the north of thecountry, at almost $38 million per year. Damage from flooding is also distributed throughout Mary, Ahal and Balkan provinces at $14–22 million per annum.

Heavy flooding in Mary and Ahal are caused by numerous river channels, including the Morghab and Tejen rivers, extending from the south through those two regions which have high economic exposure.

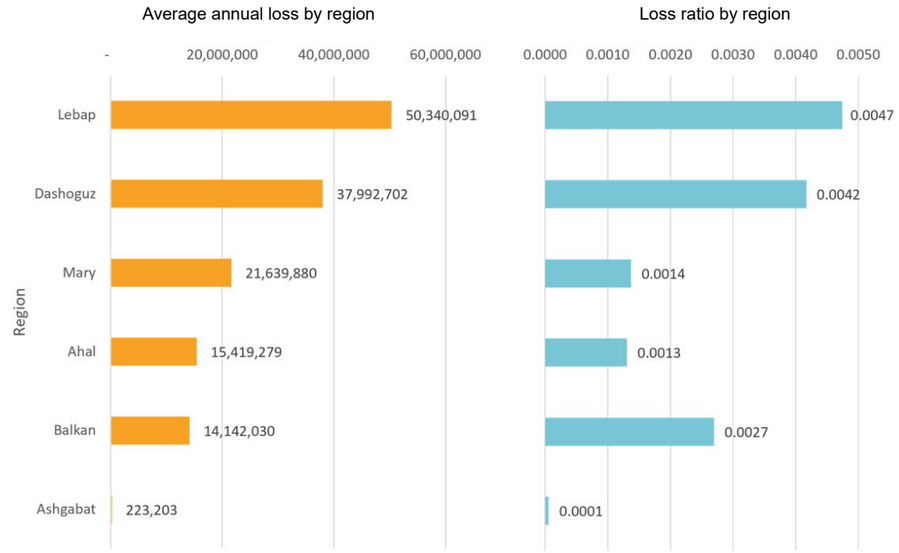
As seen in Figure 11, Lebap and Dashoguz also have the largest damage ratios in Turkmenistan. Flooding in those areas could be partially caused bythe Amu Darya River which flows along the northern border with Uzbekistan and through populated areas including the city of Turkmenabat.

Figure 10: Average annual loss – flood



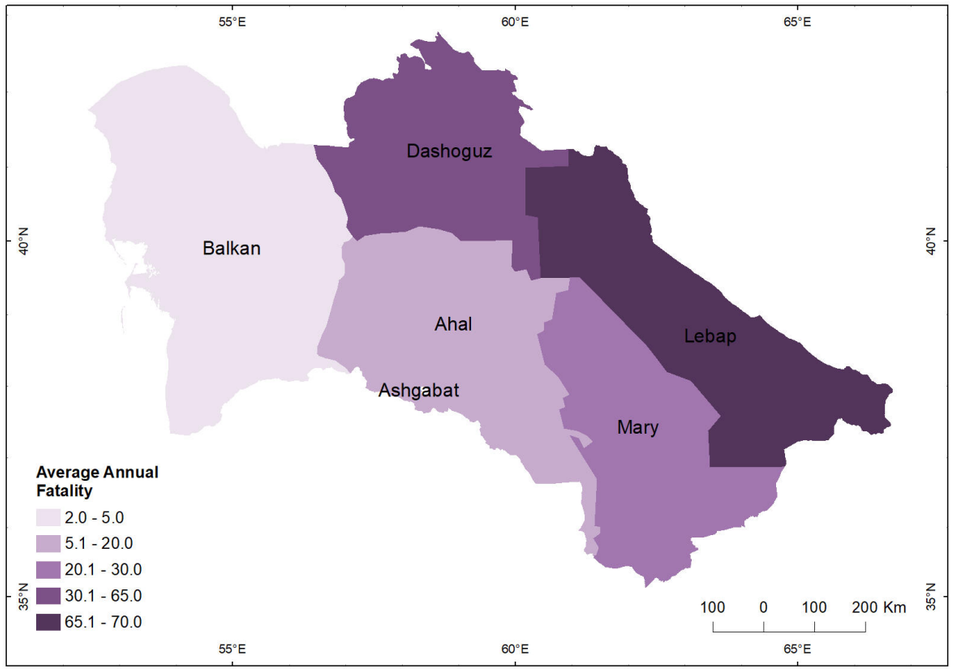
Source: JBA Risk Management

Figure 11: Breakdown of flood average annual loss and loss ratio by region



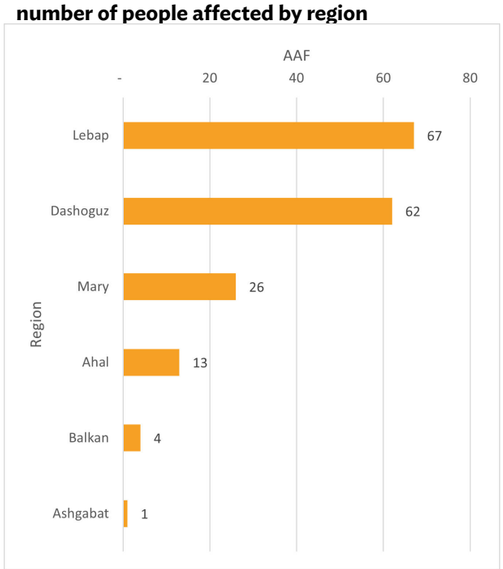
Source: JBA Risk Management

Figure 12: Average annual fatalities – flood



Source: JBA Risk Management

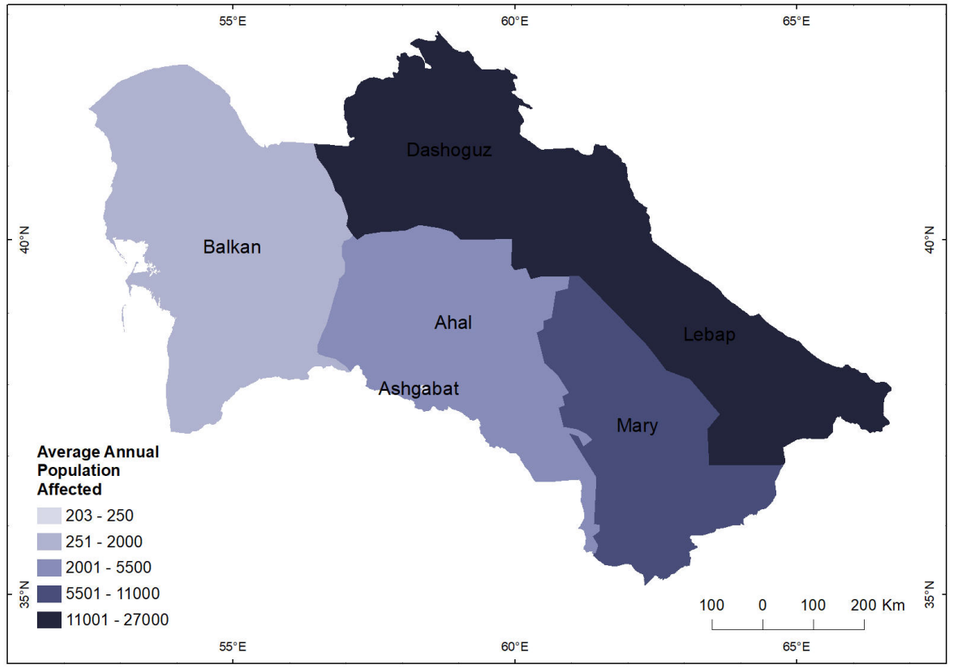
Figure 13: Breakdown of flood average annual number of people affected by region



Average annual fatalities from floods in Turkmenistan by region. Source: JBA Risk Management

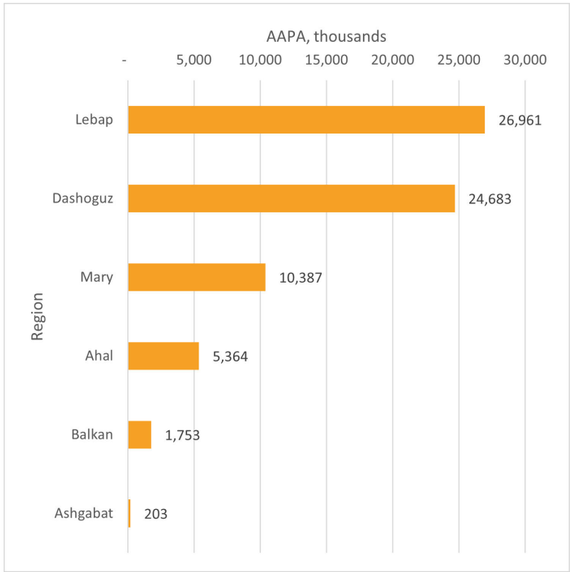
Average annual fatalities from floods are 173 in Turkmenistan. As with losses, the largest number of fatalities are in Lebap and Dashoguz, with 67 and 62 fatalities per year, respectively. These regions contain some of the country's most populated cities, which account for 43% of Turkmenistan's total population and some of which are located along the Amu Darya River. In Mary, there are on average 26 fatalities per year which is influenced by areas of dense population, including the city of Mary which is located close to the Morghab River. Figure 12 and Figure 13 show the distribution of fatalities across Turkmenistan.

Figure 14: Average annual people affected – flood



Source: JBA Risk Management

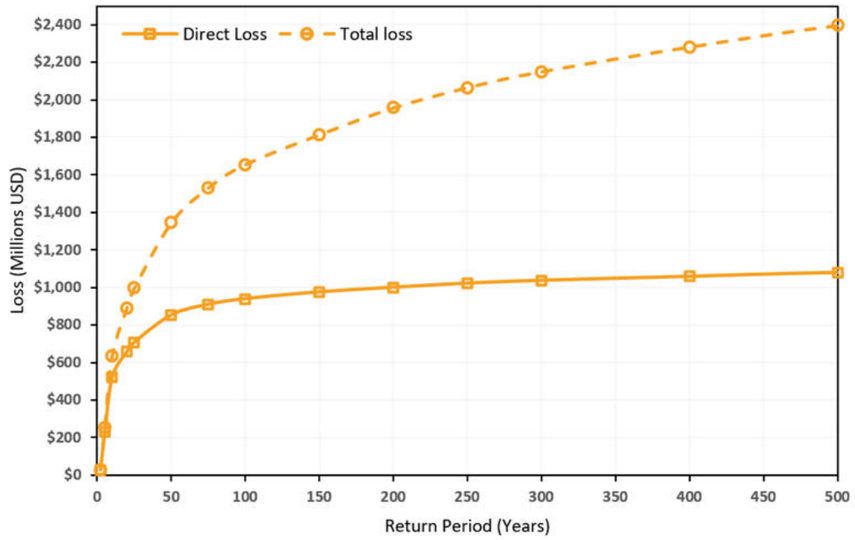
Figure 15: Breakdown of flood average annual number of people affected by region



Average annual fatalities from floods in Turkmenistan by region. Source: JBA Risk Management

There are on average over 69,000 people affected by floods every year in Turkmenistan. At the province level, as seen in Figure 14 and Figure 15, this is particularly concentrated in northern Turkmenistan, where 52,000 people are affected in Lebap and Dashoguz combined. The average number of people affected by floods also exceeds 10,000 in Mary. These three provinces contain the largest populations in the country, housing around 1.2–1.4 million people. The distribution of people affected is consistent with areas at risk of river flooding at the 200-year return period.

Figure 16: Exceedance probability curves – floods



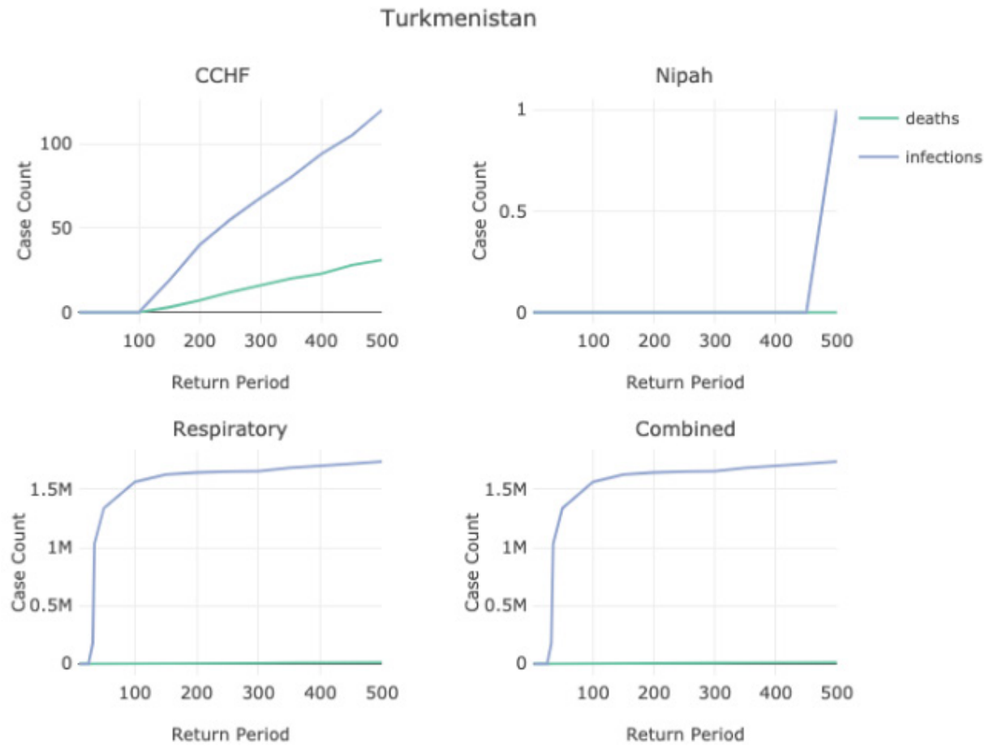
Source: JBA Risk Management.

The exceedance probability (EP) curves for Turkmenistan show the direct and total loss from all flood events in any given year for the given return periods. Loss increases most significantly between the 2 and 20-year return periods, which indicates susceptibility to floods in this return period range. Direct loss at the 100-year return period is modelled at almost $940 million, which is approximately 2.3% of Turkmenistan's nominal GDP. Direct loss increases at a slower rate above the 50-year return period and reaches almost $1.1 billion at the 500-year return period. Total loss increases significantly between the 2 and 50 year return period and continues to grow. Total loss is modelled at nearly $1.7 billion at the 100-yer return period and approximately $2.4 billion for the 500-year return period.

Risk analysis

Infectious disease

Figure 17: Exceedance probability curves – pandemic, including Crimean-Congo haemorrhagic fever (CCHF), Nipah virus infection, respiratory viruses and combined (all pathogens)



Source: Metabiota

The modeled exceedance probability (EP) curves include only those infections and deaths that are in excess of the regularly occurring annual baseline. For the included respiratory diseases like pandemic influenza and novel coronaviruses, this baseline will be zero, but for diseases like Crimean-Congo Haemorrhagic Fever (CCHF), which is endemic in some CAREC countries, the baseline will be higher than zero. Box 2 highlights the pathogens modelled as part of this analysis.

Box 2: Pathogens modelled

- Respiratory: a range of novel respiratory pathogens are included such as pandemic influenza, emergent coronaviruses (Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS)). This does not include endemic pathogens such as measles. A re-emergence of SARS-CoV-1 or a new SARS coronavirus are included.
- Crimean-Congo haemorrhagic fever is caused by a tick virus is transmitted by tick bites or through contact with infected animal blood or tissues. Symptoms include fever, muscle ache and pain, dizziness, nausea, vomiting, diarrhoea, sleepiness, and depression. The case fatality rate is estimated between 10-40%. Some medicines seem to be effective.[1]
- Nipah virus is a zoonotic virus (it is transmitted from animals to humans) ; it is also transmitted through food or people. It can cause a range of illnesses, from asymptomatic infection to severe respiratory illness and fatal encephalitis. The case fatality rate is estimated between 40-75% and there is currently no treatment or vaccine available.[2]

Table 1: Average annual losses - pandemic, including Crimean-Congo haemorrhagic fever, Nipah virus infection, respiratory viruses and combined (all pathogens)

Pathogen	Average Annual Loss - Infections	Average Annual Loss - Deaths
Combined	43,927	127
Respiratory	43,925	126
CCHF	2	<1
Nipah	<1	<1

Source: Metabiota

The pathogen EP curves for Turkmenistan in Figure 17 highlight that respiratory pathogens account for most epidemic risk. The respiratory pathogens EP curve climbs rapidly and steeply. This is because respiratory pathogens tend to be highly transmissible and cause very large pandemics when they occur (COVID-19 and pandemic influenza are notable examples).

CCHF and Nipah virus have much lower transmission leading to much smaller outbreaks which is consistent with what is shown in the EP curves: a few cases showing up at higher return periods. Table 1 provides the average annual loss numbers on people impacted and fatalities.

[1] *https://www.who.int/news-room/fact-sheets/detail/crimean-congo-haemorrhagic-fever*
[2] *https://www.who.int/news-room/fact-sheets/detail/nipah-virus*

CHAPTER 2

Historical losses and impacts

Turkmenistan is particularly exposed to weather and climate-related hazards and is prone to natural hazard-related disasters as sandstorms, mudflows, landslides, flooding, desertification and drought. The country's agricultural sector is particularly vulnerable to drought. In areas with irrigated agriculture, the effects of drought are less tangible; however, crop yields may be reduced by up to 30% in some drought years.[3]

According to the Emergency Events Database (EM-DAT) for Turkmenistan, the number of registered natural hazard-related disaster events in the twentieth century and their impacts in the country are very low compared to other countries in the region (Table 2).[4] As part of a World Bank study conducted in 2009, experts from TurkmenHydroMet collected data on the frequency of hydrometeorological hazards in Turkmenistan by type of event, providing a more complete picture. According to the data, there were 34 floods and mudflows, 1,293 strong winds, 290 dust storms, 9 droughts, 402 dry winds, 68 spring frosts, 36 autumn frosts, 116 torrential rains, 438 periods of extreme temperatures, 58 severe frosts, 15 snowfalls, 11 hail events and one sandy cyclone from 1996 to 2007.[5]

Information on flood events in Turkmenistan is limited. The worst historic floods to have occurred since the country's independence in 1991 are the 1993 floods, which caused economic losses of $98-$200 million and affected 420 people. Uncertainty in the loss estimate of this event is largely due to differences in normalising the losses to 2020 values.

Table 2:Total impacts from floods, earthquakes and droughts, 1900 – 2019

	Fatalities	Number of people affected	Total damage ($ million; constant 2019)
Flood	–	420	176.7 – 200
Earthquake	11	–	–
Drought	–	–	–

Source: EM-DAT; National Geophysical Data Center / World Data Service (NGDC/WDS): NCEI/WDS Global Significant Earthquake Database. NOAA National Centers for Environmental Information

[3] *Mamedov B.K. Orlovsky L.G., and Bekieva G.S. (2015). Analysis of situation with drought in Turkmenistan. // Problems of desert development #3-4. p. 10-16. http://cawater-info.net/bk/water_land_resources_use/russian_ver/pdf/desert_2015-3-4.pdf*
[4] *Centre for Research on the Epidemiology of Disasters – CRED. EM-DAT. https://www.emdat.be/*
[5] *UN APCIT (2012) Review of Hydrological and Meteorological Services in the Caucasus and Central Asia region. The United Nations Asian and Pacific Training Centre for Information and Communication Technology for Development (APCICT). https://www.unapcict.org/sites/default/files/2019-01/Hydromet_kit_Eng_sm.pdf*

An increasing number of recent flood events in 2020 already demonstrates the impact of the changing climate. The Soltan bend dam burst on the Murgab river flooded hundreds of houses in villages and large parts of Lebab.[6] The dam failure caused further lack of irrigation water for farmers.

Earthquake exposure is very high in Turkmenistan as most of the country is in a seismically active zone. The deadliest event in the area was the 1948 earthquake of magnitude 7.3 in Ashgabat which caused the death of more than 100,000 people (Table 3).[7]

Table 3: The most impactful flood and earthquake events in Turkmenistan , 1900 – 2019

Year	Location	Total damage ($ millions; constant 2019)	Fatalities	Number of people affected
Floods				
1993	Turkmenistan	176.7 – 200		420
2003	Turkmenistan	0.237		
Earthquakes				
1948	Ashkhabad	265.4	110,000	
1983	Kum-Dag	12.8		
1946	Turkmenistan		400	
2000	Nebitdag-Turkmenbashi		11	

Source: EM-DAT; National Geophysical Data Center / World Data Service (NGDC/WDS): NCEI/WDS Global Significant Earthquake Database. NOAA National Centers for Environmental Information.

Kopetdag and Kurendag mountains, located in the southern part of the Balkan velayat (province), are geologically young and seismically active. The earthquakes in Krasnovodsk (in 1895), Kazanjik (1946), and Kumdag (1983) are officially registered to have occurred in the last century.[8] The biggest recent earthquake in the Balkan velayat happened in 2000. According to official media, no deaths and significant destruction were registered. However, various regional media sources report deaths of 90 people, catastrophic devastation in the city of Kazanjik, and destruction of more than 60 percent of the residential buildings.[9]

No previous pandemic event impact data is available for Turkmenistan.

[6] *Fergana.agency. (2020). Dozens of villages flooded in southeastern Turkmenistan due to dam break. 16 June. Fergana. URL: https://fergana.agency/news/119157/*
[7] *UN APCIT (2012) Review of Hydrological and Meteorological Services in the Caucasus and Central Asia region. The United Nations Asian and Pacific Training Centre for Information and Communication Technology for Development (APCICT). https://www.unapcict.org/sites/default/files/2019-01/Hydromet_kit_Eng_sm.pdf*
[8] *https://science.gov.tm/turkmenistan/regions/*
[9] *Chronicles of Turkmenistan. https://www.hronikatm.com/2020/11/earthquake-6/http://old.memo.ru/d/178.html*

CHAPTER 3

Hazard

In Turkmenistan, the seismicity accumulates in the central and western part of the country.[10] Overall, the ISC-GEM catalogue contains 7 earthquakes with a magnitude between 6 and 7.15 that occurred between 1929 and 2000. The largest earthquake included in this instrumental catalogue is the magnitude 7.2 earthquake in 1948 which occurred west of the capital city Ashgabat.

Seismic hazard

As seen in Figure 18 and Figure 19, the peak ground acceleration with a 10% probability of exceedance in 50 years (PGA10%50yr) on reference site conditions (Vs30 of 800 m/s) does not exceed 0.2g. This band of relatively higher hazard starts from the city of Mary in the west-northwest direction and goes to Ashgabat and Balkanabat. In the capital city Ashgabat, the PGA10%50yr is about 0.18g which increases to 0.41g when considering a 2% probability of exceedance in 50 years.

Figure 18: Seismic hazard map for peak ground acceleration (PGA) with a 10% probability of exceedance in 50 years

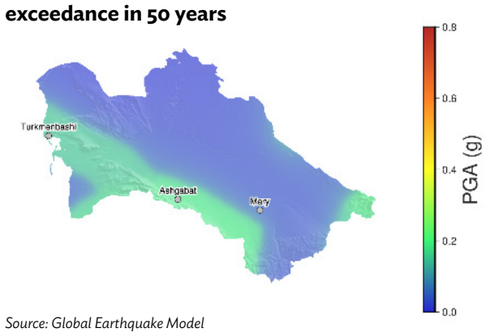
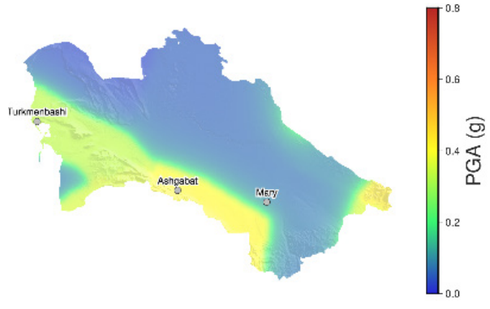


Figure 19: Seismic hazard map for PGA with a 2% probability of exceedance in 50 years.



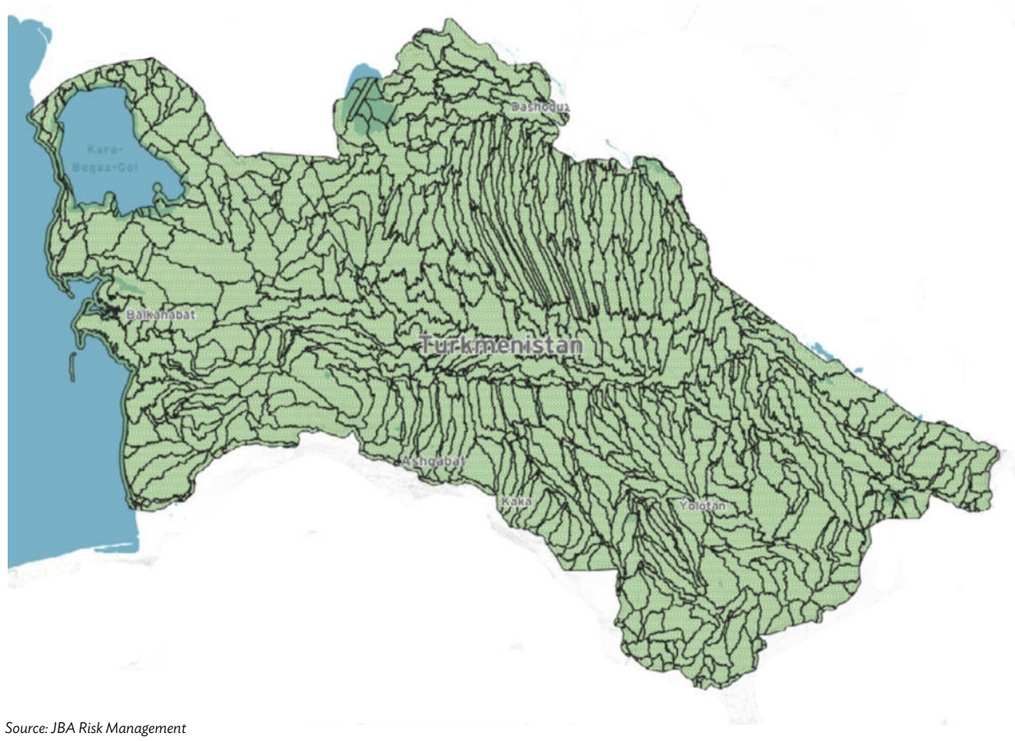
Source: Global Earthquake Model

[10] *ISC-GEM catalogue (version 7.0 – see http://www.isc.ac.uk/iscgem/)*

Map of hydrological catchment areas

Exposure to flooding can be assessed via hydrological accumulation zones (HAZ). HAZ polygons represent the natural watercourse boundaries as a means of modelling the flow of water. The HAZ polygons for Turkmenistan in Figure 20 show the structure of the hydrological basins across the country. Large areas of the country are very dry with ephemeral rivers; the dry valleys of this area are represented by the long, narrow HAZ polygons. Towards the west and the Caspian Sea, the land is flat and low-lying but still dry with limited flood risk. As a result, the population is concentrated in the west of the country.

Figure 20: Hydrological catchments used for flood modelling



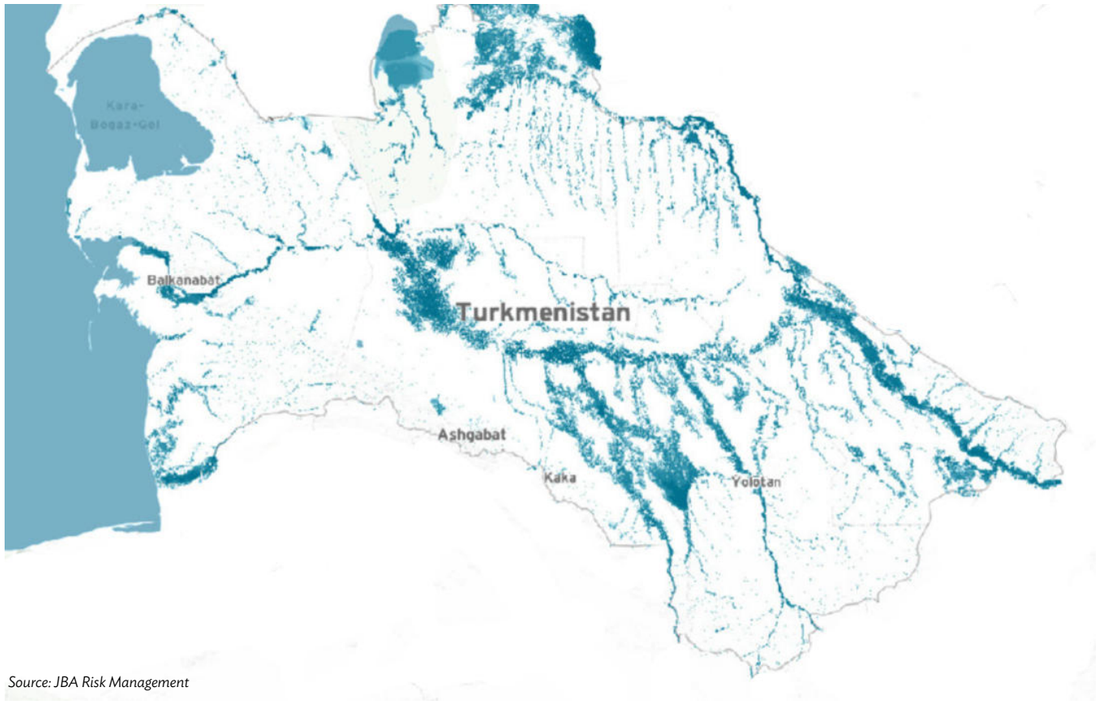
Source: JBA Risk Management

Flood hazard map for pluvial and fluvial flooding

Flood modelling estimates losses and impacts on the basis of flood maps for river (fluvial) and surface water (pluvial) flooding generated at 30 metre spatial resolution. These maps use observed river and rainfall data to generate extreme rainfall and river flow volumes. Maps are generated for different return periods. The 1 in 200-year return period river flood map in Figure 21 highlights the main rivers of Turkmenistan. This event severity is often used for planning purposes as a plausible extreme event.

Major rivers include the Amu Darya, the Morghab, and the Tejen. As shown in the map, many of the areas of river flood are relatively dry and sparsely populated regions where the risk is limited to times of intense rainfall. In the south, the Morghab River flows south from the border with Afghanistan and spreads out into a broad, flat area of land aroundthe city of Mary. Further north and west, areas of low-lying land appear to be irrigated farmland with limited population. Along the northern border with Uzbekistan, the Amu Darya River flows south-southeast to the west-northwest through a relatively heavily populated region which includes Turkmenabat, one of the largest cities in the valley.

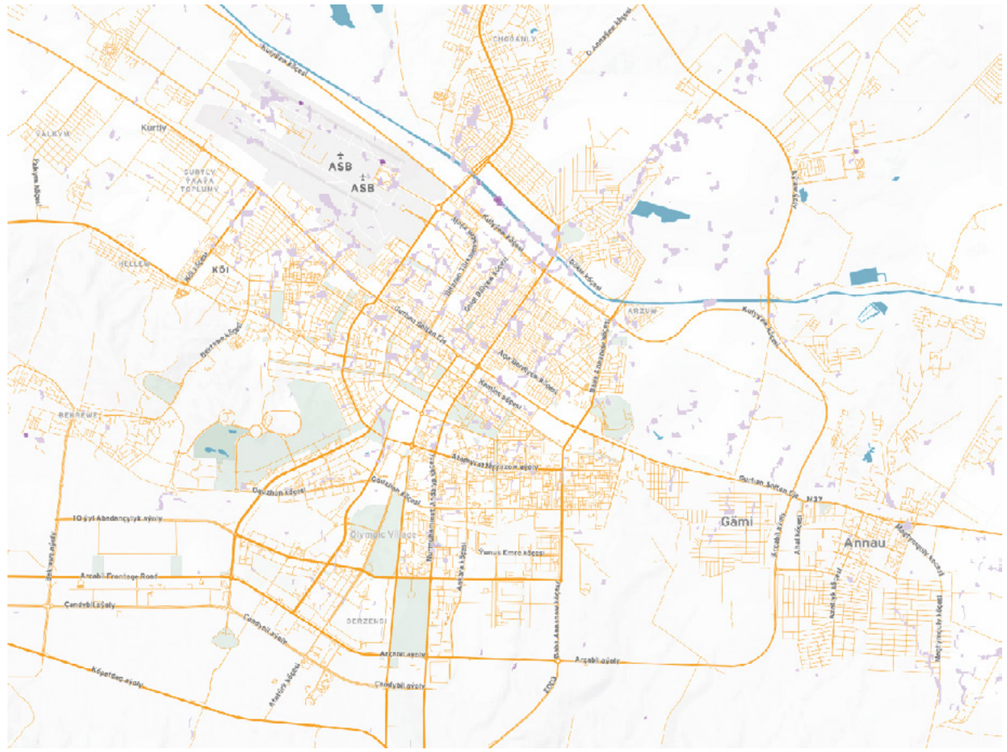
Figure 21: Map of river (fluvial) flooding (areas in blue) at the 200-year return period level



Source: JBA Risk Management

[10] *UNDP, 2019*

Figure 22: Map of surface water (pluvial) flooding (areas in purple) at the 200-year return period level for the Ashgabat region



Source: JBA Risk Management

Ashgabat is in a relatively dry area and to the south of higher ground. The surface water flood map for the city in Figure 22 shows areas of localised risk throughout the city and close to the airport.

Climate conditions

Historic climate

Turkmenistan's climate is predominantly arid with the Karakum desert covering approximately 70% of the country. Figure 23 and Figure 24 show that precipitation in the desert regions averages between 50 and 120mm per year. Precipitation is greatest, ranging from ~120mm to 380mm annually, over the Kopet Dag mountains on the southern border with Iran and the Köýtendag Range on the south-eastern border with Uzbekistan. Most precipitation falls between November and May, with March and April historically the wettest months. Average temperatures span monthly means of 1°C in January to 29°C in July;[11] temperature in the north ranges from 12 to 17°C while the south ranges from 15 to 18°C.[12]

Annual temperatures have been increasing since the 1950s at a rate of about 0.3°C per decade[13] with warming most pronounced in the winter.[4] There are no clear, statistically significant precipitation trends across the country. Nonetheless, some areas have experienced increasing incidence of drought and longer duration dry spells since the 1970s; the steppe areas of the Karakum experienced drought in six out of the ten years from 1999 to 2008.[14]

Figure 23: Annual mean precipitation between 1951-2007

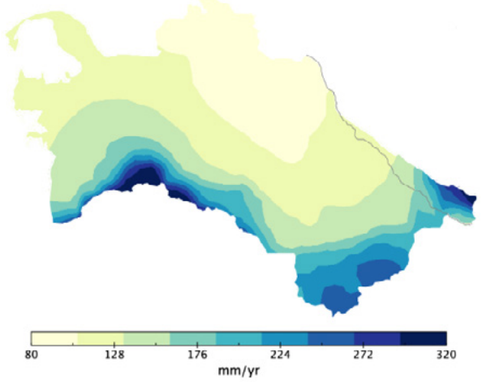
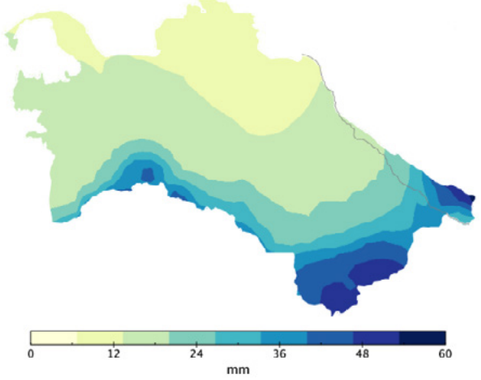


Figure 24: April-June (primary flood season) mean precipitation between 1956-1995



Note: the precipitation scales are different between the annual and seasonal means.
Source: analysis using APHRODITE Russian domain precipitation dataset.[15]

[11] *World Bank Group (2021) Turkmenistan: Historical Climate Data. Climate Change Knowledge Portal. https://climateknowledgeportal.worldbank.org/country/turkmenistan/climate-data-historical*
[12] *Lioubimtseva, E., J. Kariyeva and G. Henebry (2014) Climate change in Turkmenistan. In: The Turkmen Lake Altyn Asyr and Water Resources in Turkmenistan, Handbook of Environmental Chemistry. L. Zonn and A. Kostianoy [eds.]. Springer-Verlag: Berlin.*
[13] *Government of Turkmenistan (2015) Third Communication of Turkmenistan under the United Nations Framework Convention on Climate Change (UNFCCC). Ashgabat.*
[14] *Mamedov, B., L. Orlovsky and G. Bekieva (2015) 'Analysis of situation with drought in Turkmenistan'. Problems of Desert Development 3-4: 10-16.*
[15] *Yatagai, A. K. Kamiguchi, et al. (2012) 'APHRODITE: Constructing a long-term daily gridded precipitation dataset for Asia based on a dense network of rain gauges'. BAMS, doi:10.11.75/BAMS-D-11-00122.1*

Future precipitation projections

Two Regional Climate Model-Global Climate Model (RCM-GCM) simulations from the Coordinated Regional Climate Downscaling Experiment (CORDEX) Central Asia domain were used to examine climate change impacts on precipitation. Two Representative Concentration Pathways (RCP4.5 and RCP8.5) were selected; these represent a medium and high (business-as-usual) emissions pathway respectively. The RCMs were bias corrected before precipitation projection analysis of how conditions could shift between the 2050s (2031-2070) and a historical reference period of 1956-1995.[16] The multi-model mean information was used to examine yearly and seasonal changes under RCP4.5 and RCP8.5.

Precipitation extremes from each model and RCP were individually used to calculate future precipitation intensities, which are relevant to estimating future flood risk. The area-averaged annual maximum rainfalls for a 24-hour duration for each province were extracted and analysed for different return periods (2, 5, 10, 20, 50, 100, 200-, 500-, 1000-, 1500-, 5000- and 10000-year events).

Projections from two regional climate models using RCP4.5 and RCP8.5 indicate annual mean precipitation could slightly increase for much of the country, except for parts of Mary and Lebap provinces along the border with Afghanistan, by the 2050s in comparison with that of 1956-1995. Increases under RCP4.5 range between 10 and 20%; under RCP8.5, increases range between 10 and 90%.

The largest increases under RCP8.5 are in the Balkan province toward the Caspian Sea. On a seasonal basis, much of the increase is projected to occur in the January to March period. As shown in Figure 25 and Figure 26, little change is projected during the January to March period under either RCP, except for the 10 to 60% change in the Balkan province. Studies using a larger set of climate models demonstrate similar spatial patterns in possible precipitation shifts under climate change. However, they also indicate that there is uncertainty in future precipitation[3] and that projections should be treated with caution. Any increases in precipitation will be offset by greater evapotranspiration as annual mean temperatures could rise approximately 1.5 to 4°C by the 2050s depending on the model and emission pathway.[3,4]

Figure 25: RCP 4.5 2050 April-June precipitation percentage change

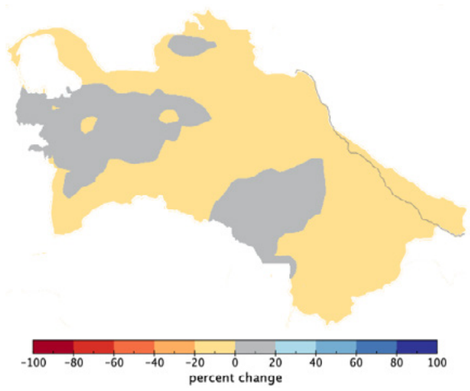
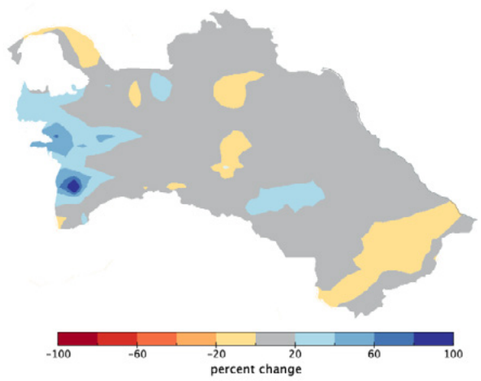


Figure 26: RCP 8.5 2050 April-June precipitation percentage change



Source: Bias corrected multi-model projections from CORDEX Central Asia domain

[16] *The historical reference period of 1956-1995 was used over the standard 30-yr period 1961-1990 because climate over Central Asia is modulated by the Atlantic Multidecadal Oscillation and this reference period is long enough to cover two phases of the AMO, among other multidecadal climate processes. The 2050s (period 2031-2070) were chosen for the flood model (and climate modeling) as a more policy relevant period than the more distant 2070s, and a climate change signal is detectable.*

Much of Turkmenistan is arid and will continue tobe so in the future. Nonetheless, short-duration (24-hour or less) or multi-day extreme precipitation events can contribute to flooding. Potential changes in the intensities of 24-hour duration extremes mirror the spatial changes in projected mean annual and spring season shifts. Over Mary and Lebap the intensities of more frequent events could increase; in Mary, what was historically the 1 in 70-year event may shift to the 1 in 20-year. Meanwhile, the intensities of rare events (e.g., the 1 in 500-year or greater) could actually decrease. In Balkan and Dashoguz provinces, 24-hour extremes could intensify more. In Balkan, for example, what was once approximately the 1 in 200-year event could shift to the 1 in 20-year event. Select shifts in Ashgabat's projected short duration precipitation extremes are shown in Table 4.

The projected changes in 24-hour duration extreme precipitation intensities in Ashgabat for 2031-2070 (the 2050s) are compared to historical 24-hour intensities for different return periods. The table shows the median of the multi-model ensemble and the 25th and 75th percentiles in brackets for the future scenarios. Box 3 describes the methodology behind the future climate calculations.

Table 4: Ashgabat 24-hr duration extreme precipitation intensity (mm/hr)

Return period	1951-2007	2050s	
	Historical	RCP4.5	RCP8.5
20-year	0.71	0.80 (0.79, 0.81)	0.83 (0.78, 0.88)
100-year	0.94	1.02 (1.01, 1.03)	1.05 (0.98, 1.14)
200-year	1.04	1.10 (1.09, 1.12)	1.15 (1.06, 1.24)
500-year	1.16	1.23 (1.22, 1.25)	1.27 (1.17, 1.38)

Source: ODI

Box 3: Future climate methodology

Climate change impacts on precipitation were examined by use of Regional Climate Models. Two Representative Concentration Pathways (RCPs) were selected: RCP 4.5 as a medium emissions pathway and RCP 8.5 as a high (business-as-usual) pathway.

Multi-model projections simulated how precipitation could differ in the 2050s compared to the historical reference period of 1956-1995. Precipitation projections were made to examine how conditions could differ in the 2050s to the historical reference period of 1956-1995. This reference period accounts for two phases of the Atlantic Multidecadal Oscillation, which modulates climate over Central Asia. The 2050s were chosen as a policy relevant period where a climate change signal is detectable.

Further information on the approach is detailed in the Technical Documentation

CHAPTER 4

Exposure

Turkmenistan is located in Central Asia, between the Caspian Sea in the west, Iran and Afghanistan in the south, and Uzbekistan and Kazakhstan in the north. Comparatively, Turkmenistan is the second largest country in Central Asia with a total area of 488,100 sq. km (188,456 sq. mi). Turkmenistan's boundary length totals 5,504 km (3,420 mi), of which nearly a third is shoreline along the Caspian Sea.

Nearly 6 million people live in Turkmenistan with 1 million people living in the capital, Ashgabat, and further population centres in the cities of Mary, Turkmenabat and Dashoguz. As seen in Table 5, population growth is currently around 1.5 % a year, down from a peak of 3% a year in the 1990's.

Turkmenistan's economy and employment are concentrated in the industrial sector and remains heavily dependent on natural resources. The country's share of value added through industry as percent of GDP is 57%, the largest among all CAREC countries. Meanwhile, its value added and share of employment in agriculture are amongst the lowest in the region.[17] Table 6 shows key economic indicators for Turkmenistan.

Table 5: Population totals, distribution and trends (data from 2019, if *from 2020)

Population (thousands)	5,942.09
Population growth date (%/year)	1.5
Share of population living in urban areas (%)	52
Urbanisation rate (%/year)	2.4
% of total population age 0-14	31
% of total population age 15-64	65
% of total population ages 65 and above	5

Source: World Bank Open Data

Table 6: Key economic indicators (data from 2019, if *from 2020)

GDP (million USD, current)	40,761.14
GDP per capita (USD, current)	6,966.60
Country / territory economic composition	Country / territory economic composition
Agriculture, forestry and fishing, value added (% of GDP)	9.3
Employment in agriculture (% of total employment) (modelled ILO estimate)	19*
Industry (including construction, value added (% of GDP)	57
Employment in industry (% of total employment) (modelled ILO estimate)	43*
Services, value added (% of GDP)	28.1
Employment in services (% of total employment) (modelled ILO estimate)	38*

Source: World Bank Open Data

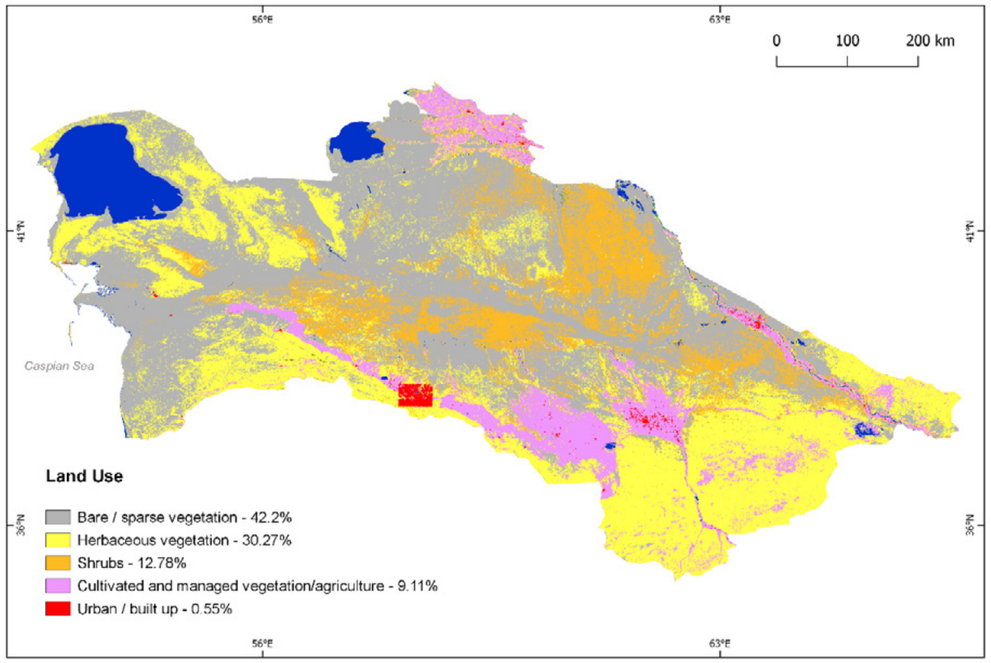
[17] *The World Bank (2021). World Bank Open Data. Employment in agriculture (% of total employment) (modelled ILO estimate). Accessed April 2021 at: https://data.worldbank.org/indicator/EN.POP.DNST?most_recent_value_desc=false*

Turkmenistan has adopted several strategic development and infrastructure plans to be implemented in the next decade. The national program of socio-economic development for 2011-2030 provides a framework and directions for the economy. The cross-cutting goal for the upcoming years is to decrease the dependence on natural gas and diversify the national economy[18], through strategies such as strengthening the chemical industry and becoming a transport and logistics corridor between Europe and Asia.[19]

There are a few ongoing cross-border infrastructural projects. The Afghanistan-Turkmenistan-Azerbaijan-Georgia-Turkey transport corridor is a multi-modal project focusing on railways and roads between the five countries. The project is expected to boost regional integration and increase trade with other countries, thus stimulating economic growth.[20] Another project is the Turkmenistan-Afghanistan-Pakistan-India (TAPI) gas pipeline that aims to supply about 33 billion cubic metres of Turkmen gas per year to the large Indian market.[21] However, despite a few large-scale transport projects, such as the Turkmenbashi International Sea Port on the Caspian Sea and a railway between Kazakhstan and Iran, the country's infrastructure "remains weak and logistic costs very high".[22]

[18] *OECD. (2019). Sustainable Infrastructure for Low-Carbon Development in Central Asia and the Caucasus. Hotspot Analysis and Needs Assessment. Strategic infrastructure planning for sustainable development in Turkmenistan. URL: http://www.oecd.org/env/outreach/Item3-Assessment-Turkmenistan-RUS.pdf*
[19] *Statement of Shamukhammed DURDYLYEV, Deputy Chairman of the Cabinet of Ministers of Turkmenistan. 27 October 2020. State News Agency of Turkmenistan (TDH) - Turkmenistan today. URL: https://tdh.gov.tm/ru/post/24862/promyshlennost-stroitelstvo-elektroenergetika:-potentsial-rosta*
[20] *OECD. (2019). Sustainable Infrastructure for Low-Carbon Development in Central Asia and the Caucasus. Hotspot Analysis and Needs Assessment. Strategic infrastructure planning for sustainable development in Turkmenistan. URL: http://www.oecd.org/env/outreach/Item3-Assessment-Turkmenistan-RUS.pdf*
[21] *Tass. (2019). Afghanistan started construction of its TAPI gas pipeline. Retrieved form URL: https://tass.ru/ekonomika/6753681.*
[22] *OECD. (2019). Sustainable Infrastructure for Low-Carbon Development in Central Asia and the Caucasus. Hotspot Analysis and Needs Assessment. Strategic infrastructure planning for sustainable development in Turkmenistan. URL: http://www.oecd.org/env/outreach/Item3-Assessment-Turkmenistan-RUS.pdf*

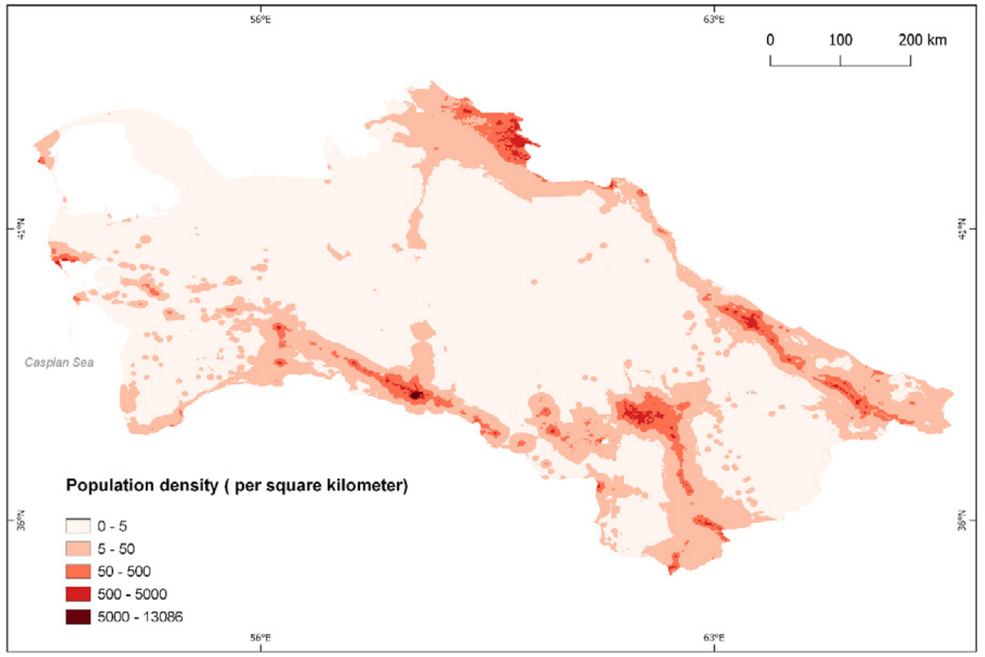
Figure 27: Land use in Turkmenistan



Source: FAO GlobCover

Figure 27 shows the map of land use in Turkmenistan. Large parts of the country are given over to sparse vegetation, shrubs and herbaceous vegetation with under 10% used for managed vegetation and agriculture. The Karakum canal, the world's longest irrigation canal, supports most of the farmed land. It stretches 1,350 kilometers (745 miles) from Haun-Khan to Ashgabat and brings water from the Amu-Darya to the inhabited areas in southern Turkmenistan. Draining the Amu-Darya, it runs most of the length of Turkmenistan and is used to supply water for cotton farms and other agriculture including grains such as wheat and corn, fodder crops, with wool, meat, and milk from raising of livestock, chiefly sheep that lie alongside it.

Figure 28: Population density map



Source: WorldPop

The average population density in Turkmenistan is only 12 people per km^2 in 2019, making it one of the least densely populated countries in the world. This is largely because most of the country is covered by the Turan Depression and the Karakum Desert. Figure 28 shows that the most densely populated regions of the country are the border areas in the north and south of the country, with significant population clusters around the capital city of Ashgabat.

Table 7: Asset replacement cost (billion USD) for residential, commercial and industrial buildings

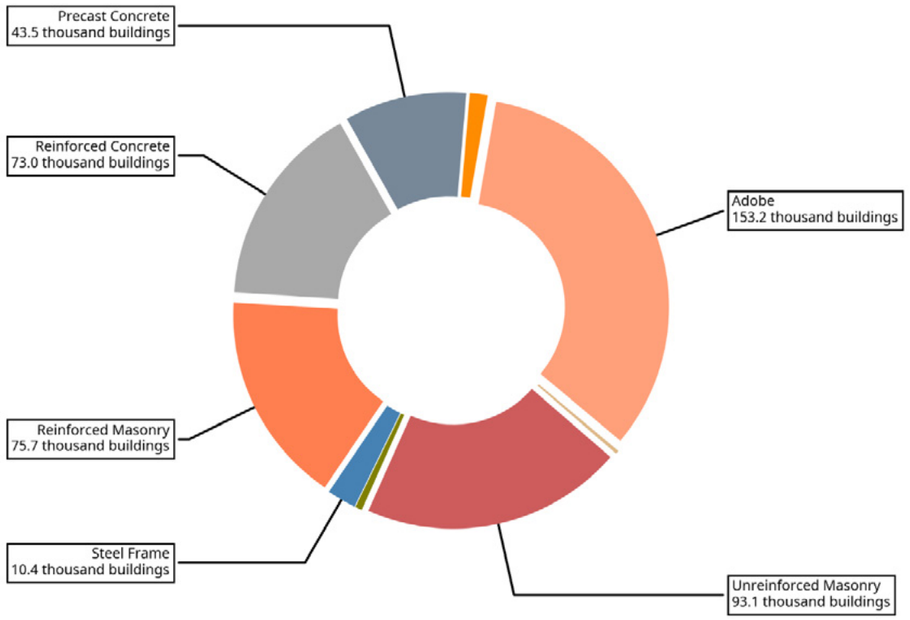
Asset replacement cost (billion $)	
Residential buildings	56.3
Commercial buildings	N/A
Industrial buildings	N/A
Total buildings	N/A

Source: Global Earthquake Model database for residential, commercial and industrial buildings.

Table 7 shows asset replacement costs for residential buildings in Turkmenistan would total $56.3 billion. Data for commercial and industrial buildings is not available.

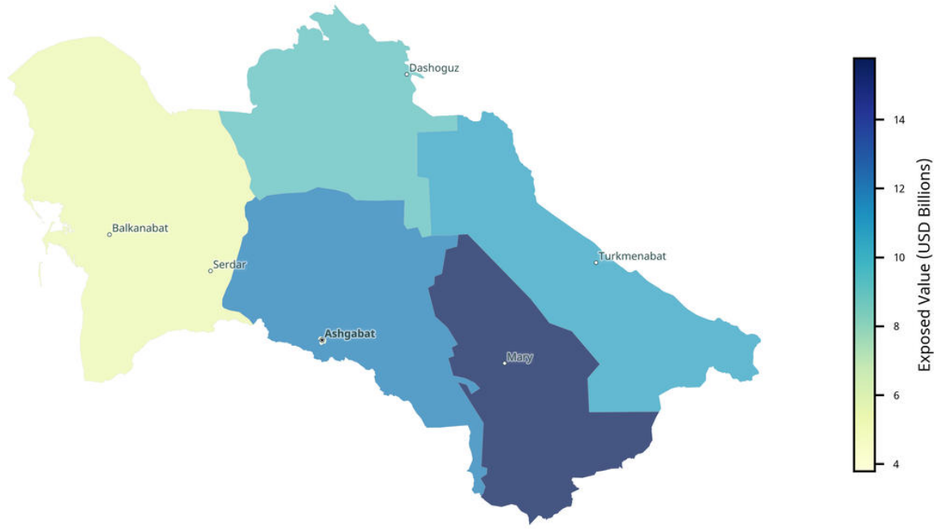
Figure 29 shows the breakdown of building stock by building type. Adobe structures with an estimated total of 153,238 buildings make up the largest fraction (33.4%) of the total building stock. This is followed by unreinforced masonry structures (93,149 buildings, or 20.3%) and reinforced masonry structures (75,664 buildings, or 16.5%).

Figure 29: Breakdown of different building types



Number of residential, commercial, and industrial buildings by primary structural type
Source: Global Earthquake Model

Figure 30: Asset replacement cost (residential, commercial and industrial buildings)



Source: Global Earthquake Model

Figure 30 shows the distribution of asset replacement costs across Turkmenistan. This is largely concentrated in the southern parts of the country around the capital Ashgabat and the region of Mary, which is a large industrial centre for natural gas and cotton, two of the nation's major exports.

There are two sources of possible secondary detrimental impact of earthquakes on the environment and ecological systems.[23] First is the presence of oil refineries and chemical plants while the second is extraction of hydrocarbon raw materials in the coastal shelves of the Caspian Sea and in oil and gas areas, as well as the materials' transportation by long pipelines.

There is some indication that future seismic risks are considered in the development of new infrastructure and construction in Turkmenistan. For example, the utility conduit for the collection of sewage and drainage water, distribution of freshwater, and the laying of electricity and telecommunication cabling has been designed to resist damage up to 9.8 on the Richter scale.[24] As part of the implementation of the Presidential Decree "On the construction of industrial and production facilities of the Ministry of Industry and Construction Production of Turkmenistan in 2020-2023", new enterprises equipped with modern equipment are being built in the country and existing ones are being modernized.[25]

The national plans also include the improvement of housing, including construction of new houses for the population and modernization of the existing housing stock. Within the framework of the National Rural Program until 2025 there are plans to build 13 hospitals, 20 health houses, 163 preschool institutions, 201 secondary schools, 16 houses of culture, 11 water treatment plants, 13 sewage treatment plants, as well as residential buildings with a total area of 1,896.4 thousand square meters.[26] The program of comprehensive development of the capital city of Ashgabat and many cities in provinces and etraps (districts) is gaining visible results. However, most of the new buildings are in earthquake-prone regions with an area of 6-9 points exceeding 70 per cent of the total territory of the country.[27]

[23] *Golinsky G. (2000). Determination of the main parameters of strong earthquakes to assess the seismic hazard of Turkmenistan territories Dissertation for the degree of Candidate of Physical and Mathematical Sciences. Institute of Physics of the Earth. Russian Academy of Sciences.*
[24] *Wallis S. (2006) 'Foundation for building a new Ashgabat', Tunnel Talk. (https://www.tunneltalk.com/Turkmenistan-Feb2006-Foundation-of-a-new-Ashgabat.php)*
[25] *https://tdh.gov.tm/ru/post/24862/promyshlennost-stroitelstvo-elektroenergetika:-potentsial-rosta*
[26] *https://www.mfa.gov.tm/ru/articles/4*
[27] *Golinsky G. (2000). Determination of the main parameters of strong earthquakes to assess the seismic hazard of Turkmenistan territories Dissertation for the degree of Candidate of Physical and Mathematical Sciences. Institute of Physics of the Earth. Russian Academy of Sciences.*

CHAPTER 5

Vulnerability

The social impacts of hazard events are greatly affected by the structure and organization of societies and economies. Vulnerability can be thought of as one determinant of disaster risk, the other being the natural hazard event. The structure of politics, economics and livelihoods affects vulnerability to disaster events. Policy and investment choices can increase or decrease vulnerability, and so determine the overall level of disaster risk. Deliberate policies, such as for disaster risk reduction and finance, can reduce vulnerability. Other forces, such as pattern of urbanisation or decline of ecosystem services, may unintentionally increase vulnerability.

Socio-economic vulnerability

As one of the most vulnerable countries to climate change in Asia, Turkmenistan is forecast to suffer water shortages, increased desertification and land degradation. These will not only influence food security but also threaten the well-being of the population. Table 8 provides an overview of socio-economic vulnerability indicators for Turkmenistan.

Table 8: Socio-economic vulnerability indicators

Poverty headcount ratio at national poverty lines (% of population)	N/A
Human Capital Index	N/A
GINI index	40.8 (1998)
Gender Inequality index	N/A
Household size	N/A
Age dependency ratio (% of working age population)	55 (2019)
Unemployment rate	4.1 (2020)
General government gross debt (% of GDP)	31.366 (2018)
Under five child mortality (per 1000 live births)	42 (2019)
Life expectancy at birth (female)	72 (2019)
Life expectancy at birth (male)	65 (2018)
% of population using at least basic sanitation services	99 (2017)
% of population using at least basic drinking water services	99 (2017)

Source: World Bank Open Data; United Nations Population Division; UNDP; IMF World Economic Outlook Database

Those in rural areas and with livelihoods dependent on agriculture and livestock are particularly vulnerable to suffering negative impacts during drought situations. Yield capacities of desert oases and steppe pastures are strongly influenced by precipitation, evapotranspiration, and soil moisture. Pasture yields in the Karakum steppes have decreased by an average of 24% annually during drought years between 1991 and 2008. The losses were more pronounced during the severe drought years between 1999 and 2008, with the annual yield averages only at 55% of the average yield from 1961 to 1990. Livestock production suffered in tandem; as a result, herders sought to transport cattle from the most drought-affected areas (Badkhyz and Karabil) to the oases in Mary and from central Karakum to the Zaunguz oases.[28]

[28] *Veysov S.K., Kepbanov Y.A., Durikov M.Kh., and Aganov S.E. (2019). Adaptation measures to climate change in Turkmenistan. //Problems of desert development #3. P.24. URL: https://www.science.gov.tm/files/desert_2019-3-4.pdf; Mamedov B.K. Orlovsky L.G., and Bekieva G.S. (2015). Analysis of situation with drought in Turkmenistan. // Problems of desert development #3-4. p. 10-16. URL: http://cawater-info.net/bk/water_land_resources_use/russian_ver/pdf/desert_2015-3-4.pdf*

Coping capacity

Recognising the need for interagency coordination in addressing risks and enhancing emergency prevention and response, the Government of the Republic of Turkmenistan established in April 2021 a National Platform for disaster risk reduction.[29] Turkmenistan has also begun reporting through the Sendai Framework and has provided data in relation to Target E in 2020.[30] In parallel, the country is engaging in the customisation of DesInventar to facilitate data collection on disaster losses. The process, which is expected to take place in 2021, includes the introduction of appropriate indicators and the creation of categories for disaggregation.[31]

Turkmenistan, alongside Kazakhstan, Kyrgyz Republic and Tajikistan, also signed a declaration committing to cooperate in disaster risk reduction and supporting a global agreement on climate change at the First Regional Forum of Heads of Disaster Management Authorities of Central Asian countries in Ashgabat in 2015.[32]

Table 9 provides key coping capacity indicators for Turkmenistan.

Table 9: Key coping capacity indicators

Financial inclusion (% of population aged 15+ with access to bank account)	40.6% (female pop: 35.5%) (2017)
Insurance coverage	0.72% (2019)*
Share of population covered by public safety nets	N/A
Internet coverage (% of population using the internet)	21 (2017)
Metabiota Epidemic Preparedness Index score (100 = maximum score, 0 = minimum score)	63 (2019)
Public and private health expenditure (% of GDP)	6.93 (2017)
Number of physicians (per 1,000)	2.2 (2014)
Number of hospital beds (per 1,000)	7.4 (2013)
Government effectiveness (-2.5 to +2.5)	-1.16 (2019)
Corruption Perception Index	19 (2019)

Source: World Bank Open Data; Worldwide Governance Indicators (WGI) Project; Transparency International; Data relevant to national preparedness to detect and respond to epidemics and pandemics from Metabiota's Epidemic Preparedness Index[33]
**Refers to total insurance penetration, rather than just the non-life segment*

[29] *Government of the Republic of Turkmenistan and United Nations Turkmenistan (2021) 2020 UN Turkmenistan Annual Results Report. https://turkmenistan.un.org/sites/default/files/2021-05/UN_ResultsReport_EN_web.pdf*
[30] *(2020) 'Reporting Against Sendai Framework Targets Through Sendai Framework Monitor in Central Asia', United Nations Office for Disaster Risk Reduction - Regional Office for Europe.*
[31] *Government of the Republic of Turkmenistan and United Nations Turkmenistan (2021) 2020 UN Turkmenistan Annual Results Report. https://turkmenistan.un.org/sites/default/files/2021-05/UN_ResultsReport_EN_web.pdf*
[32] *Government of Turkmenistan (2015) 'Ashgabat Declaration'. https://www.preventionweb.net/files/47548_ashgabatdeclarationen.pdf*
[33] *Oppenheim, B., Gallivan, M., Madhav, N. K., Brown, N., Serhiyenko, V., Wolfe, N. D., & Ayscue, P. (2019). Assessing global preparedness for the next pandemic: development and application of an Epidemic Preparedness Index. BMJ global health, 4(1).*

The legal framework for managing disaster risk in Turkmenistan consists of the following laws:

- Constitution of Turkmenistan of May 18, 1992, as amended on September 25 2020.[34]
- Law of Turkmenistan of March 13, 2021 "On prevention and liquidation of emergency situations"[35]
- Law of Turkmenistan of August 22, 2020, 261-VI "On International Humanitarian Aid in Emergency Situations"[36]
- Law of Turkmenistan "On Nature Protection" of March 01, 2014. (with amendments and additions, adopted by the Law of Turkmenistan of 18.08.2015) (Articles 49, 50)[37]
- Law of Turkmenistan "On Hydrometeorological Activity" of September 15, 1999. (amended and supplemented by Amendments introduced by Law of Turkmenistan No. 32-IV of 18.04.2009 and No. 149-IV of 26.11.2010) (Article 15)[38]
- Water Code of Turkmenistan. Approved and enacted since January 1, 2017. (Articles 63, 96, 97)[39]

Additional and more specific issues related to the reduction of disaster risk and climate change impact are covered by additional environmental, agricultural and health laws.

The State Commission for Emergency Situations (SCES) under the Cabinet of Ministers of Turkmenistan is the main body responsible for the prevention and elimination of the consequences of emergencies related to natural disasters.[40] The Commission also coordinates all emergency responses. In May 2007, the State Agency for Emergency Situations was created and was later transformed into the Department of Emergency Situations under the Ministry of Defense, which was the main body responsible for dealing with emergency situations including natural hazard related disasters.

Disaster preparedness was included in the United Nations Development Assistance Framework (UNDAF) review of Turkmenistan for the first time, and the regional conference on seismic risk reduction held in the capital city Ashgabat demonstrated Turkmenistan's willingness to cooperate at the regional level.[41] In 2011, the country requested participation in the Knowledge Management workshop held under the Disaster Preparedness European Community Humanitarian Office (DIPECHO) project. Although not formally a part of the project, Turkmenistan has increased its efforts in disaster risk reduction and integrated disaster risk reduction into education.[42]

In 2008, the President established a Disaster Prevention and Rescue Services department in the Ministry of Defence with a $25 million budget.[43] The emergency situation and civil safety services are controlled by the disaster management department under the Ministry of Defence while disaster mitigation and response is handled by the special Directorate within the same ministry.[44]

The Ministry of Agriculture and Environmental Protection of Turkmenistan , which implements the state policy of the President of Turkmenistan in the field of agriculture and environmental protection, is engaged in the development of agriculture, as well as food security and environmental protection, land relations and hydrometeorology.[45]

At the local level, the coordination of disaster management involves the province's authorities. Regular meetings are held at velayat (province) and etrap (district) levels where representatives of relevant organizations and khykimliks (heads of the local authorities) discuss issues of water use and protection, impact of harmful water events (e.g., floods or drought), and other water-related issues (e.g., drinking water supply, homestead plots).[46]

[34] *https://minjust.gov.tm/mcenter-single-ru/6*
[35] *https://turkmenportal.com/catalog/18733*
[36] *https://turkmenportal.com/catalog/17356*
[37] *https://unece.org/DAM/env/pp/compliance/Requests_from_the_MOP/ACCC-M-2017-2_Turkmenistan/Law_on_nature_protection_2014_rus.pdf*
[38] *https://www.osce.org/files/f/documents/6/4/203546.pdf*
[39] *https://minjust.gov.tm/mcenter-single-ru/22*
[40] *UN APCIT. (2012). Review of Hydrological and Meteorological Services in the Caucasus and Central Asia region. The United Nations Asian and Pacific Training Centre for Information and Communication Technology for Development (APCICT). https://www.unapcict.org/sites/default/files/2019-01/Hydromet_kit_Eng_sm.pdf*
[41] *(2009) 'Compendium of Good Practices and Tools on Disaster Risk Reduction in Education in Central Asia', UNISDR /UNICEF/ DIPECHO*
[42] *(2009) 'Compendium of Good Practices and Tools on Disaster Risk Reduction in Education in Central Asia', UNISDR /UNICEF/ DIPECHO.*
[43] *Gurenko E. and Dumitru D. (nd) 'Mitigating the Adverse Financial Effects of Natural Hazards on the Economies of Central Asia. A Study of Catastrophe Risk Financing Options', Europe and Central Asia Region of the World Bank/ UNISDR Europe and Central Asia.*
[44] *Gupta S. (2009) 'Central Asia and Caucasus Disaster Risk Management Initiative (CAC DRMI) Risk Assessment for Central Asia and Caucasus Desk Study Review', UNISDR/ The World Bank.*
[45] *The Ministry of Agriculture and Environmental Protection of Turkmenistan - https://minagri.gov.tm/en*
[46] *Kurtovezov G.D. (2019). Regional Diagnostic Report on Water Sector Development in Central Asia and Afghanistan. Turkmenistan. Regional Environmental Center of Central Asia. Smart Waters.*

The Red Crescent Society of Turkmenistan is a humanitarian organization that provides needs-based services to the most vulnerable communities. The organisation works in line with the National Society Strategy for 2007-2010 and in close collaboration with the State Commission on Emergency Situations; its chairperson is also a member of the State Emergency Management Commission under the Cabinet of Ministers. With the International Federation of the Red Cross and Red Crescent Societies, the organisation, amongst other things, aims to bolster recovery from disaster events, reduce the vulnerability of people in hazard-prone areas, and strengthen the capacity of the national society in disaster preparedness and response. However, there is still a need to develop the skills of the disaster response teams and ensure they have the relevant tools for a more effective disaster response.[47]

Sectoral policies and programmes are further contributing to disaster risk reduction efforts in the country. The Ministry of Education of Turkmenistan in partnership with UNICEF for instance has developed an educational program designed for preschool education. The Disability Inclusive Disaster Risk Reduction (DiDRR), adapted for the needs of Turkmenistan, enables the education of children, including those with disabilities, on safe ways to prepare for and respond to disaster events.[48]

Guided by the UN Framework for the Immediate Socio-Economic Response to COVID-19, the Government of Turkmenistan also developed an immediate socio-economic response plan (SERP) to acute infectious disease pandemic.[49]

Turkmenistan's sectors most vulnerable to climate change are water resources and agriculture. Since 1999, the government has been working to take actions against climate change. In 2000, the country submitted its Initial National Communication on Climate Change. In 2010, the Second National Communication was published which sought to expand on the activities related to addressing the problems of climate change. A Third National Communication was published in 2015. The country's position is reflected in the number of state programs currently under implementation, specifically the Strategy of Socio-economic Development of Turkmenistan Until 2030 and the National Climate Change Strategy of Turkmenistan.[50] Adaptation is a key feature of the latter, implemented through the National Action Plans for Adaptation and Mitigation, and will be an integral part of plans for socioeconomic development.[51]

The National Climate Change Strategy, implemented through the National Action Plan, aims to optimize agricultural facilities and research on drought resistant and salt resistant crops; improve water management and strengthen international cooperation on conservation; develop preventative programs to reduce the adverse effects of climate change on pollution and health; fight soil salinization and desertification; and adopt a law on pastures to prevent degradation of pastures.[52] The Strategy also outlines courses of action concerning electrical energy, oil and gas, transport, tourism, economic upturn, greenhouse gas emissions, and natural climatic conditions. As Turkmenistan is rich in energy resources, the country is keen on using environmentally safe and energy saving technologies in the most damaging industries in the economy.[53]

Turkmenistan has presented its Intended Nationally Determined Contributions (INDCs), a non-obligatory scheme reflecting the country's willingness to reduce or restrain its greenhouse gas emissions. The country has committed to reduce its emissions by designing a low-carbon development policy[54] and by supporting development and implementation of new technologies.

[47] (2011) 'Revised Plan 2011. Turkmenistan', International Federation of Red Cross and Red Crescent Societies.
[48] UNICEF (2017) 'Inclusive disaster risk reduction education for more resilient children'.
[49] (2020) 'Immediate Socio-Economic Response Plan to Acute Infectious Disease Pandemic: Turkmenistan', United Nations, Turkmenistan.
[50] Ministry of Nature Protection of Turkmenistan (2015) 'Third National Communication of Turkmenistan Under the United Nations Framework Convention on Climate Change (UNFCCC)'.
[51] (2015) 'Intended Nationally Determined Contribution of Turkmenistan in accordance with the decision 1/CP.20 UNFCCC'.
[52] Government of Turkmenistan (2015) 'Ashgabat Declaration'.
[53] Ministry of Nature Protection of Turkmenistan (2015) 'Third National Communication of Turkmenistan Under the United Nations Framework Convention on Climate Change (UNFCCC)'.
[54] (2015) 'Intended Nationally Determined Contribution of Turkmenistan in accordance with the decision 1/CP.20 UNFCCC'.

In 2016, integration of the Sustainable Development Goals (SDGs) into national programmes began as the country adopted the 2030 Agenda by the Government of Turkmenistan. Through seventeen national consultations, the government defined the SDGs that were applicable to them and integrated them into their development plans (it was discovered that 84% of the SDG targets corresponded with existing policies in Turkmenistan). In 2019, a 7-year action plan was put in place to achieve sustainable development. The Programme of the President of Turkmenistan for Social and Economic Development set targets that are relevant to the 17 SDGs. Turkmenistan already has a strong social policy in place, particularly in health and education,[55] but still needs to improve its policies to provide finance for development. Whilst the country has its own public finance system, it needs to supplement this with international assistance.[56]

In 2020, the Sustainable Development Cooperation Framework between the Government of Turkmenistan and the United Nations was agreed upon. The framework will support the government's policy implementation and, specifically, will assist in strengthening climate adaptation and mitigation measures and enhancing disaster risk reduction, preparedness and response. It will also support the country in its ambition to strive for a more rational use of natural resources which are becoming increasingly scarce. Turkmenistan has potential to achieve its SDG goals but challenges, such as its landlocked status, water and land resource management, and climate change adaptation, require greater investment in human capital and governance, a diversified economic base, and urgent action in relation to climate change.[57]

[55] (2019) 'Voluntary National Review of Turkmenistan Empowering people and ensuring inclusiveness and equality', Sustainable Development Goals.
[56] (2019) 'Voluntary National Review of Turkmenistan Empowering people and ensuring inclusiveness and equality', Sustainable Development Goals.
[57] (2020) 'Sustainable Development Cooperation Framework between the Government of Turkmenistan and United Nations', United Nations, Turkmenistan.

Protection Gap

The protection gap is traditionally defined as the proportion of losses from disaster events that are not insured. Identifying the level of risk which has not been reduced (through risk reduction investment) or transferred (through risk financing) is to identify the contingent liability that will need to be met in the event of a disaster. This is important for the design of risk management and arrangement of risk financing: identifying the protection gap informs on where financing is most needed. Table 10 provides the details underpinning this assessment for Turkmenistan.

Table 10: Key Protection Gap indicators

AAL as % of GNI[58]	0.18%	
Un-funded AAL, ($m, %)	N/A	
Average annual human losses from flood and earthquakes	Flood	EQ
	173	7
Event frequency where direct & indirect loss and damage, less (assumed) insured losses, exceed existing ex-ante risk retention	Flood	EQ
	N/A	N/A
Event frequency where direct damage, less (assumed) insured losses, exceed existing ex-ante risk retention	Flood	EQ
	N/A	N/A
Event frequency where estimated emergency response costs exceed current risk retention mechanisms	Flood	EQ
	N/A	N/A
Macro-economic context and ability for sovereign to borrow	Limited access to intl' debt markets	
Ability of individual and households to access resources after an event	Growing financial inclusion but still lower other countries in region.	

Source: Consultant team modelling

[58] GNI data (in current international $) used to take account of the importance of remittances in many parts of the CAREC region. GNI data taken from World Development Indicators. GDP used for Inner Mongolia and Xinjiang where province level GNI data is not available drawing from press reports.

Compared to earthquake risk, flood risk results in significantly greater losses in Turkmenistan. The average annual loss (AAL) associated with flood risk is around $140 million, whereas the loss associated with earthquakes is only $11 million. The total AAL from both perils of around $151 million ($227 million with indirect costs) is equivalent to around 0.18% of GNI, which is the median across all CAREC countries.

Disaster risk financing in Turkmenistan is sourced through ministries, agencies, organisations, national and local budgets, and insurance funds. Local governments provide financing first then national funds are provided if they are sufficient. An Emergency Reserve Fund is also available to use post disaster; these funds are allocated by the State Committee on Emergency Situations of Turkmenistan under the country's president. These allocations can be changed if permission is given by the Ministry of Finance and Economy. There is borrowing potential from the Central Bank of Turkmenistan to the Cabinet of Ministers through the Ministry of Finance and Economy. There are also insurance providers who offer cover for agriculture, mortgages, and multi-peril private property insurance.[59]

In terms of ex-ante risk finance instruments, Turkmenistan relies on contingency reserves to support disaster risk response and recovery. However, it has not been possible to identify the resources that might be available in these funds. The insurance penetration rate in Turkmenistan, at 0.72% of GDP in 2019, appears to be relatively high compared to other countries in the region, but this may reflect the monopoly position of the State Insurance Organization of Turkmenistan. In the absence of information on the amount of resources in the reserve funds in Turkmenistan, it is not possible to provide a quantified assessment of the protection gap comparable to that provided to other countries.

Overall, there is limited data available on the disaster risk financing arrangements in place in the country. There are both local and national reserve funds, whose resources lapse at the end of each year, but the financial resources they provide the government in the event of a disaster is unclear.[60]

Most personal property remains uninsured in Turkmenistan due to the lack of ability to pay premiums and the perception that insurance is linked to low income. Whilst homeowners' policies do exist, the company providing them does not monitor its catastrophe risk accumulations. This coupled with limited actuarial skills to price catastrophe risk properly means that the company would struggle with payment claims should a major earthquake occur.[61]

The broader fiscal position of Turkmenistan is also unclear although the IMF estimates that the public debt has grown over the last five years but remains sustainable. However, the limited data on the country's fiscal position of the country limits access to international capital markets.

[59] (2019) 'Forum on Financial Protection against Natural Disasters in Central Asia Proceedings', The World Bank/ GFDRR.
[60] World Bank (2019) Forum on Financial Protection against Natural Disasters in Central Asia: Proceedings. http://documents1.worldbank.org/curated/en/820381574227673469/pdf/Forum-on-Financial-Protection-Against-Natural-Disasters-in-Central-Asia-Proceedings.pdf
[61] Gurenko E. and Dumitru D. (nd) 'Mitigating the Adverse Financial Effects of Natural Hazards on the Economies of Central Asia. A Study of Catastrophe Risk Financing Options', Europe and Central Asia Region of the World Bank/ UNISDR Europe and Central Asia.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