COUNTRY RISK PROFILE **MONGOLIA**

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

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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
DRR	Disaster Risk Reduction
EP	Exceedance Probability
GEM	Global Earthquake Model Foundation
IPCC	Intergovernmental Panel on Climate Change
JBA	Jeremy Benn Associates
NEMA	National Emergency Management Agency
PRC	People's Republic of China
RCP	Representative Concentration Pathway
TA	Technical Assistance

Currency

Currency Unit	United States Dollar/s ($)

List of figures and tables

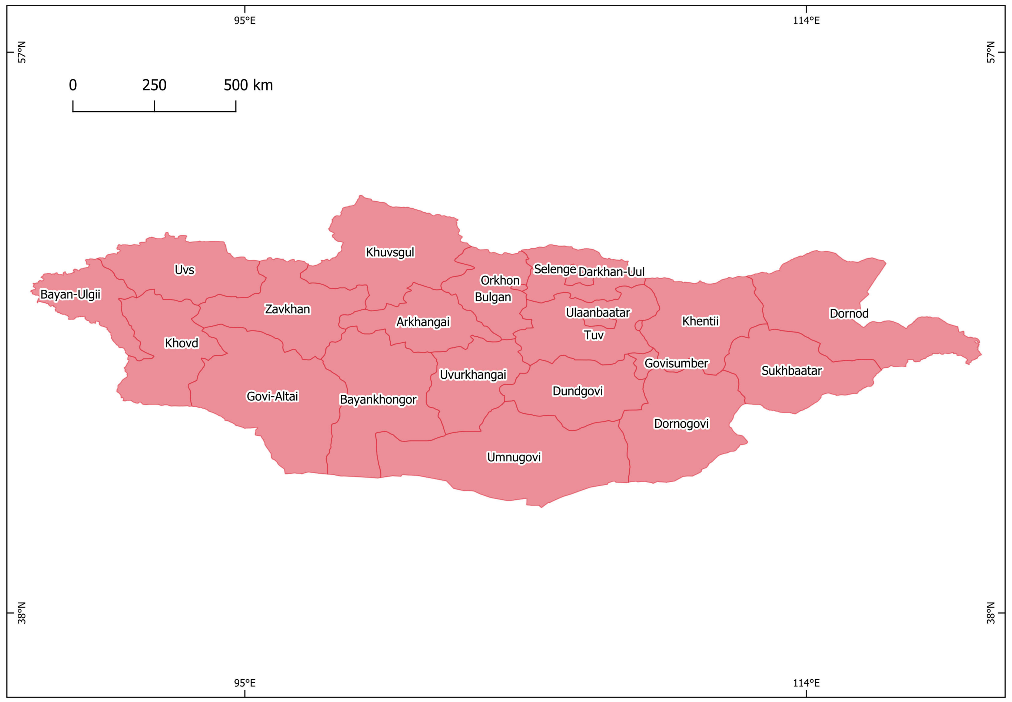
Profile summary

Landlocked between the Russian Federation in the North, and People's Republic of China in the South, Mongolia is the least densely populated sovereign country globally with a population of over 3.2 million spread over 600,000 sq miles. The country is divided administratively into 21 aimags (provinces) and the municipality of Ulaanbaatar, which has independent administrative status.

Mongolia has three main physical features: the Mongolian plateau region of rolling grasslands (steppes) which covers almost two-thirds of central Mongolia; the highland mountain ranges in the North-East, West and South-West; and the Gobi Desert which dominates the southern third of Mongolia.

Mongolia is exposed to frequent flood events, especially in the Ulaanbaatar area. Average annual loss from floods is $24 million across Mongolia with average annual fatalities (AAF) estimated at 92.

Figure 1: Provinces of Mongolia



Seismicity in Mongolia accumulates in the central and western part of the country where numerous active fault structures have been detected. Average annual loss due to earthquakes in Mongolia is estimated at $0.6 million, with Ulaanbaatar accounting for almost two-thirds. Due to low exposure and vulnerability in the areas of the country with moderate seismic hazard, average annual fatalities nationally are modeled at 1.

Historic events further demonstrate that flooding drives the majority of economic loss in Mongolia. The 1996 Ulaanbaatar flooding is the most significant event recorded. If it were to happen today, there would be almost $200m in damages and over 270,000 people affected.

Value at risk is concentrated in Ulaanbaatar with little exposure elsewhere. At province level, the greatest damage from floods is modelled in the north

Box 1: Key facts

GDP: 13,852,000,000 (2019) | **Population: 3,225,000 (2019)**

1 IN 100 YEAR FLOOD ECONOMIC LOSS **$400,000,000**	1 IN 100 YEAR EARTHQUAKE LOSS **$7,700,000**	AVERAGE ANNUAL LOSS FLOOD **$24,000,000**	AVERAGE ANNUAL LOSS EARTHQUAKE **$600,000**
AVERAGE ANNUAL PEOPLE AFFECTED FLOOD **17,589**	AVERAGE ANNUAL PEOPLE AFFECTED EARTHQUAKE **4,210**	AVERAGE ANNUAL PEOPLE AFFECTED INFECTIOUS DISEASE **28,867**	
EVENT FREQUENCY WHERE FLOOD LOSS EXCEEDS EXISTING COVER **1 IN 10**	EVENT FREQUENCY WHERE EARTHQUAKE LOSS EXCEEDS EXISTING COVER **>1 IN 200**		

of the country, particularly in Darkhan-Uul, Selenge, Khuvsgul and Ulaanbaatar, where average annual loss is $2.5–3.5 million. In contrast, values below $200,000 are concentrated in southern Mongolia, where economic exposure is lowest. This is influenced by the distribution of precipitation in Mongolia, which is highest in the north of the country, whereas the south is typified by very low annual precipitation. The northern provinces also contain the Selenge River and its tributaries which flow northeast from the central mountains of Mongolia to the Russian border, and also the Kherlen River which flows east through towns in the northeast provinces.

Climate change scenario analysis indicates annual mean precipitation is projected to decrease slightly by −10 to −20% under both RCP4.5 and RCP8.5 for a vast majority of the country, including areas most exposed to flood risk. Decreases in 24-hr extreme precipitation intensities are also projected for these scenarios. Extreme event intensities are relevant for estimating future flood risk.

Mongolia is exposed to respiratory outbreaks, with a very low background risk to other pathogens. Respiratory pathogens 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 million people impacted, approximately one-third of the total population.

Mongolia has experienced rapid economic growth over the past 30 years, almost tripling its GDP per capita. However, the economy remains highly dependent on natural resources, which means growth can be volatile and reliant on global commodity prices.

Mongolia has a large number of policies and plans related to disaster risk reduction. Recent reviews indicate a need for streamlining, as currently responsibilities are overlapping and unclear. An overarching disaster risk financing strategy, which includes the assessment of disaster risk and promotion of disaster risk reduction, financing and insurance, is being designed with support from ADB. Financial provisions for disaster events are made through a budget to the National Emergency Management Agency (NEMA) and the two main national contingency funds. The government has specified that all government organizations should plan to spend 1% of their income on disaster related activities. However, due to lack of funds, Mongolia does not have a specific programme for disaster recovery and so is dependent on international aid for much of its disaster response funding.

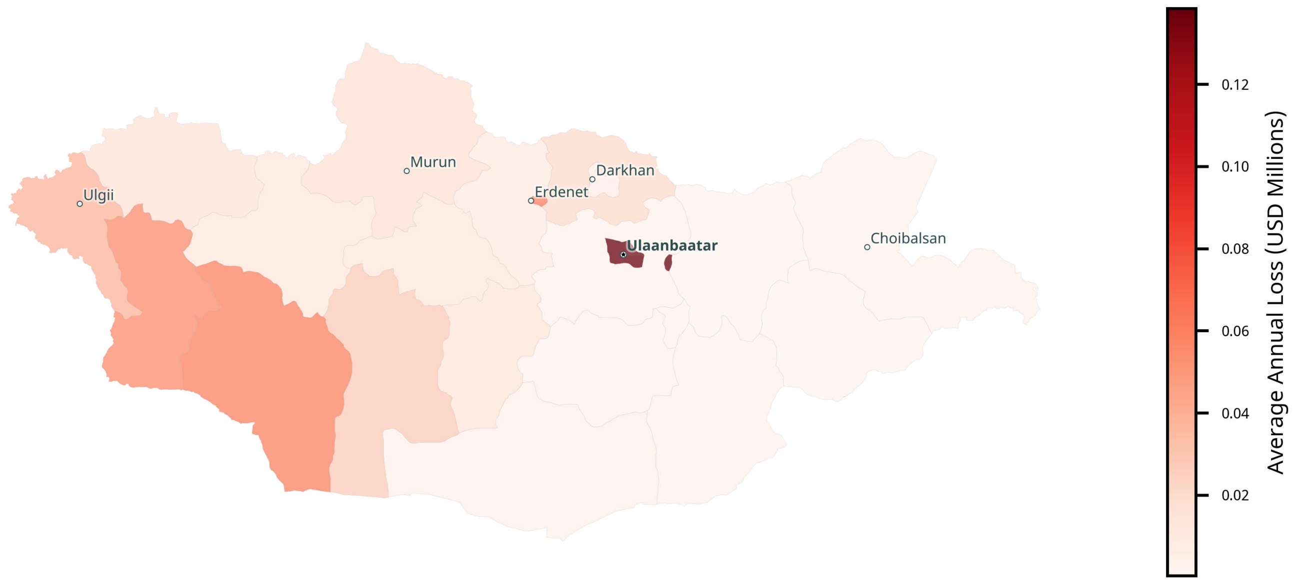
Risk analysis

The extent and geographic pattern of earthquake, flooding and infectious disease across Mongolia is revealed through probabilistic modelling. 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

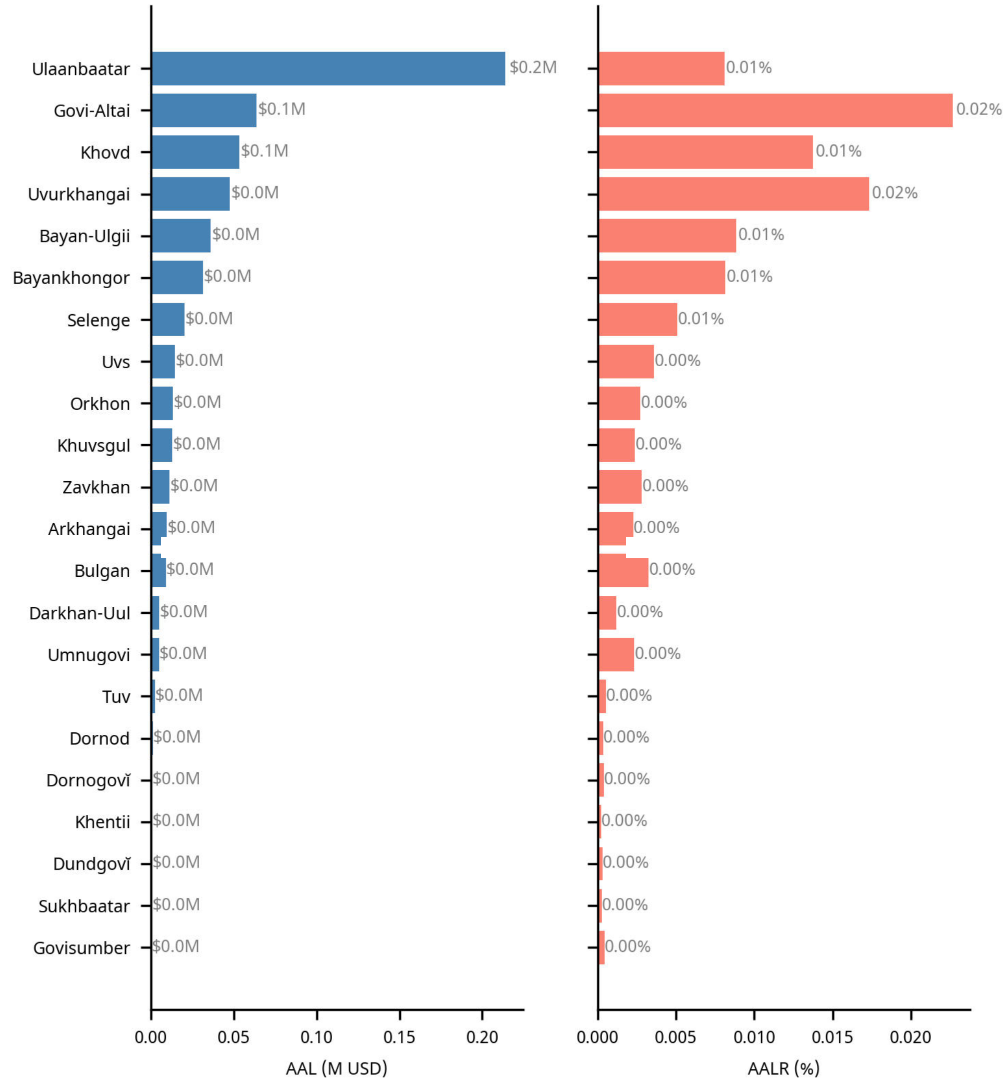
Figure 2 shows average annual loss (AAL) due to earthquakes in Mongolia. Total AAL is estimated at $0.6 million. Ulaanbaatar, which is home to more than half of the built asset value of Mongolia, has the highest AAL in the country at $0.2 million, followed by Govi-Altai and Khovd both at around $0.1 million. Govisumber and Sukhbaatar have the lowest AAL in thecountry.

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

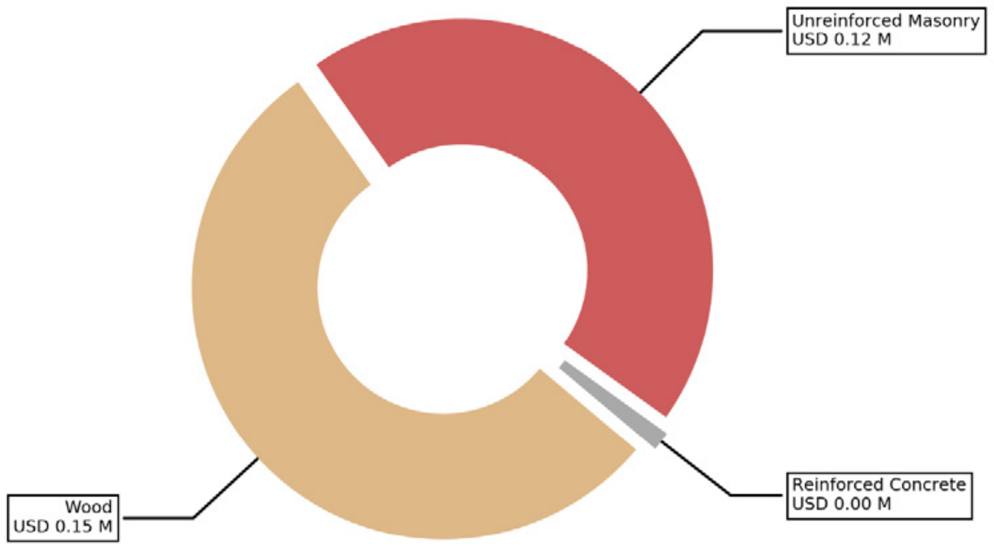
The average annual loss ratio (AALR) in each region is the AAL for the region normalized by the total exposed value of buildings in that region. The AALR represents the proportion of the replacement value of the building stock that is expected to be lost due to damage. As a normalized risk metric, the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

Figure 3 compares the AAL for the different regions of Mongolia (left) and also shows the AALR for each region, expressed as a percentage of the total replacement value of buildings in the respective regions. Looking at the relative risk, Govi-Altai is the region with the highest AALR, followed by Uvurkhangai.

Despite the moderate seismic hazard in Mongolia, the average annual loss expected due to earthquakes is exceptionally low in comparison to neighboring CAREC member countries. This is because the dominant form of construction in the areas with moderately high seismic hazard is the traditional *ger* housing, which suffers negligible damage during earthquakes.

While Ulaanbaatar does have a higher proportion of unreinforced masonry and reinforced concrete structures that are more vulnerable than the *gers*, the seismic hazard in and around Ulaanbaatar is low, resulting in a lowered risk estimate even in the capital city.

Figure 4: Average annual loss by asset types - earthquakes

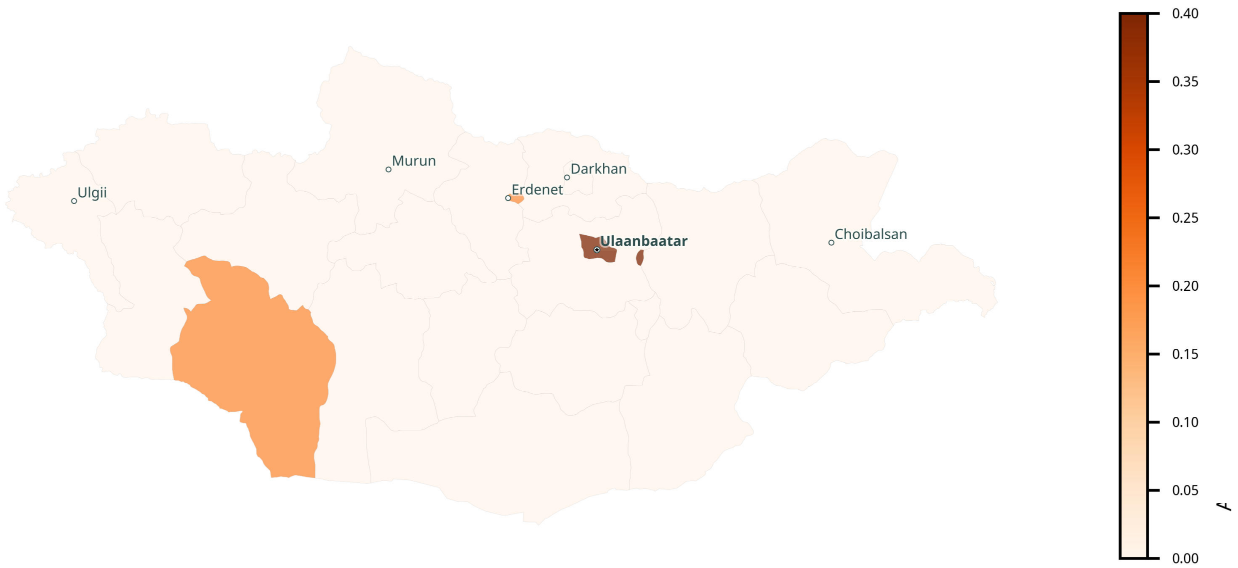


Source: Global Earthquake Model

Figure 4 shows the disaggregation of the AAL due to earthquakes by primary construction type in Mongolia. Gers and wood-frame housing structures contribute the most to the AAL at national level, at $0.15 million. Unreinforced masonry structures follow, with an AAL contribution of $0.12 million.

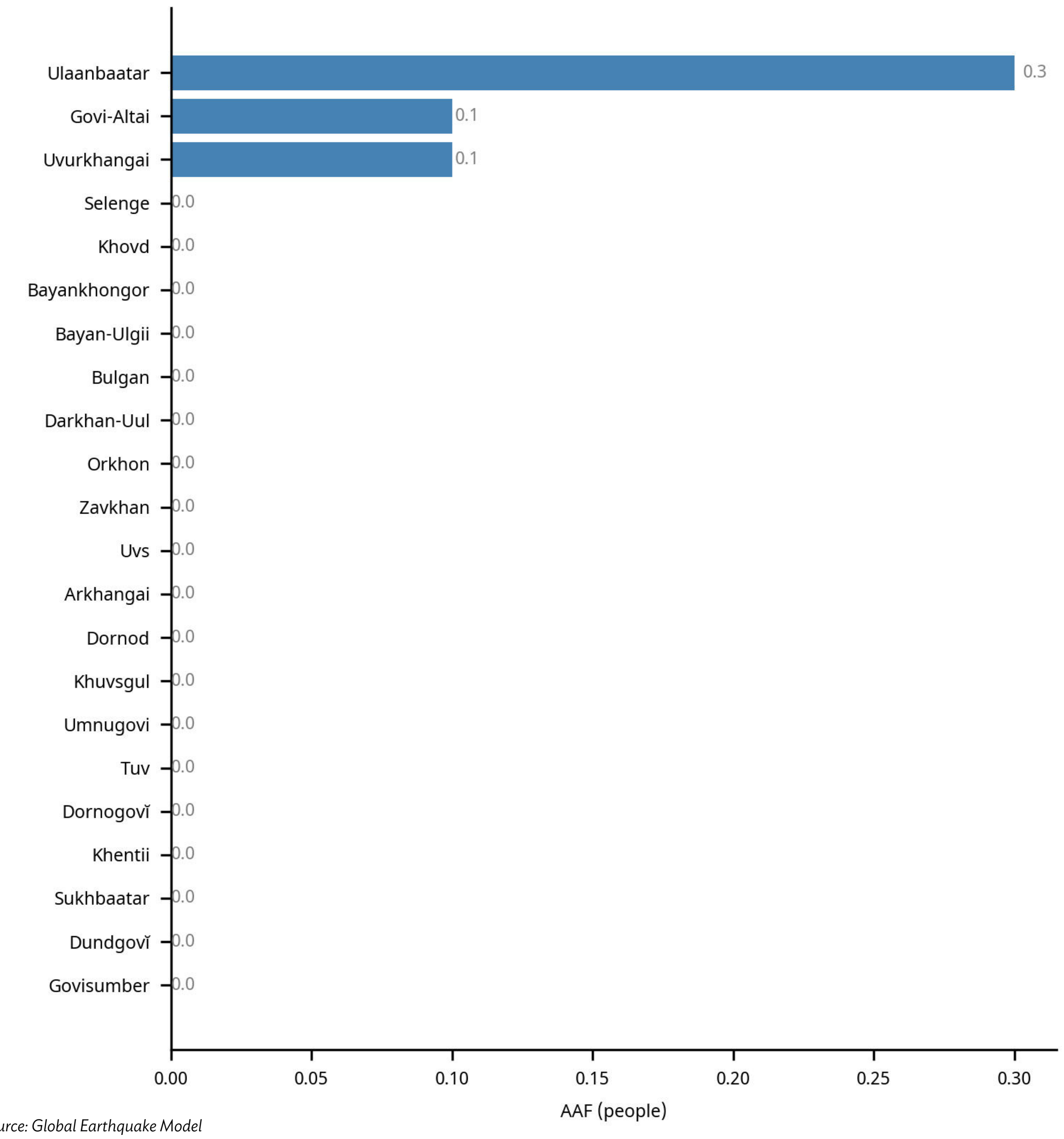
The average annual fatalities (AAF) from earthquakes, shown in Figure 5, is less than 1 person. This number is the lowest amongst CAREC member countries. Reasons for the low expected AAF are similar to those described previously with regards to the AAL – low exposure and vulnerability in the parts

Figure 5: Average annual fatalities - earthquake



Source: Global Earthquake Model

Figure 6: Breakdown of earthquake average annual fatalities by region



Source: Global Earthquake Model

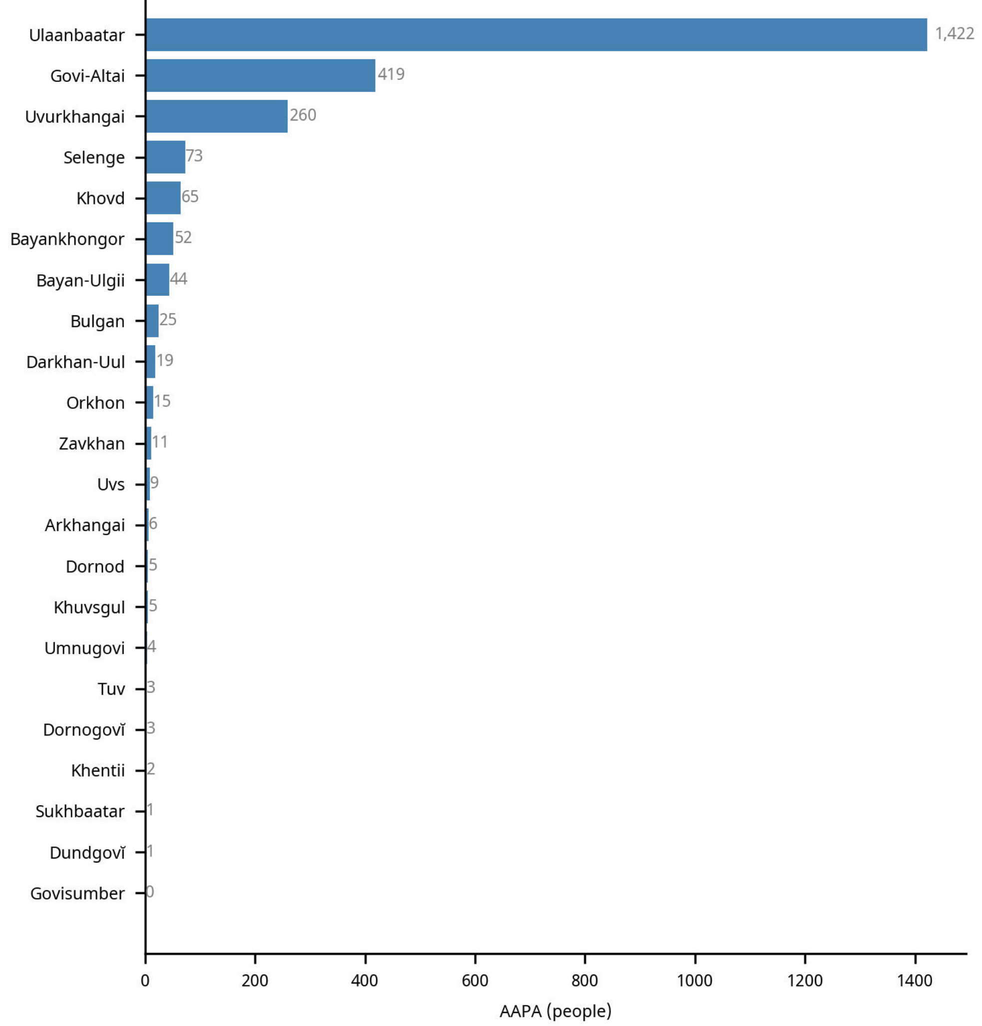
of the country with moderate seismic hazard, and low seismic hazard in and around Ulaanbaatar which contains the more vulnerable buildings.

Figure 6 provides the breakdown of fatalities at the province level. Ulaanbaatar has the highest AAF at 0.3 persons, followed by Orkhon and Govi-Altai at around 0.1 persons. AAF values in the remaining provinces are negligibly low.

Figure 7: Average number of people affected – earthquake

Source: JBA Risk Management

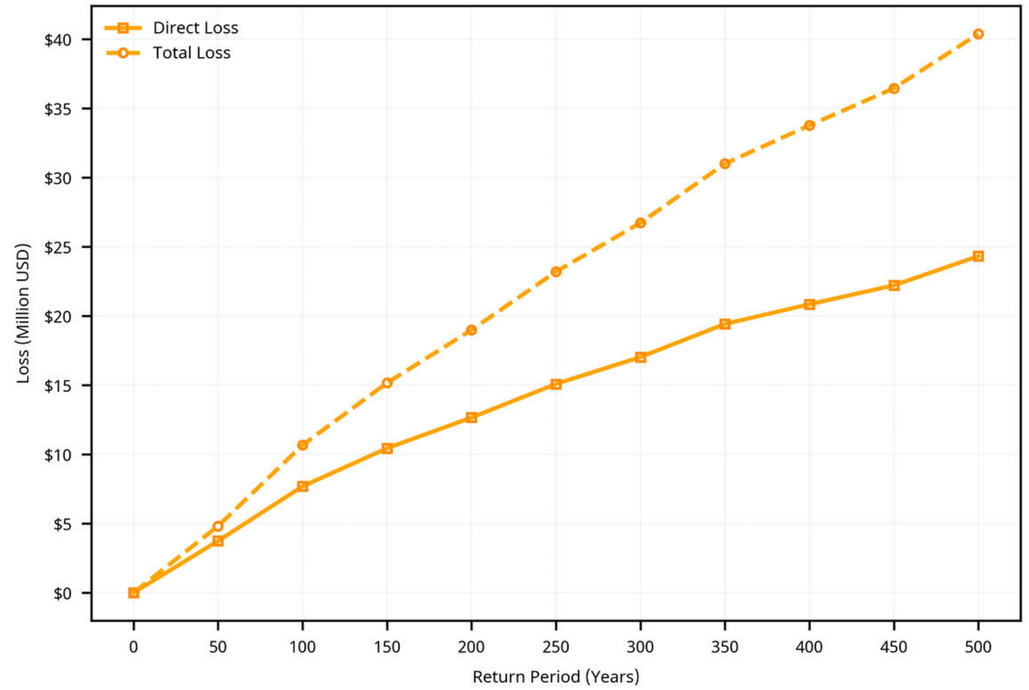
Figure 8: Breakdown of average annual number of people affected by region - earthquake



Source: Global Earthquake Model

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 provides a geographical view on the people affected by earthquakes and Figure 8 provides a numerical breakdown per region. An average of 2,445 peopleare estimated to be affected annually by earthquakesin Mongolia. Ulaanbaatar has the highest average annual number of people affected in the country at 1,422, followed by Govi-Altai and Uvurkhangai at 419 and 260 respectively.

Figure 9: Exceedance probability curves – earthquake



Source: Global Earthquake Model

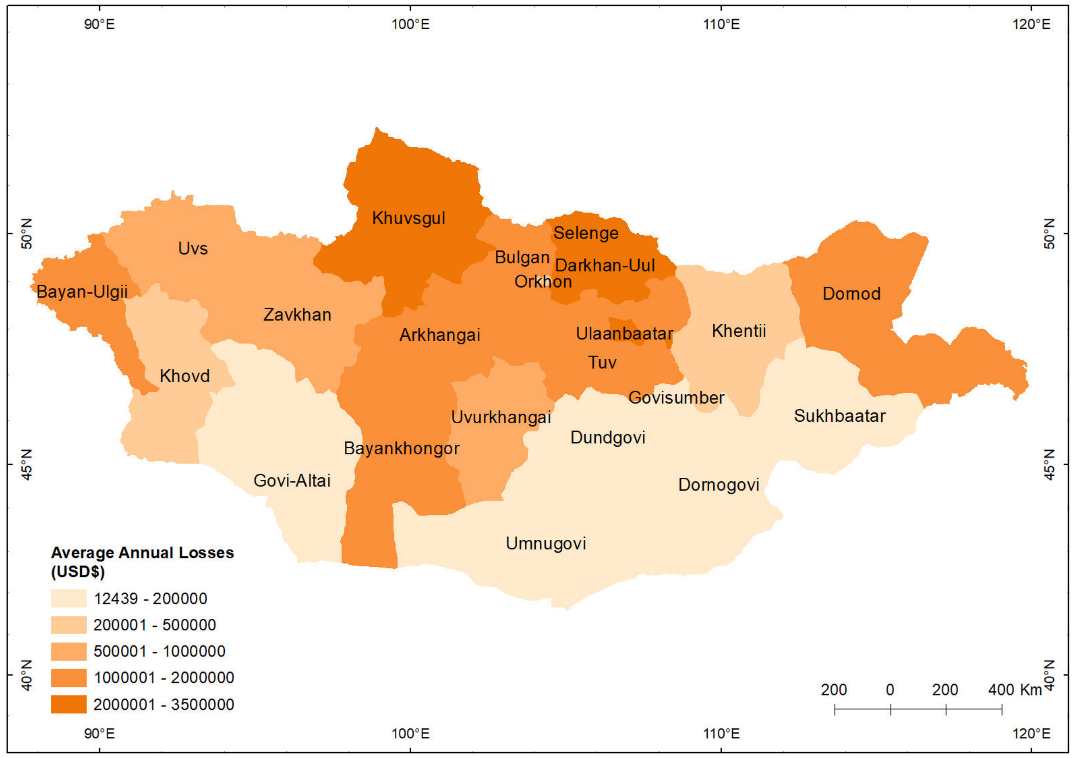
The exceedance probability curve in Figure 9 shows the total loss from all events in any given year. Curves are modeled for both direct and total loss. Direct loss displays the modeled loss to residential, industrial and commercial assets. Total loss accounts for secondary impacts from the onset of disaster events, accounting for the reconstruction time

Direct loss increases from $3.7 million for the 50-year return period, to $24.3 million for the 500-year return period. Direct loss is modelled at $7.7 million at the 100-year return period for Mongolia, which is approximately 0.05% of the country's nominal GDP. The EP curves for both direct and total loss accumulate reasonably slowly, underlining the limited nature of earthquake risk, even for extreme events.

Flood risk

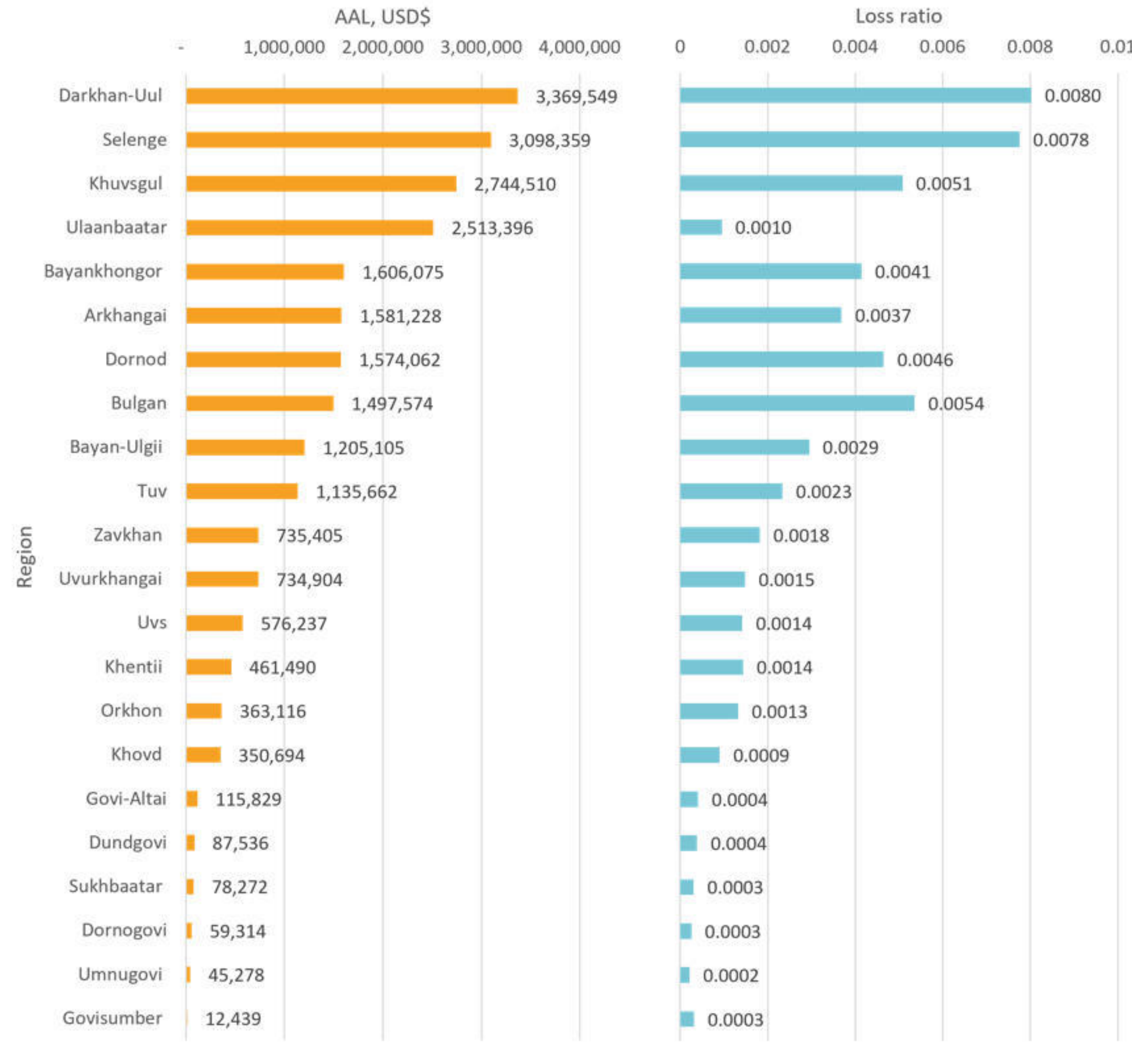
Average annual loss (AAL) from floods is $24 million across Mongolia. At province level, as shown in Figure 10 and Figure 11, the greatest loss is modelled in the north of the country, particularly in Darkhan-Uul, Selenge, Khuvsgul and Ulaanbaatar, where AAL is $2.5–3.5 million. In contrast, AAL values below $200,000 are concentrated in southern Mongolia, where economic exposure is lowest.

Figure 10: Average annual loss – flood



Source: JBA Risk Management

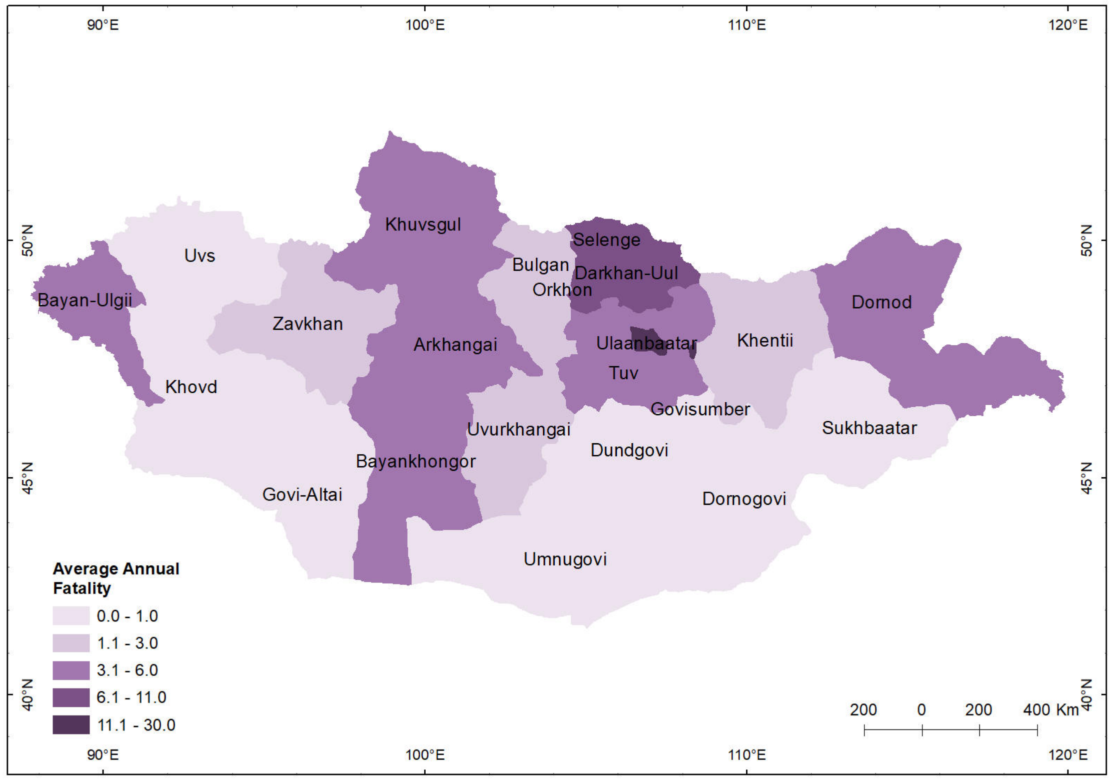
Figure 11: Breakdown of average annual loss and loss ratio by region - flood



Source: JBA Risk Management

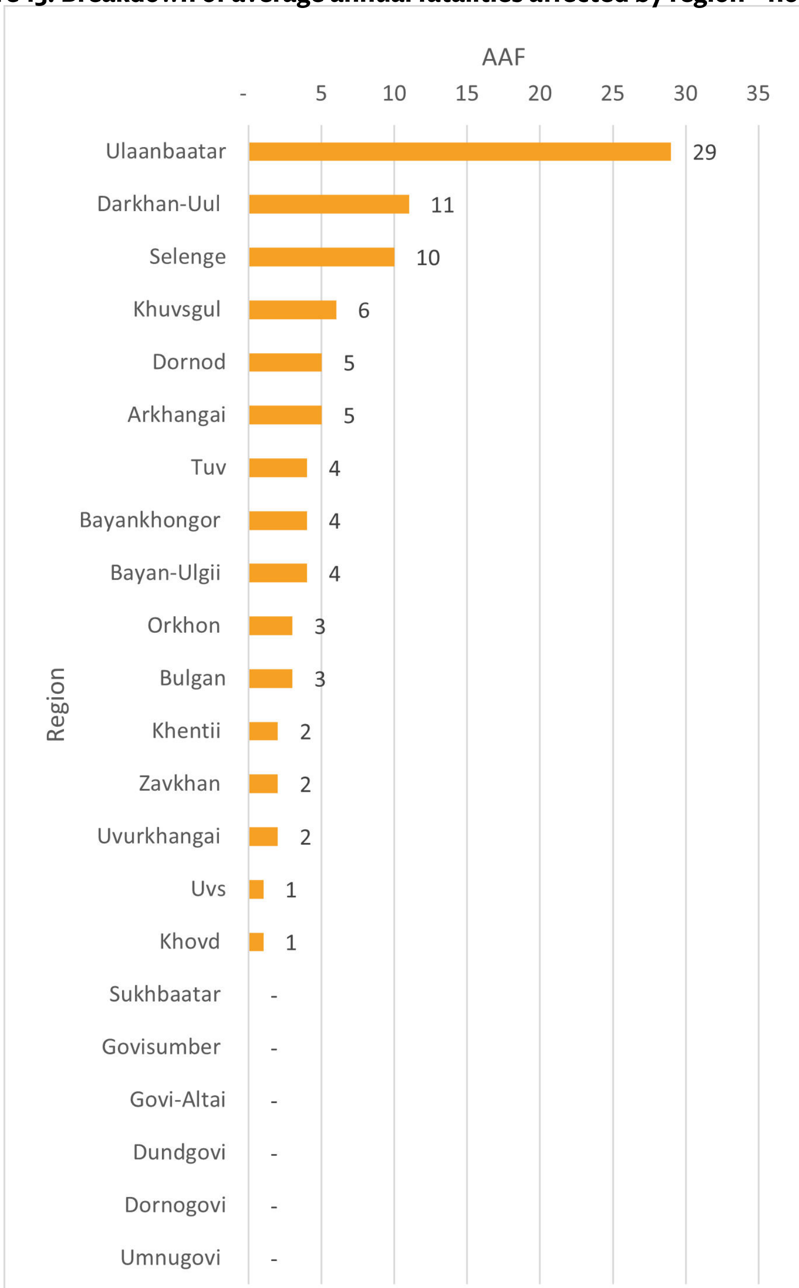
The greatest damage ratios are also located in Darkhan-Uul and Selenge at 0.008 and 0.0078 respectively, while those with the lowest ratiosare found in the south (such as Umnugovi and Govisumber). This dichotomy is influenced by the distribution of precipitation in Mongolia, which is highest in the north of the country and very low in the south. The northern provinces also contain the Selenge River and its tributaries which flow northeast from the central mountains of Mongolia to the Russian border, and the Kherlen River which flows east through towns in the northeast provinces.

Figure 12: Average annual fatalities – flood



Source: JBA Risk Management

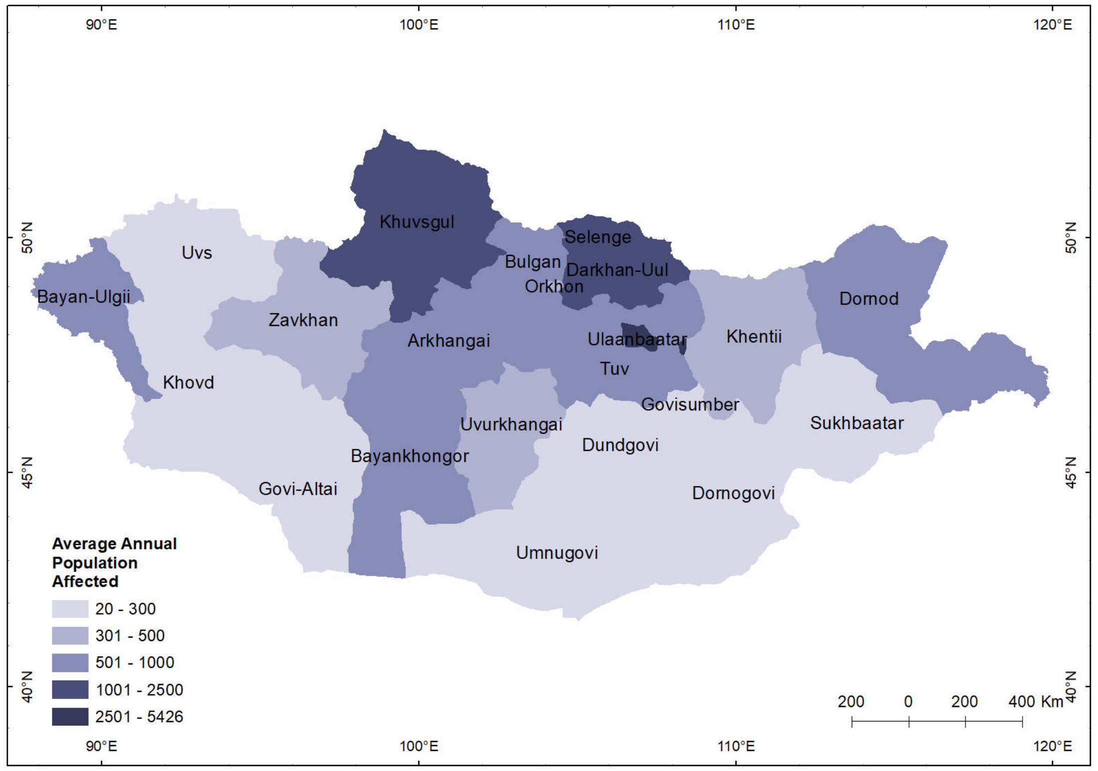
Figure 13: Breakdown of average annual fatalities affected by region - flood



Source: JBA Risk Management

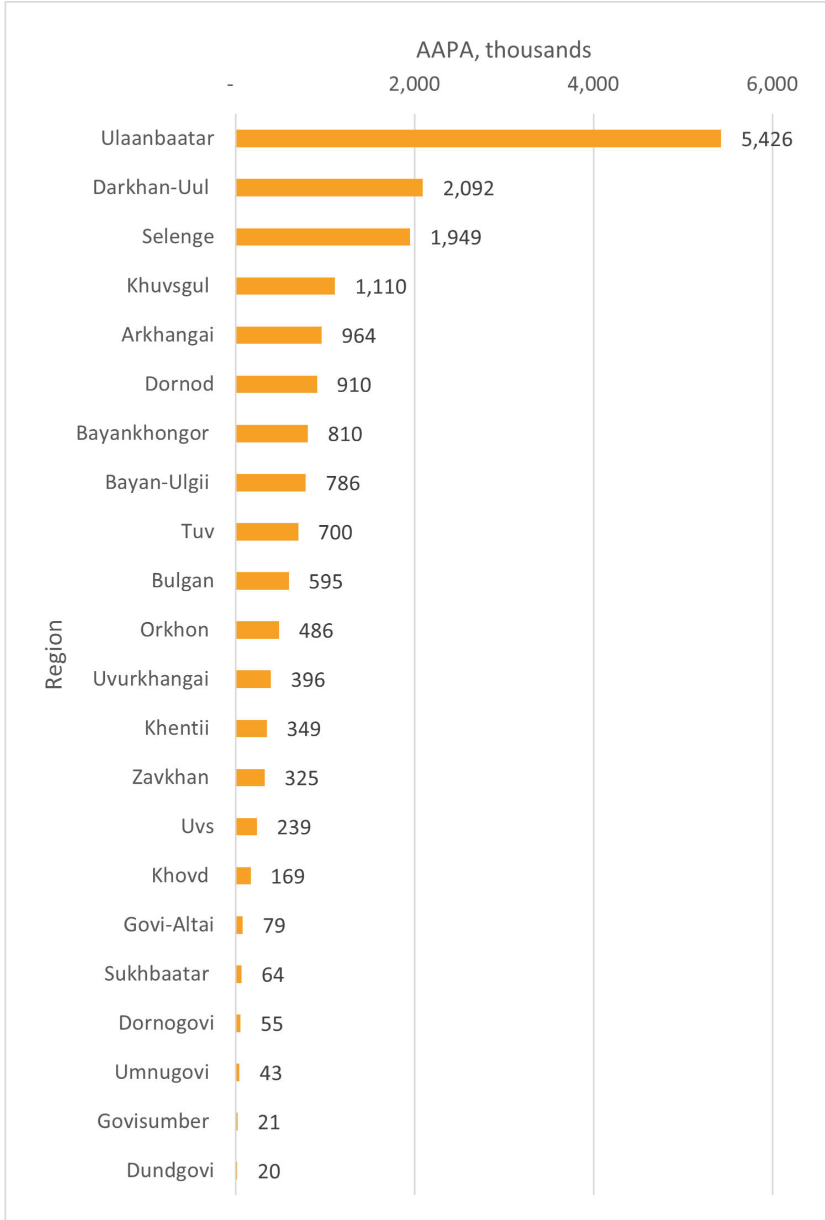
Average annual fatalities (AAF) from floods are estimated at 92 in Mongolia. Figure 13 shows that the provinces with highest AAF values are Ulaanbaatar, Darkhan-Uul, and Selenge which are in northern Mongolia (shown in Figure 12). These provinceshave the three largest populations within Mongolia, which is particularly concentrated in Ulaanbaatar where the population is 1.9 million. The higher value of AAF from floods in northern Mongolia is also influenced by higher rates of annual precipitation and the location of the Tuul River, which flows through Ulaanbaatar.

Figure 14: Average annual people affected – flood



Source: JBA Risk Management

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

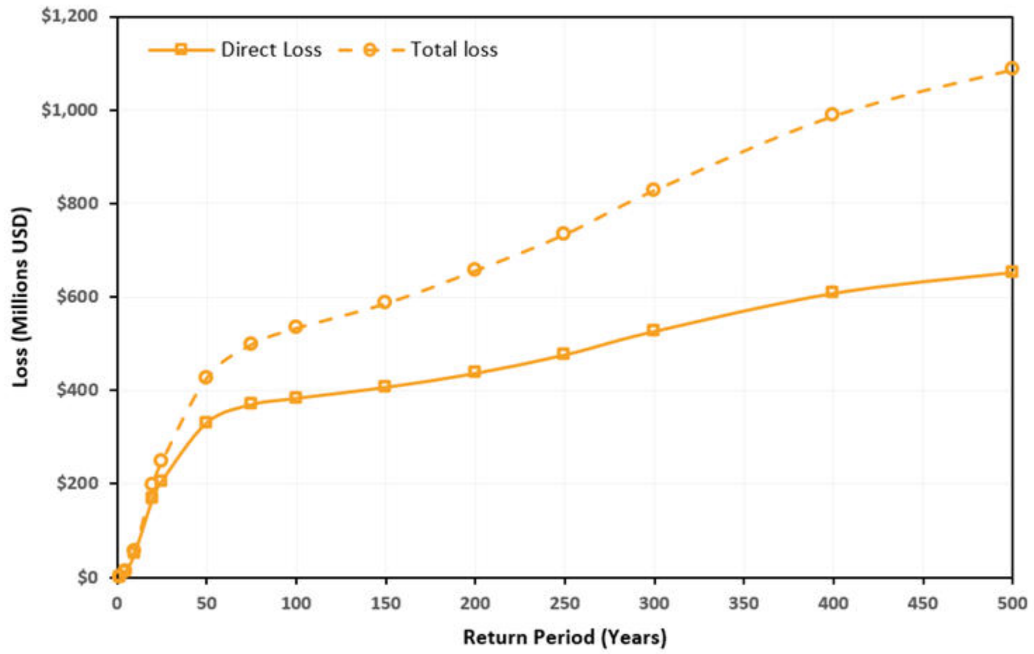


Source: JBA Risk Management

Average annual people affected (AAPA) by flood across Mongolia is 17,589. Ulaanbaatar and northern provinces including Darkhan-Uul and Selenge have the highest AAPAs as shown in Figure 14 and Figure 15. In the south, where province level populations are below 50,000, AAPA is below 100. The Tuul River, which flows through the most populated area in Ulaanbaatar, is a contributing factor to the higher AAPA in the northern provinces.

Risk analysis

Figure 16: Exceedance probability curves – floods



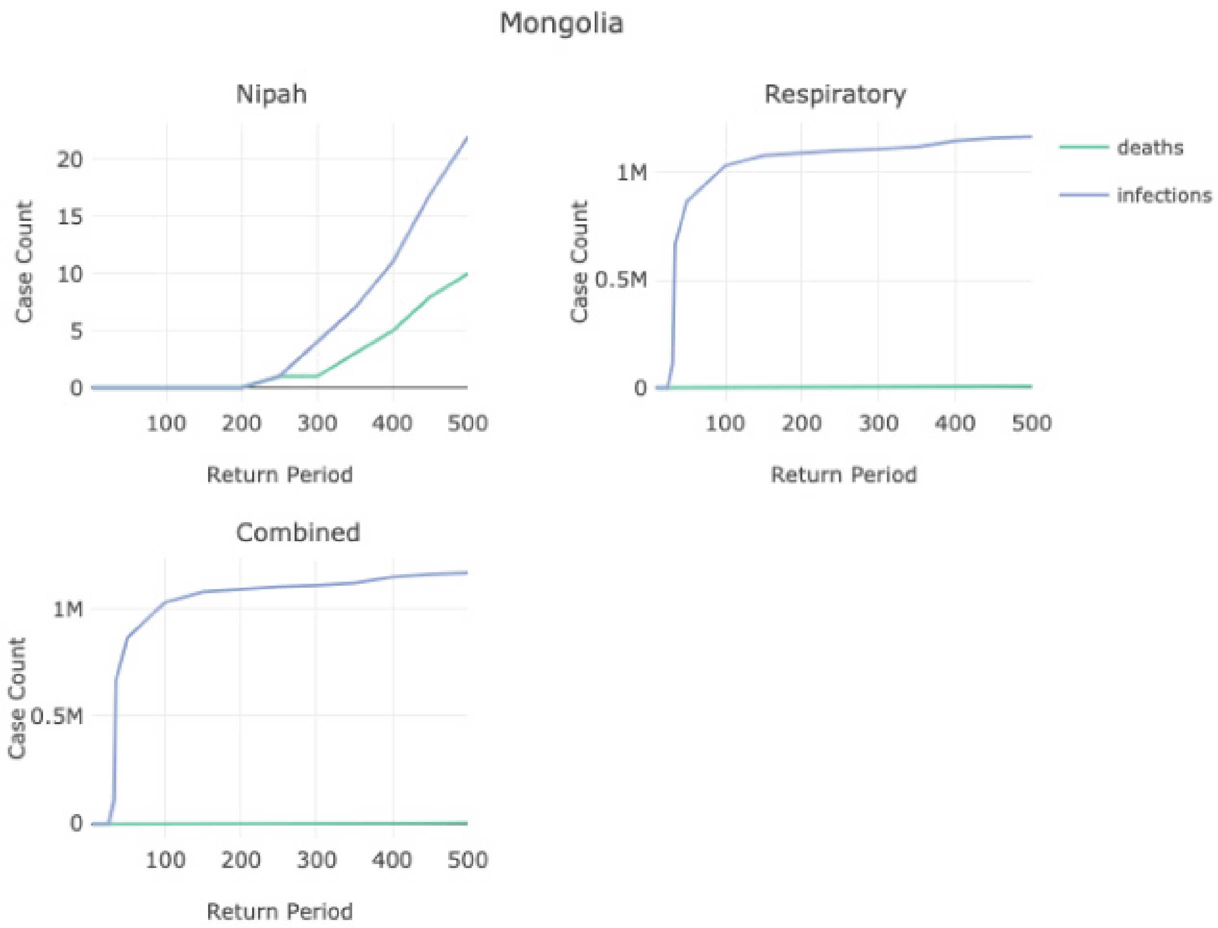
Source: JBA Risk Management.

The exceedance probability curve shown in Figure 16 gives the total losses from flood events in any given year. Loss increases initially between the 2 to 50-year return periods, before increasing at a much slower rate between the 50 to 150-year return periods. This underlines the importance of risk reduction for floods up to a 1-in-50-year, given the potential for loss to accumulate rapidly.

At the 100-year return period, direct loss is nearly $400 million in Mongolia, which is around 2.8% of the country's nominal GDP. Direct loss increases more slowly from 150 to 500-year return periods. Total loss follows a similar pattern as direct loss. At the 100-year return period total loss is just over $530 million. Total loss increases significantly beyond the 100-year return period and at a faster rate than direct loss.

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
**Note that the graph for CCHF was omitted due to low risk in this country.*

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	28,867	67
Respiratory	28,867	67
Nipah	<1	<1
CCHF	<1	<1

Source: Metabiota

The modelled exceedance probability (EP) curves include only those infections and deaths which 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 modeled as part of this analysis.

The pathogen EP curves for Mongolia in Figure 17 highlight that respiratory pathogens account for the majority of epidemic risk. The respiratory pathogens EP curve climbs rapidly and steeply. This is due to the fact that 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. There is no CCHF EP curve shown for Mongolia as the risk is extremely low. Table 1 provides the AAL numbers on people impacted and fatalities.

Box 2: Pathogens

- 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 and 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]

[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*

Historical losses and impacts

Mongolia has experienced frequent flooding, especially in Ulaanbaatar. Between 1990 and 2019, this has affected between 14,000 and 25,000 people, causing close to 100 deaths and resulting in an estimated half a million dollar in economic losses as highlighted in Table 2.

Cold waves, severe winter conditions and winter storms known as dzud, are also common in Mongolia and have cumulatively impacted over 4 million people between 1990 and 2019.[3] Significant earthquakes in turn are rare, with the last severe event occurring in 1957.[4]

Table 3 provides a view of some of the most impactful events in Mongolia. One of the largest floods in Mongolia was in 1966 when 103.5mm of rainfall fell in just 2 days, the equivalent of 43% of total expected annual precipitation. The flooding left an estimated 4,000 families homeless and caused $.75m (300m togrogs) in losses at the time from floods. The Flood Risk Management Strategy adopted by the Municipality of Ulaanbaatar in 2015 estimates that a flood of the size of the 1966 event would cause the city over $80 million in economic losses if it were to happen again, given increases in exposure.

Table 2:Total impacts from floods, earthquakes and droughts, 1990 – 2019

	Fatalities	Number of people affected	Total damage ($ million; constant 2019)
Flood	80 – 104	13,875 – 25,451	0.46 - 80.375
Earthquake	-	-	-
Drought	-	450,000	-

Source: EM-DAT with validation from other sources including Swiss Re, ReliefWeb, World Bank for floods; National Geophysical Data Center / World Data Service (NGDC/WDS): NCEI/WDS Global Significant Earthquake Database. NOAA National Centers for Environmental Information.

[3] Centre for Research on the Epidemiology of Disasters – CRED. EM-DAT. (https://www.emdat.be/)
[4] National Geophysical Data Center / World Data Service (NGDC/WDS) (2020) NCEI/WDS Global Significant Earthquake Database. NOAA National Centers for Environmental Information (https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.ngdc.mgg.hazards:G012153)

Floods in August 1982 resulted from intense summer rainfall (44mm in 20 minutes), creating flash flooding in 42 dry riverbeds.[5] Floods in 2003 led to 15 deaths, 93 houses destroyed, and economic losses of around $270,000.[6] In the 2009 floods, at least 1,975 families were affected, with 1,000 gers (residential housing) swept away by the flood waters.[7]

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

Year	Location	Total damage ($ millions; constant 2019)	Fatalities	Number of people affected
Floods				
1966	Ulaanbaatar	59.1 – 196.9	57 – 130	270,000
2003	Bulgan, Teshig, Mogod districts (Bulgan province), Bayangol, Chingeltei, Sukhbaatar, Songinokhairkhan, Bayanzurkh districts (Ulaanbaatar city), Tsogt-Ovoo district (Umnugovi province), Khalkhgol district (Dornod province), Orkhontuul district (Selenge province), Tseel, Erdene districts (Tuv province), Govi-Altai, Bayankhongor provinces	0.3 – 0.4	15 – 20	1,650
2009	Bayanzurkh, Khan-Uul districts (Ulaanbaatar city), Tseel, Tugrug districts (Govi-Altai province), Dundgovi and Tuv provinces	0.1	26	15,000
1996	Ulaanbaatar		41	
2019	Bayanzurkh, Khan-Uul districts (Ulaanbaatar city), Tseel, Tugrug districts (Govi-Altai province), Dundgovi and Tuv provinces		12	500
1994	Bayangol, Chingeltei, Sukhbaatar, Songinokhairkhan, Bayanzurkh districts (Ulaanbaatar city), Bulgan, Teshig, Mogod districts (Bulgan province), Tsogt-Ovoo district (Umnugovi province), Khalkhgol district (Dornod province), Orkhontuul district (Selenge province), Tseel, Erdene districts (Tuv province), Govi-Altai, Bayankhongor provinces		5	
2018	Ulaanbaatar; Tuv province			8,301
Earthquakes				
1957	Altai		30 – 1,200	

Source: EM-DAT with validation from other sources including Asian Disaster Reduction Center (ADRC), ReliefWeb, IFRC and UN OCHA for floods; National Geophysical Data Center / World Data Service (NGDC/WDS): NCEI/WDS Global Significant Earthquake Database. NOAA National Centers for Environmental Information.

[5] Oyanbaatar, D. (n.d.) Floods in Mongolia http://raise.suiri.tsukuba.ac.jp/IWSTCM2006/19Oyunbaatar.pdf; https://www.restec.or.jp/geoss_ap3/pdf/day2/WG/WG2/Short_Country_Reports/08_Mongolia.pdf
[6] ReliefWeb (2003) Mongolia: Flash Floods - Situation Map (25 July 2003) https://reliefweb.int/map/mongolia/mongolia-flash-floods-situation-map-25-july-2003
[7] IFRC (2009) DREF operation update: Mongolia Floods http://www.ifrc.org/docs/appeals/09/MDRMN00201.pdf

In June and July 2020, flash floods caused by prolonged heavy rains occurred in several parts of Mongolia, affecting close to 30,000 people and killing an estimated 10.[8,9] According to the National Emergency Management Agency (NEMA), 2,360 homes were flooded across Tuv Province, Khuvsgul Province and Khentii Province. The floods alsocaused damage to livestock, killing 7,000 animals,[10] and to public infrastructure, including roads and bridges.[11]

By contrast, few historic earthquake events have generated damage at a significant scale. This is due to the main areas of seismic risk being located away from the main areas of exposure.

Since 1990, Mongolia has experienced a number of notable outbreaks with a pandemic influenza outbreak in 2009-2010 seeing over a thousand cases and 26 deaths as shown in Table 4. Economic costs associated with previous outbreaks were not captured.[12]

Table 4: Notable infectious disease outbreaks, 1990-2021

Pathogen	Date first case reported	Total cases	Total deaths	Location of origin
SARS Coronavirus	31 March 2003	6 May 2003	9	PRC
Pandemic Influenza	12 Oct 2009	3 January 2010	1,175	Mexico
Coronavirus disease 2019 (COVID-19)	11 March 2020	21 Oct 2020	326	PRC

Source: Metabiota's infectious disease database

[8] Centre for Research on the Epidemiology of Disasters – CRED. EM-DAT. (https://www.emdat.be/)
[9] Floodlist (2020) Mongolia – Floods Leave 8 Dead, 2,300 Homes Damaged (http://floodlist.com/asia/mongolia-floods-july-2020)
[10] Floodlist (2020) Mongolia – Floods Leave 8 Dead, 2,300 Homes Damaged (http://floodlist.com/asia/mongolia-floods-july-2020)
[11] Reliefweb (2020) Mongolia: Flash Floods - Jun 2020 (https://reliefweb.int/disaster/ff-2020-000168-mng)
[12] The economic impact of SARS: How does the reality match the predictions? (2008) - https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7114672/

Hazard

Mongolia experiences significant natural hazard risk with dzuds, droughts, snowstorms, wildfire and dust storms all common alongside earthquake and flood.

Seismic hazard

Seismicity in Mongolia accumulates principally inthe central and western part of the country where numerous active fault structures have been detected. The largest earthquake that occurred in this country is a magnitude 8.33 event that happened in 1905near Tsetserleg, followed by a 7.95 event in the sameyear. Both earthquakes occurred on the Bulnai fault system, for a total rupture length exceeding 670km.

In 1957, a magnitude 8.1 earthquake occurred in the Govi-Altai region on a fault system with both strike and thrust faulting. The recurrence interval for these energy event sequences is in the order of thousands of years.

As shown in Figure 18 and Figure 19, seismic hazard across Mongolia is for the most part moderate, with values of the peak ground acceleration with a 10% probability of exceedance in 50 years (PGA10%50yr) on reference site conditions (i.e. considering a Vs30 of 800 m/s) lower than 0.3g. In Ulaanbaatar, the PGA10%50yr is lower than 0.1g.

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

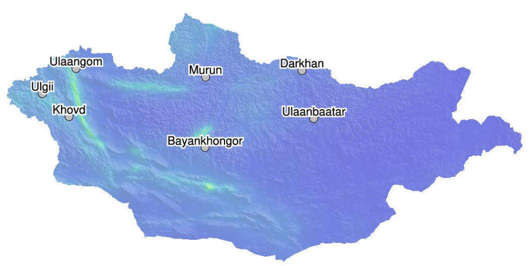
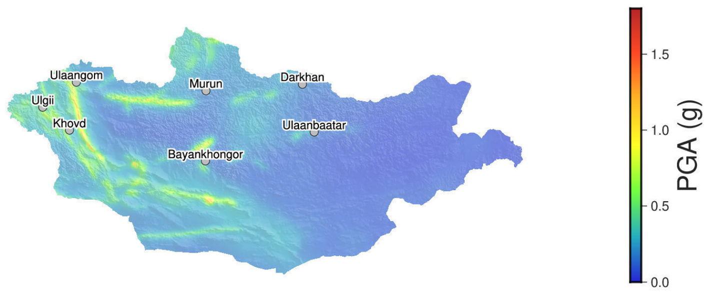


Figure 19: Seismic hazard map for PGA with a 2% probability of exceedance in 50 years.



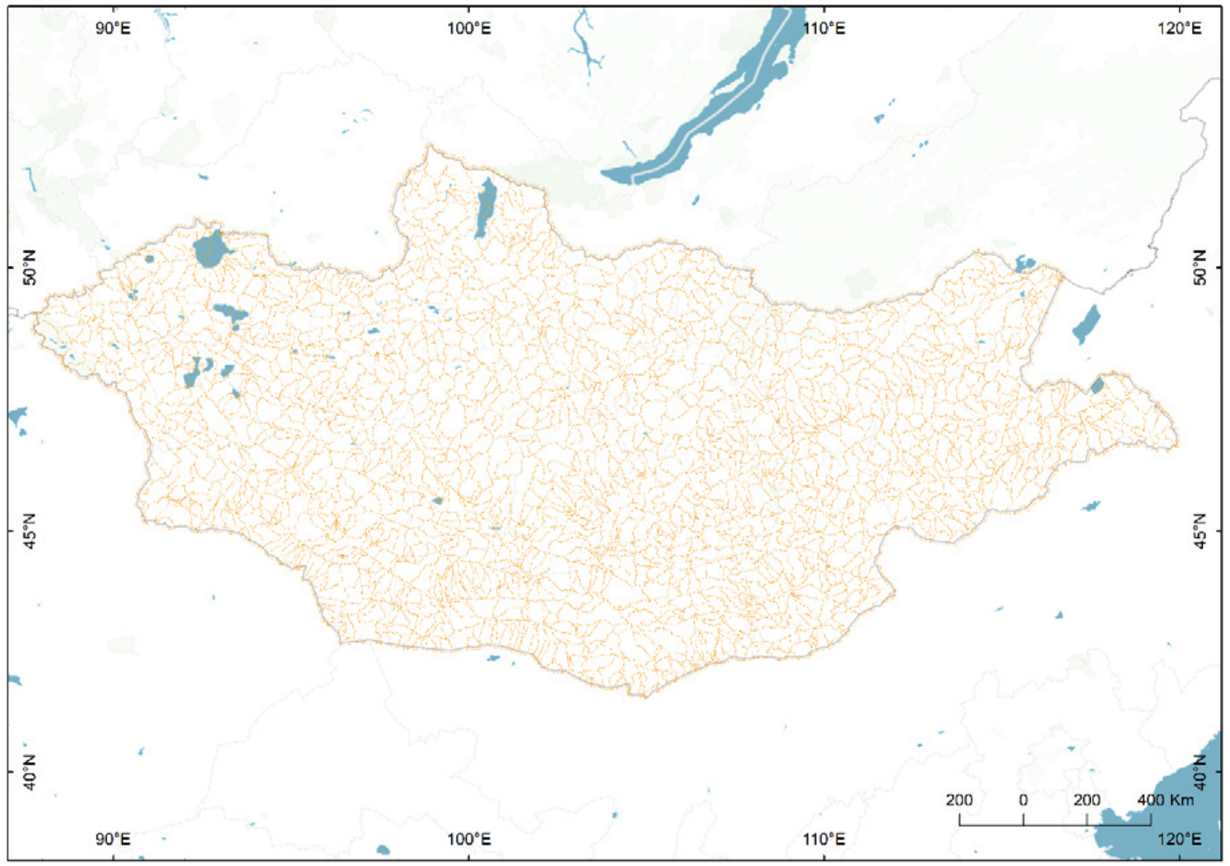
Source: Global Earthquake Model

Hydrological catchment areas

The rivers of Mongolia originate in the mountains. Most of them are the upper streams of the great rivers of Siberia and the Far East, carrying their water north into the Arctic or east to the Pacific oceans. In the West and South, most water simply drains one of three separate basins, the Northern Arctic basin in northern and central Mongolia, the Pacific Ocean Basin and the Central Asian Internal basin.

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 Mongolia, as provided in Figure 20, show the structure of the hydrological basins across the country. Much of the south of the country is arid with narrow, dry valleys only flooded by infrequent seasonal rainfall. To the north, the land is flatter and the few river valleys tend to be broader, draining larger areas.

Figure 20: Hydrological catchments used for flood modelling



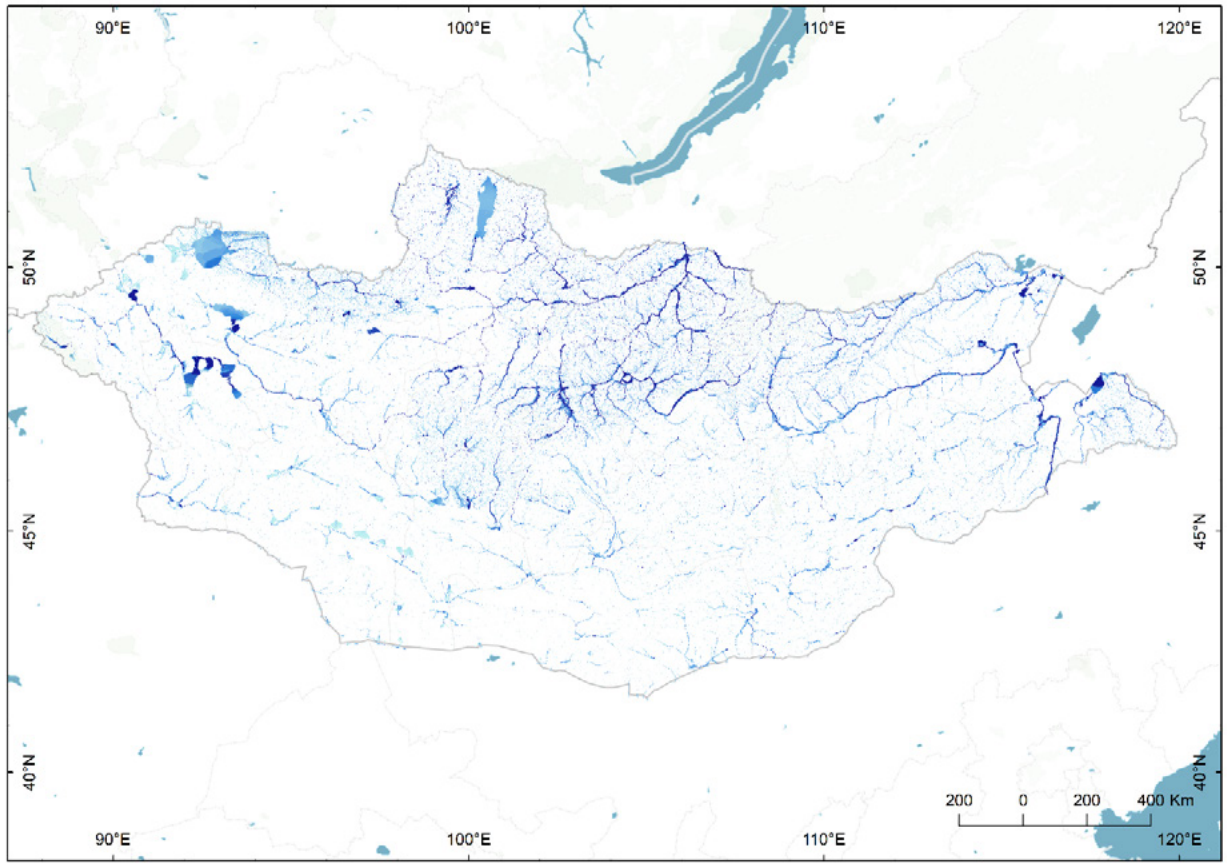
Source: JBA Risk Management

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 Mongolia. A significant footprint along the main rivers, particularly in the north and central regions is evident. This event severity is often used for planning purposes as a plausible extreme event.

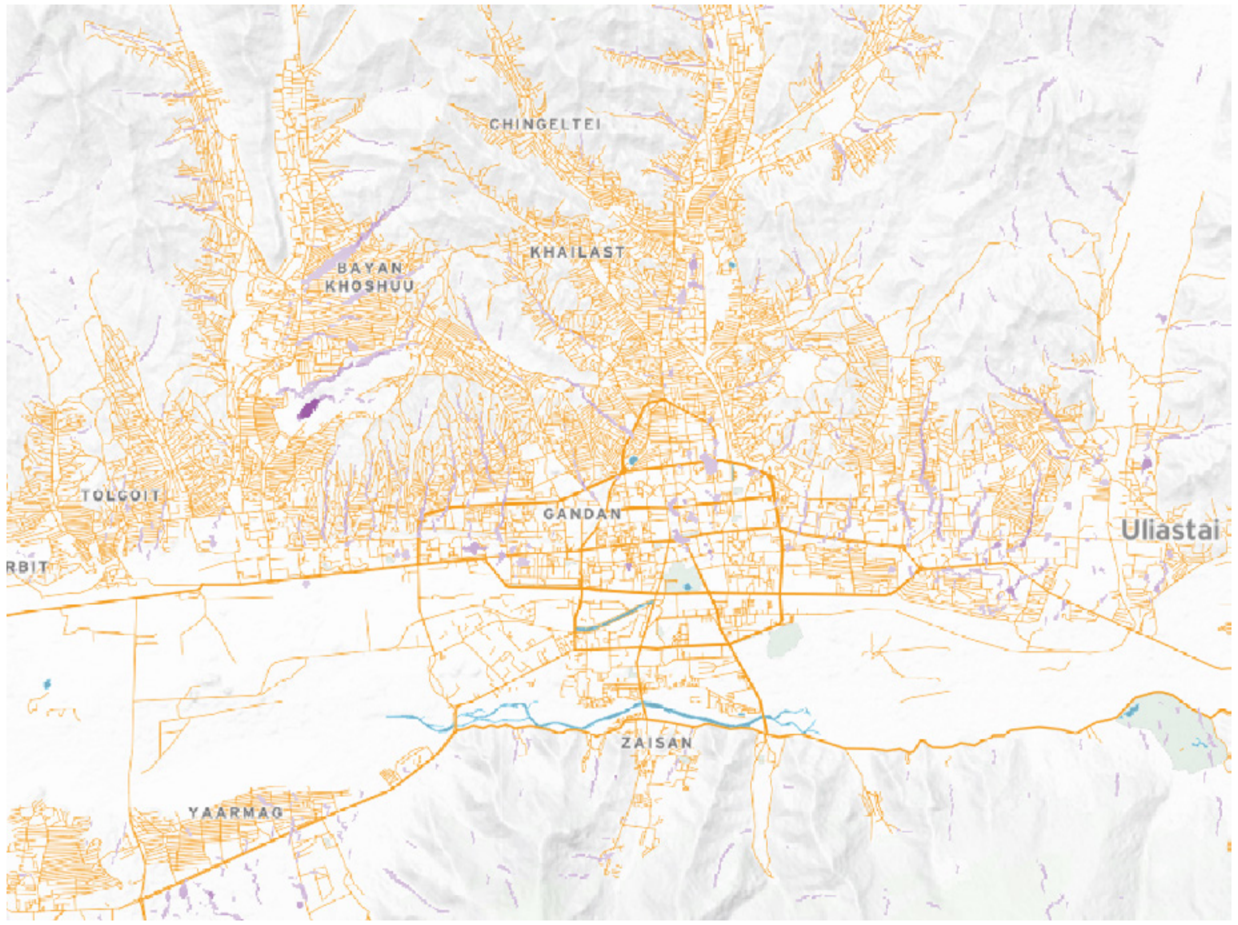
Rivers and lakes cover 0.67% of the country's territory. Rivers in the north flow into the Arctic Ocean and those in the northeast flow into the Pacific. Waters originating in western and southern Mongolia terminate at lakes in the Central Asian Inland Basin, a closed basin with no outflow to rivers or other surface water bodies. The Tuul River runs east to west from hills northeast of Ulaanbaatar, past the capital. In the east of Mongolia, the Kherlen River runs through a relatively narrow valley with several towns along its bank, crossing the border with the People's Republic of China before entering Hulun Lake.

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



Source: JBA Risk Management

Figure 22: Map of surface water (pluvial) flooding at the 200-year return period levelfor the Ulaanbaatar region



Source: JBA Risk Management

The flood map of Ulaanbaatar in Figure 22 shows narrow valleys prone to surface water flooding in the east and west of the city and some areas of surface water flood risk in the city centre, close to the Selbe River. Outside of these regions, flash flooding occurs in areas with declining soil quality, high evapotranspiration rates, and summer short-duration, extreme rainfall events.

Climate conditions: historic climate

Mongolia has extreme climate zones, ranging from humid to arid, with long winters and short summers. Much of the country's precipitation falls during the summer (June to August) and is associated with synoptic scale weather systems advecting moisture from Central Asia and western Siberia, and with the East Asia Monsoon.

There is a distinct spatial pattern to precipitation. The north of the country receives more precipitation (annual average precipitation of 200 to ~350 mm) than the desert regions of the south (with <25 to 200 mm). Precipitation is also higher in the mountainous regions than in the lowlands as shown in Figure 23 and Figure 24. Summer precipitation amounts tend to fall in short, intense bursts, with 40-65 mm recorded as falling in less than 2 hours in some locations.

Figure 23: Annual mean precipitation between 1951-2007

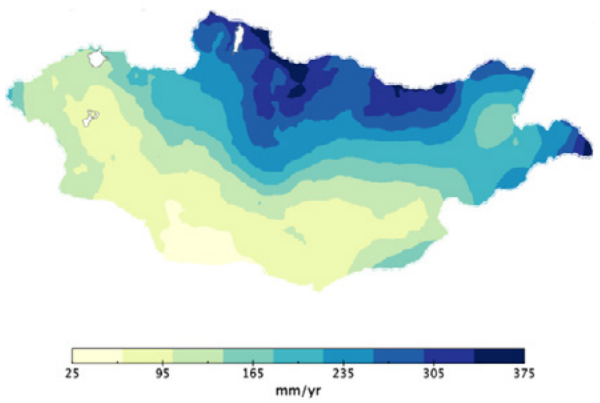
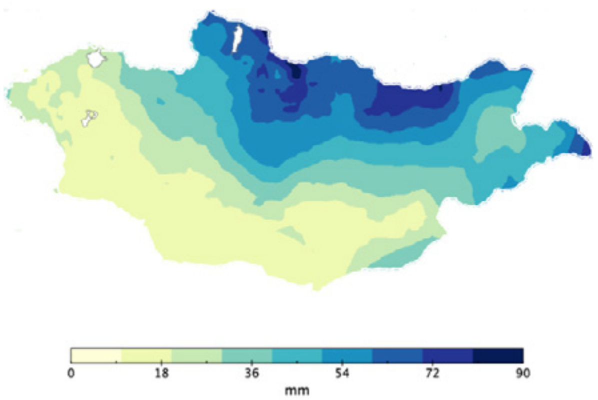


Figure 24: April-June (primary flood season) mean precipitation between 1956-1995



Note: the precipitation scales are different between the annual and seasonal means.
Source: analysis using APHRODITE[13] Russian domain precipitation dataset. The period 1956-1995 was used as the historical period against which to compare future climate projections

[13] *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:10.1175/BAMS-D-11-00122.1*

Seasonal and diurnal temperature swings are extreme. Average winter temperatures at lower elevations can drop to -30°C due to the Siberian Anticyclone and may give rise to dzud.[14] Mean annual temperatures can exceed 25°C in the Gobi region. The number of cool days and nights have decreased significantly across most of the country over the period 1961-2010.[15] Maximum values of daily maximum temperatures are increasing over the Gobi region, while annual mean maximum and minimum temperatures have increased between 0.2 to 0.8°C over much of the country between 1963-2012.[16]

Flooding and flash flooding events occur predominantly in summer months (June to September) and is associated with heavy rainfall events called aadar boroo. A limited number of studies indicate that summer rainfall is increasingly associated with thunderstorm activity, falling as short, intense events lasting less than an hour rather than as steady multi-day rain.[17,18] More frequent cases of these shorter, more intense rain events have been observed in the Khangai mountains of Khuvsgul, Zavkhan and the steppes of Dornogovi and Sukhbaatar since the 1980s. These observations correspond with herder reports of more, shorter intense summer rains damaging rangelands and flash floods killing livestock.[19]

[14] *Kang, S., K. Jang and B. Lkhamsuren (2015) 'Satellite-based Assessments on Regional Summer and Winter Conditions Triggering Massive Livestock Loss (Dzud) in Mongolia'. In: Proceedings of the Trans-disciplinary Research Conference: Building Resilience of Mongolian Rangelands. Ulaanbaatar Mongolia, June 9-10, 2015*
[15] *Nyamstseren et al. (2018) 'A comparative study of temperature and precipitation-based aridity indices and their trends in Mongolia'. International Journal of Environmental Research, doi:10.1007/s41742-018-0143-6*
[16] *Venable et al. (2015) 'Spatial Changes in Climate across Mongolia'. In: Building Resilience of Mongolian Rangelands: A Trans-disciplinary Research Conference. Full proceedings at: https://tinyurl.com/yy6oo4ve*
[17] *Qin F., et al. (2018) 'Decadal decline of summer precipitation fraction observed in the field and from TRMM satellite data across the Mongolian Plateau'. Theoretical and Applied Climate Change: https://doi.org/10.1007/s00704-018-2655-6*
[18] *Vandandorj, S. et al (2017) 'Changes in event number and duration of rain types over Mongolia from 1981 to 2014'. Environmental Earth Sciences: https://doi.org/10.1007/s12665-016-6380-0*
[19] *Goulden, C. et al (2016) 'Interviews of Mongolian herders and high resolution precipitation reveal an increase in short heavy rains and thunderstorm activity in semi-arid Mongolia'. Climatic Change: DOI 10.1007/s10584-016-1614-4*

Climate conditions: future precipitation projections

Precipitation extremes from each model-RCP combination were individually used to calculate future precipitation intensities, which are relevant to estimating future flood risk. Box 3 describes the methodology behind the future climate projections further. The area-averaged March to October annual maximum rainfalls for a 24-hr duration for each aimag was extracted and analysed for different return periods (2, 5, 10, 20, 50, 100, 200-, 500-, 1000-, 5000- and 10000-year events).

Annual mean precipitation is projected to decrease slightly by −10 to −20% under both RCP4.5 and RCP8.5 for a band through the centre of the country as highlighted by the maps in Figure 25 and Figure26. Under RCP8.5, this band extends from roughly Govisumber westward through northern Govi-Altai. Through the winter (January to March), mean precipitation could decrease by the 2050s between−10 to −40% over western aimags (e.g., Bayan-Ulgii and parts of Khovd and Uvs); increases of between10 and 20% are projected for parts of Dornod and Sukhbaatar in comparison with winter means from 1956-1995. During the summer (July-September) mean precipitation is projected to minimally decrease by 0 to −20% for large swaths of the country under both RCPs, though the spatial patterns vary between the two as seen in Figure 25 and Figure 26.

Decreases in 24-hr extreme precipitation intensities are projected under both RCP4.5 and RCP8.5 for Ulaanbaatar (see Table 5), Tuv, Selenge, Orkhon, Umnugovi, Khuvsgul, Govisumber, Dornogovi, Darkhan-Uul, Bulgan. In the other aimags, intensities could increase despite little to no projected change in summer means. This could imply that recently seen trends of increases in the frequency and intensityof short-duration extremes could continue into the future and extend into other aimags.

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

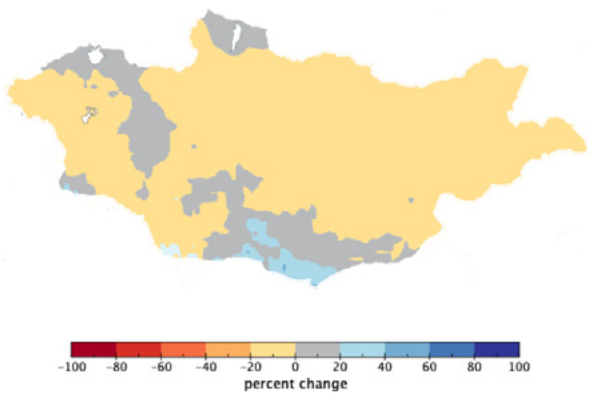
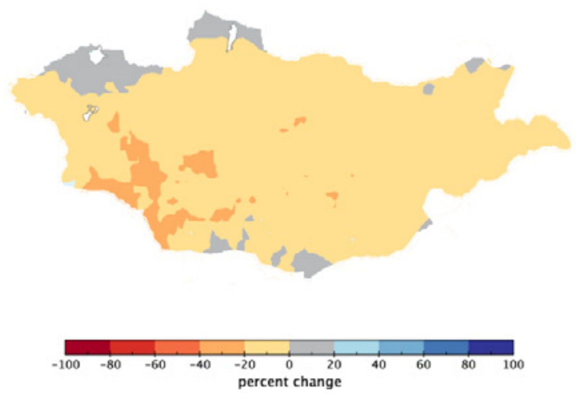


Figure 26: RCP 8.5 2050 April-June precipitation percentage change



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

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. 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.

Table 5: Ulaanbaatar 24-hr duration extreme precipitation intensity (mm/hr)

Return period	1951-2007	2050s	
	Historical	RCP4.5	RCP8.5
20-year	1.27	1.25 (1.11, 1.38)	1.31 (1.22, 1.38)
100-year	1.8	1.56 (1.35, 1.75)	1.63 (1.51, 1.74)
200-year	2.03	1.69 (1.46, 1.90)	1.75 (1.62, 1.88)
500-year	2.33	1.86 (1.59, 2.11)	1.94 (1.78, 2.09)

Source: ODI

Projected changes in 24-hr duration extreme precipitation intensities in Ulaanbaatar for 2031-2070 (the 2050s) as compared to historical 24-hr intensities of 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.

Exposure

With a population of over 3.2 million in 2019, Mongolia is the least densely populated sovereign country globally, as shown in Table 6.[20] Mongolia has experienced rapid urbanisation over the past 30 years, and close to 70% of Mongolians lived in urban areas in 2019. Ulaanbaatar alone accounts for almost half of the country's overall population, and over 60% of its GDP.[21]

Mongolia has experienced rapid economic growth over the past 30 years, almost tripling its GDP per capita to around $4,300 in 2019 (Table 7). However, in 2020, economic impacts from the COVID-19 pandemic resulted in the worst economic contraction in the country since the early 1990s (5.3%)[22]. In part, this was driven by a global decrease in demand for commodities and border closures with the PRC, and a domestic service sector hit hard by COVID-19 containment measures. Government relief and stimulus packages, including income support and tax relief measures, have supported businesses and households during the pandemic. However, these measures also increased the budget deficit and contributed to a renewed rise in government debt relative to GDP. [22]

Mongolia's economy is very small with the industry and service sectors each contributing close to 40% of GDP. Table 7 highlights that over half of the population are employed in services, followed by 27% in agriculture and 19% in industry.

Table 6: Population totals, distribution and trends (all data from 2019)

Population (thousands)	3225.17
Population growth date (%/year)	1.7
Share of population living in urban areas (%)	69
Urbanisation rate (%/year)	1.9
% of total population age 0-14	31
% of total population age 15-64	65
% of total population ages 65 and above	4

Source: World Bank Open Data

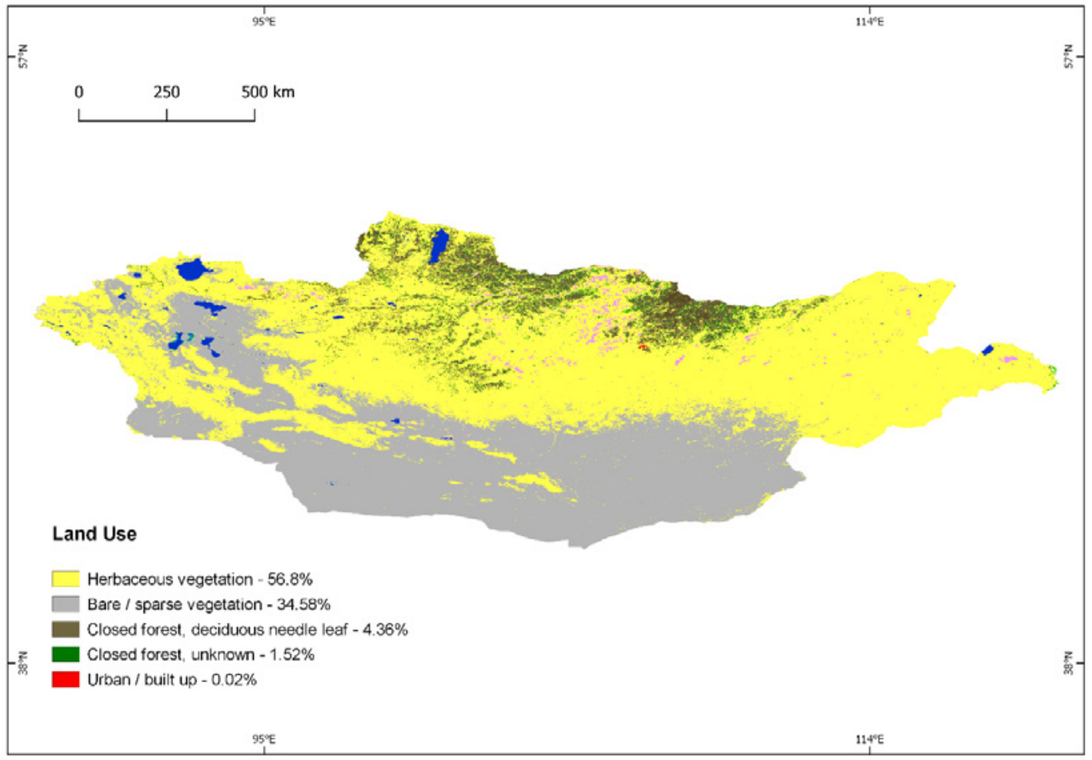
Table 7: Key economic indicators (data from 2019, if *from 2020)

GDP (million USD, current)	13852.85
GDP per capita (USD, current)	4295.2
Agriculture, forestry and fishing, value added (% of GDP)	11
Employment in agriculture (% of total employment) (modelled ILO estimate)	27*
Industry (including construction, value added (% of GDP))	39
Employment in industry (% of total employment) (modelled ILO estimate)	19*
Services, value added (% of GDP)	39
Employment in services (% of total employment) (modelled ILO estimate)	54*

Source: World Bank Open Data

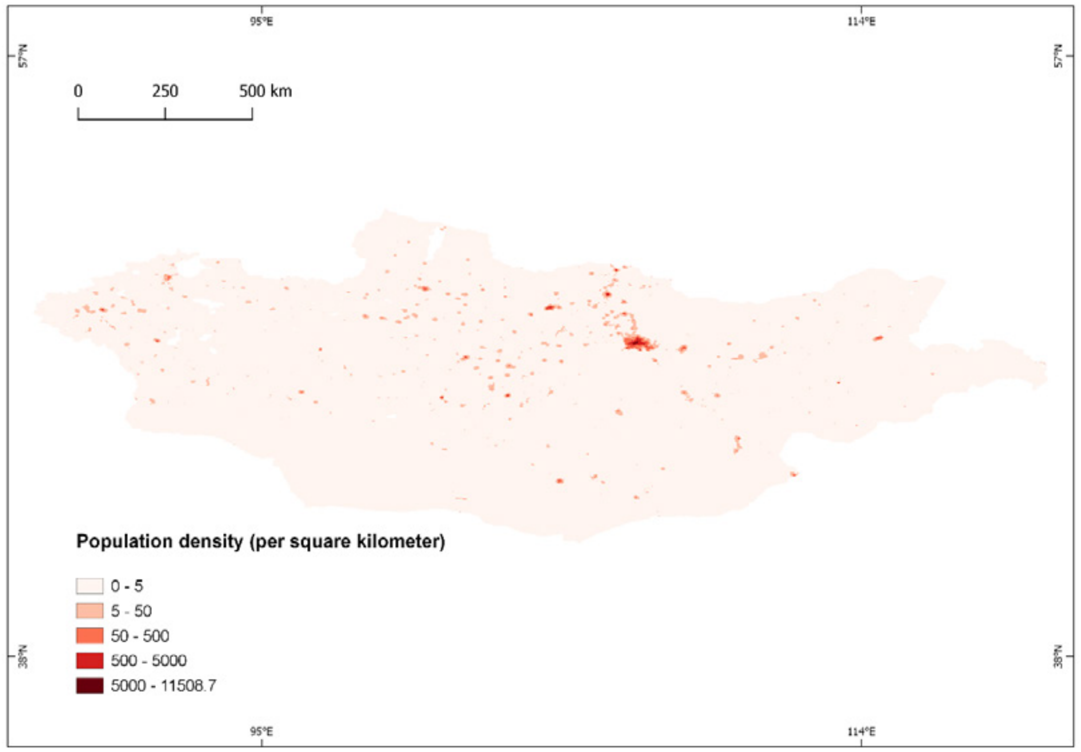
[20] *The World Bank (2021). World Bank Open Data. Population density (people per sq. km of land area) Accessed April 2021 at: https://data.worldbank.org/indicator/EN.POP.DNST?most_recent_value_desc=false*
[21] *ADB (2018). Urban sector fact sheet. Manila: ADB. (https://www.adb.org/sites/default/files/publication/404296/mongolia-urban-sector-fact-sheet.pdf)*
[22] *The World Bank (2021). 'The World Bank in Mongolia'. (https://www.worldbank.org/en/country/mongolia/overview)*

Figure 27: Land use in Mongolia



Source: FAO GlobCover

Figure 28: Population density map



Source: WorldPop

Mongolia's economy is highly dependent on the country's natural resources, which means growth is volatile and reliant on global commodity prices. The Government of Mongolia pursues a strategy of diversification to help address economic instability[23] brought on by the volatility of global commodity prices.

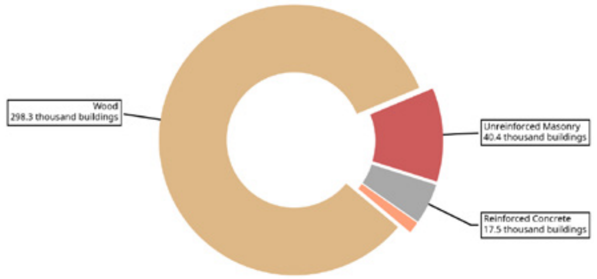
The cashmere industry in Mongolia is the second largest globally and cashmere is the country's third largest export.[24] Mongolia produces 40% of the world's cashmere, with production including more than a third of the population and accounting for 15% of GDP.[25][26] Quality and quantity of cashmere goats have decreased in recent years. Increasingly volatile weather patterns complicate production with dry summers preventing vegetation growth, meaning malnourished goats, affecting their hair quality, and survival rates. Farmers attempt to make up for lost revenue by increasing their herd sizes, bringing risk of overgrazing and desertification.[27] Figure 27 shows the land use map for Mongolia. The sparse nature of Mongolia is evident in the land use map. There is barely any cultivated agriculture, whilst urbanization by total size is very small.

Table 8: Asset replacement cost (billion USD) for residential, commercial and industrial buildings

Asset replacement cost (billion $)	
Residential buildings	9.9
Commercial buildings	11.7
Industrial buildings	5.9
Total buildings	**26.9**

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

Figure 29: Breakdown of different building types



Source: Global Earthquake Model

The 2020 population and housing census of Mongolia reports a total national population of 3,296,866, with 68% of the population live in urban areas. The capital and largest city, alone contains nearly 46% of the entire population of the country, as highlighted in Figure 28. The central region of Mongolia has the next highest level of urbanization following Ulaanbaatar. Of the 897,427 total households in Mongolia, just under 61% live in houses, while 38% live in *gers*, which are the traditional portable round tents of Mongolia consisting of a latticework of bamboo or light wood and covered with felt. The remaining 1% households live in other types of dwellings.

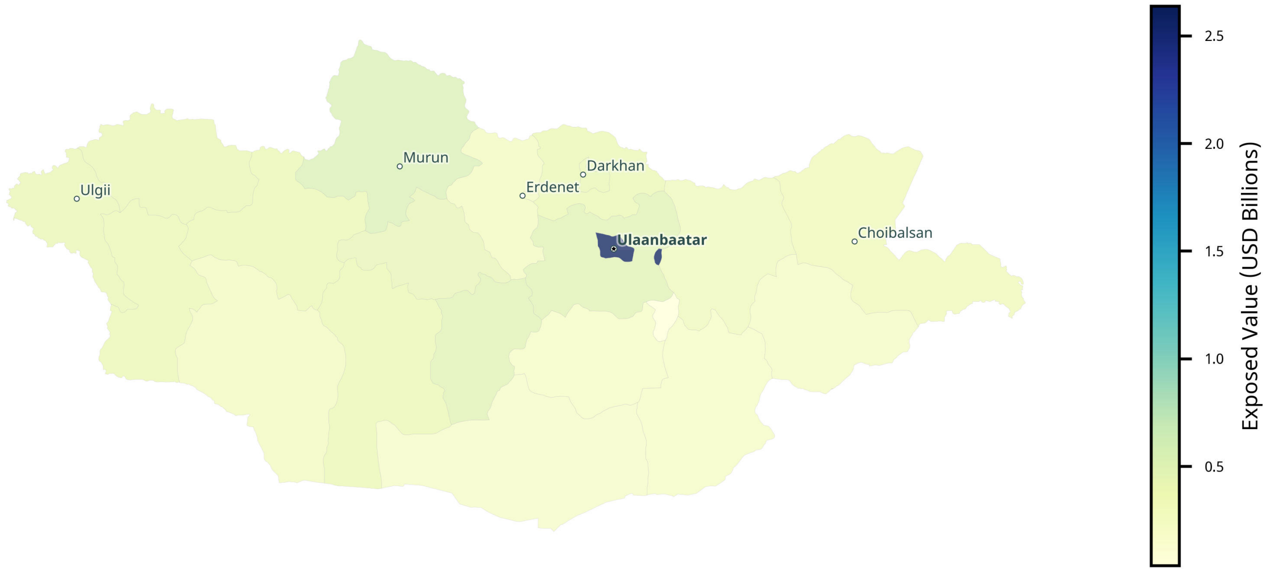
Mongolia is estimated to have a total of 418,185 residential buildings valued at $9.9 billion, 55,349 commercial buildings valued at $11.7 billion, and 51,172 industrial buildings valued at $5.3 billion, as shown in Table 8.

Dwelling types are quite different in the rural and urban areas of the country. In rural areas, two-thirds of the households live in *gers*. The remaining rural households live in unreinforced masonry or concrete block masonry houses. In urban areas, just under one-quarter of the households live in *gers*, with the rest of the urban dwellers living in private or detached houses, or increasingly in apartment blocks. Of the apartment buildings, 30% are clay brick masonry structures, 11% are concrete block masonry structures, 25% are reinforced concrete cast-in-place moment frame structures, and 18% are prefabricated concrete structures.

Most of the apartment buildings in Ulaanbaatar are masonry structures with thick load-bearing walls. Cast in place reinforced concrete structures and pre-cast panel structures make up most of the remaining non-ger building stock of Ulaanbaatar.

[23] *Helble, M., Hill, H. and Magee, D. (eds.) (2020). Mongolia's economic prospects. Resource-rich and landlocked between two giants. Manila: ADB. (https://www.adb.org/sites/default/files/publication/611416/mongolia-economic-prospects.pdf)*
[24] *Timmins B. (2020) 'Cashmere and climate change threaten nomadic life', BBC News.*
[25] *Hafey J. (2020) 'COVID-19 and Cashmere: Rethinking One of Mongolia's Largest Industries', The Diplomat.*
[26] *Roningen V. (1999) 'The Impact of a Ban on Mongolian Raw Cashmere Exports', Gobi Regional Economic Growth Initiative.*
[27] *Pi A. (2016) 'Cashmere Catastrophe', Digital Initiative, Harvard Business School.*

Figure 30: Asset replacement cost



Source: Global Earthquake Model

Gers and other wood-frame structures with an estimated total of 298,256 buildings make up the largest fraction (82.6%) of the total building stock, as shown in Figure 29. This is followed by unreinforced masonry structures (40,408 buildings, or 11.2%) and reinforced concrete structures (17,538 buildings, or 4.9%). Asset replacement costs are shown in Figure 30, with a heavy concentration of exposed value in the capital Ulaanbaatar.

Value-at-risk is otherwise similar across the rest of the country, with slightly higher values in the north and western parts of the country. This pattern is influential for the low modeled seismic risk in Mongolia, with areas of hazard not intersecting with those of exposure.

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 urbanization or decline of ecosystem services, may unintentionally increase vulnerability

Socio-economic vulnerability

Mongolia is becoming warmer due to climate change. Rainfall is becoming more variable and the intensity of short duration (a few hours) rains has increased in some parts of the country. These heavy rains further contribute to the erosion of fragile pastureland. As Mongolia's livestock are raised on open pastures, they are directly affected.[28] Due to its vulnerability to seasonal conditions, Mongolia's agriculture sector is highly volatile.[29]

Table 9 shows socio-economic vulnerability indicators for Mongolia. The country's spatially disparate population is heavily engaged with livestock, herding and animal husbandry, with the agriculture sector overall employing almost 27% of the total population. Many households who herd livestock practice *otor*, a non-customary migration strategy employed to escape the harsh weather in winter. Factors such as disability and age make this practice complicated. Without support to help move the livestock, families are often unable to escape the harsh conditions.[30]

Table 9: Socio-economic vulnerability indicators

Poverty headcount ratio at national poverty lines (% of population)	28.4 (2018)
Human Capital Index	0.6 (2020)
GINI index	32.7 (2015)
Gender Inequality index	0.32 (2018)
Household size	4.3 (2019)
Age dependency ratio (% of working age population)	54 (2019)
Unemployment rate	5.9 (2020)
General government gross debt (% of GDP)	N/A
Under five child mortality (per 1000 live births)	16 (2019)
Life expectancy at birth (female)	74 (2018)
Life expectancy at birth (male)	66 (2018)
% of population using at least basic sanitation services	58 (2017)
% of population using at least basic drinking water services	83 (2017)

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

[28] *Batima P., Erdenetsetseg B., Gombluudev P., and Natsagdorj L. (2005) 'Observed Climate Change in Mongolia', AIACC Working Paper No.12.*
[29] *Helble, M., Hill, H. and Magee, D. (eds.) (2020). Mongolia's economic prospects. Resource-rich and landlocked between two giants. Manila: ADB. (https://www.adb.org/sites/default/files/publication/611416/mongolia-economic-prospects.pdf)*

Few measures are in place to support those with disabilities during disaster events. Those with hearing and sight impairments are at a disadvantage when it comes to warnings of national disasters or evacuations broadcast on radio and television. Likewise, emergency shelters do not regularly cater for those with disabilities.[31]

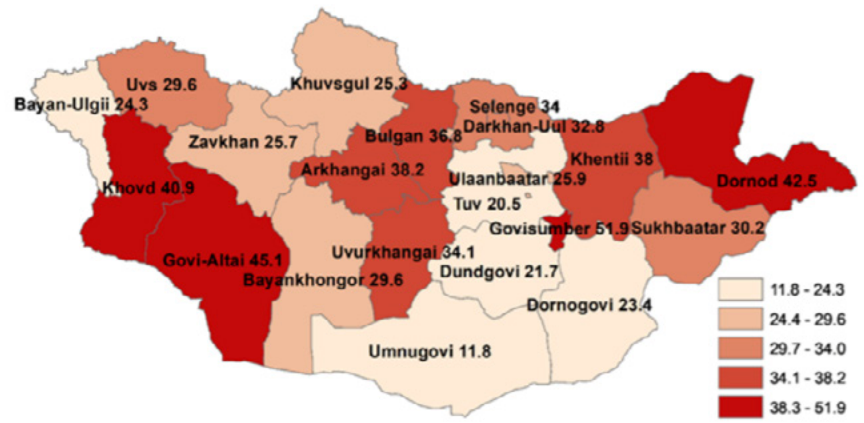
Mongolia has experienced robust macroeconomic growth in recent years, but is struggling to convert the level of economic growth into commensurate increases in household welfare, particularly for the poor. The share of the population under the national poverty line[32] decreased slightly in recent years, from 29.6% in 2016 to 28.4% in 2018. In absolute terms, however, the reduction was minimal due to high population growth during the same period.[33]

Progress in poverty reduction was greater in rural areas than in urban areas, where poverty rates stagnated between 2016 and 2018. Poverty rates are still higher in rural than in urban areas (30.8% compared to 27.2% respectively in 2018), but the gap is narrowing. This is attributed in part to stagnating wages in urban areas and simultaneous increases in farm income and an expansion of social protection programmes that target poverty and extreme poverty. As of 2018, more than six out of ten poor Mongolians lived in urban areas, especially in Ulaanbaatar. In addition to people already under the national poverty line, 15% of the population is clustered just above, meaning this group remain vulnerable to unexpected shock.[34]

While herders used to be among the poorest of the Mongolian population, this has changed in recent years and only a third of herders were estimated to be poor in 2018. The Mongolian National Statistics Office relates increases in the wellbeing of herders to growing demand and prices for livestock products, enhanced market access, government subsidies and transfers, and greater opportunities for diversification of income-generating activities in rural areas, for instance towards wage employment.[35]

Access to services such as sanitation and reliable heating sources remains challenging especially for ger dwellers in urban districts and for people living in remote rural areas. The lack of service access is particularly pronounced in the Khangai and Western parts of the country[36], where poverty rates are also high as seen in Figure 31.

Figure 31: Proportion of the population under the national poverty line



Source: National Statistics Office of Mongolia and The World Bank (2020) Mongolia Poverty Update 2018. Main report of "household socio-economic survey 2018". Ulaanbaatar: National Statistics Office of Mongolia

[30] *Murphy D. J. (2011) 'Going on Otor: Disaster, mobility, and the political ecology of vulnerability in Uguumur, Mongolia,' University of Kentucky Doctoral Dissertations. 168.*
[31] *CRPD – UN Committee on the Rights of Persons with Disabilities (2015) 'Implementation of the UN Convention on the Rights of Persons with Disabilities in Mongolia. Submission to the CRPD Committee of the response to the list of issues on Mongolia by Disabled People's Organizations of Mongolia'.*
[32] *In 2018, the official national poverty line was set at 166,580 tugrug (about USD 70) per capita per month.*
[33] *National Statistics Office of Mongolia and The World Bank (2020) Mongolia Poverty Update 2018. Main report of "household socio-economic survey 2018". Ulaanbaatar: National Statistics Office of Mongolia (http://documents1.worldbank.org/curated/en/532121589213323583/pdf/Mongolia-Poverty-Update-2018.pdf)*
[34] *Ibid*
[35] *Ibid*
[36] *Ibid*

In Mongolia, citizens are able to claim 700 m^2 of land for residential use in and around Ulaanbaatar. This led to huge spatial growth of ger settlements with inadequate infrastructure. Many residents lack basic services and are vulnerable to the impacts of flooding due to climate change and extreme air pollution from wood and coal used in fires.[37] The Flood Resilience in Ulaanbaatar Ger Areas - Climate Change Adaptation project aims to enhance the climate change resilience of the most vulnerable ger settlements through community-driven small-scale protective and basic-services interventions.

Objectives include improving knowledge on flood hazards, improving adaptive capacity of the settlements and increasing the infrastructure around the settlements. Support is also needed through land use planning to avoid people living in such high-risk environments in the first place. Mongolia is at risk of ignoring the vulnerabilities to climate change in the drive to develop urban areas. Cities need to be designed with the people at its core taking into account challenges related to climate change and other hazards.[38]

[37] GFDRR (2015) 'Boosting flood resilience in Mongolia', https://www.gfdrr.org/en/feature-story/boosting-flood-resilience-mongolia
[38] Adaptation Fund (2018) 'Flood Resilience in Ulaanbaatar Ger Areas – Climate Change Adaptation through community-driven small-scale protective and basic-services interventions', https://www.adaptation-fund.org/project/flood-resilience-ulaanbaatar-ger-areas-fruga-climate-change-adaptation-community-driven-small-scale-protective-basic-services-interventions-2/

Coping capacity

Mongolia has a large number of policies and plans related to disaster risk reduction (DRR). Recent reviews indicate a need for streamlining, as currently responsibilities of government agencies are overlapping and unclear.[39] An overarching disaster risk financing strategy is being designed with support from ADB. This includes the assessment of disaster risk and promotion of disaster risk reduction, financing and insurance.[40] Table 10 provides information on Key coping capacity indicators for Mongolia.

The fiscal position in Mongolia is challenging, with government debt around 75% of GDP[41] before the COVID-19 crisis (the second highest in the CAREC region). Its economy is also heavily exposed to commodity price volatility.

Financial provisions for disaster events are made through a budget to the National Emergency Management Agency (NEMA) and the two main national contingency funds, namely the Government Reserve Fund and the Contingency Fund. The Government Reserve Fund finances the relief effort from natural or man-made disasters. Part of the budget covers stocks of food, grain, and fuel strategically located across the country. The current fund size is unclear, although around $26m was spent in 2013 and 2014. This is complemented by the Contingency Fund which covers for unexpected disruption in domestic production, including disaster events related to natural hazards.[42] Local governors can also make use of Local Governors' Reserve Funds.

Table 10: Key coping capacity indicators

Financial inclusion (% of population aged 15+ with access to bank account)	93% (female pop: 97%) (2017)
Insurance coverage	0.6% (2019)
Share of population covered by public safety nets	94% (bottom income quintile: 98.7%) (2016)
Internet coverage (% of population using the internet)	51 (2019)
Metabiota Epidemic Preparedness Index score (100 = maximum score, 0 = minimum score)	61 (2019)
Public and private health expenditure (% of GDP)	4 (2017)
Number of physicians (per 1,000)	2.9 (2016)
Number of hospital beds (per 1,000)	8 (2017)
Government effectiveness (-2.5 to +2.5)	-0.19 (2019)
Corruption Perception Index	35 (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[43]

[39] UNDRR (2019) 'Disaster Risk Reduction in Mongolia: Status Report 2019', Bangkok, Thailand, United Nations Office for Disaster Risk Reduction (UNDRR), Regional Office for Asia and the Pacific.
[40] TA-9880 Mongolia: Strengthening Capacity on Disaster Risk Assessment, Reduction, and Transfer Instruments in Mongolia
[41] https://tradingeconomics.com/mongolia/government-debt-to-gdp
[42] World Bank (2015) Mongolia: Public Financial Management Performance Report. https://www.adb.org/sites/default/files/linked-documents/49210-001-sd-02.pdf
[43] 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).

Past events have highlighted some of the challenges of the current arrangements. Support provided through national and international mechanisms after the 2009-2010 dzud was likely considerably lower than required, poorly targeted and insufficiently timely.[44] The international community's Mongolia Dzud Appeal had a target of over $18 million to raise, and yet by May 2011 only $3.3 million had been reported as being funded.[45] Similarly, after the harsh winter of 2015/16, as of April 2016, the United Nations Humanitarian Team was seeking $14.3m of external funding to support dzud relief.[46]

The governance structure for disaster risk management in Mongolia was strengthened with the establishment of the National Emergency Management Agency (NEMA) in 2003 under the Law of Disaster Protection. NEMA conducts nationwide activities for disaster protection. In 2017 this was updated to focus on prevention, rather than response and a new body was established named the National Council for DRR, chaired by the Prime Minister. The State Emergency Commission organizes disaster risk reduction activities and coordinates and monitors initial response actions. The State Disaster Protection Services, a non-permanent Disaster Protection Service is tasked with coordinating DRR activities at all levels. The government has specified that all government organizations should plan to spend 1% of their income on disaster related activities. Table 11 shows the legislative frameworks for disaster risk reduction and climate resilience in Mongolia.

[44] *Benson C. (2011) 'Dzud Disaster Financing and Response in Mongolia. Structuring Dzud Disaster Preparation, Financing and Response to Increase Resilience of Herder Households to Climatic Risk in Mongolia', World Bank.*
[45] *'Mongolia Dzud Appeal (April 2010 - May 2011)', OCHA Financial Tracking Service.* https://fts.unocha.org/appeals/340/clusters?order=total_funding&sort=desc
[46] *Mongolia – Dzud Response and Preparedness Plan (as of 25 April 2016)* https://reliefweb.int/sites/reliefweb.int/files/resources/MONGOLIA%20%E2%80%93%20Dzud%20Response%20and%20Preparedness%20Plan-FINAL.pdf

Table 11: Mongolia's legislative frameworks for disaster risk reduction and climate resilience

Implementation	Legislation	Scope	Purpose
National and local governments	The Constitution of Mongolia (1992)	National, district and municipalities	Guarantees the rights of citizens to live in safety from harm, protected against pollution and ecological imbalance. The foundation of disaster related policies
The Government of Mongolia	Concept of National Security of Mongolia (1994)	National, district and municipalities	Requires the establishment of prevention and response mechanisms to protect the national security from disaster threat
The Government of Mongolia	Law of Disaster Protection (2003)	National, district, municipalities and the private sector	Intended to regulate matters and clearly assign responsibilities related to disaster protection to state agencies, NGOs, local authorities, and the private sector
The Government of Mongolia	Concept of National Security of Mongolia (2010)	National, district and municipalities	The updated concept highlighted efforts to strengthen the DRR mechanism and to reduce vulnerabilities by encouraging participation and increasing capacity at all levels
NEMA, Local Governments	State Policy and Programme on Disaster Protection (2011)	National, district and municipalities	Intended to support sustainable development and to strengthen the DRM system by guaranteeing education and participation of all sectors and citizens
Local Governments	National Programme of Community Participatory Disaster Risk Reduction (2015)	Municipalities	Aims to achieve enhanced DRR activities aligned with the Sendai Framework on DRR (SFDRR) via community participation, capacity training, climate change adaptation and training at the localities
The Government of Mongolia	Policy of Sustainable Development in Mongolia 2030 (2015)	National, districts and municipalities	Aims to achieve enhanced DRR and disaster protection activities aligned with SFDRR and other national mechanisms
The Government of Mongolia	Mid-term Strategy to Implement the Sendai Risk Reduction in Mongolia (2017-2030)	National, districts	Strives towards gradual implementation of the SFDRR in Mongolia at national and regional levels by establishing measurable objectives and indicators
The Government of Mongolia, Mongolian Red Cross Society	Amended Law on Disaster Protection (2017)	National, districts, municipalities, NGOs, the public and the private sector	Aims to strengthen the DRR framework and move towards a more proactive approach

Source: UNDRR (2019) 'Disaster Risk Reduction in Mongolia: Status Report 2019'

In 2015, the government approved the National Programme of Community Participatory Disaster Risk Reduction. The aim of this programme is to involve the population at a community level in reducing disaster risks by enhancing their knowledge, providing education and training, promoting safe living culture, and strengthening resilience to climate change. In 2016, the Mongolian Sustainable Development Vision 2030 was established to create the national capacity for adapting to climate change and strengthening the capacity for preventative measures. NEMA then developed the Mid-Term Strategy to Implement the Sendai Framework for Disaster Risk Reduction in Mongolia (2017-2030). The aim of this strategy is to reduce disaster risks with preventative measures through mitigation and preparedness. Building disaster resilient infrastructure is taken into account in the implementation of the Sendai framework in Mongolia, but there is no evidence that climate change adaptation and disaster risk reduction are being explicitly considered in infrastructure development policy documents.

Mongolia is making good progress in implementing the Sustainable Development Goals (SDGs), with many policies embedded into the Law of Mongolia on Development Policy Planning.[47] However, deepening inequality threatens progress and a financing strategy is yet to be conceived, exemplifying the gap between policy planning and budgeting.[48] A limited shared understanding of disaster risk reduction and the risks natural hazards pose to infrastructure have hampered efforts to integrate DRR and climate change concerns into the relevant infrastructure development policies and strategies.[49]

Mongolia has also made significant progress towards implementing the Sendai Framework. Dzud maps have been developed and funds have been allocated to establish seismic observation points.

Prior to adopting the Sendai Framework, Mongolia was operating on a reactive strategy as opposed to a proactive strategy. When the Law of Disaster Protection was implemented in 2003, it entrusted the roles of disaster protection to state organisations, local authorities, NGOs, the private sector, and individuals. It was also agreed that information related to disaster events should be made public and that nationwide communication networks would be implemented to assist with broadcasting of early warning signs through the internet, mobile phone services, national radio and television. However, these networks are still not effective in reaching the more remote communities.

To counteract other vulnerabilities, Mongolia has introduced a social welfare system, which provides pensions and benefits to those with disabilities and poorer households with children. A new insurance scheme supported by the World Bank has also been implemented to provide assistance for herders in disaster events. However, some households with smaller herds will not be able to benefit from the scheme due to the cost to the scale of loss at which insurance payouts are triggered.[50]

In terms of disaster recovery, Mongolia does not have a specific programme, due to lack of funds. In 2017, the government introduced a new chapter into the Law of Disaster Protection called the International Human Assistance to support the work of NGOs in the country. This covers the illegality of discrimination in the dissemination of aid and ensures that those providing aid are not able to make a profit.[51]

[47] *UNDRR (2019) ' Disaster Risk Reduction in Mongolia: Status Report 2019', Bangkok, Thailand, United Nations Office for Disaster Risk Reduction (UNDRR), Regional Office for Asia and the Pacific.*
[48] *Government of Mongolia (2019) 'Mongolia Voluntary National Review Report 2019. Implementation of the Sustainable Development Goals'.*
[49] *Dalai S. (2020) 'Research report on resilient infrastructure in Mongolia', United Nations ESCAP.*
[50] *https://www.worldbank.org/en/news/feature/2010/03/01/protecting-mongolian-herders-against-livestock-losses*
[51] *UNDRR (2019) 'Disaster Risk Reduction in Mongolia: Status Report 2019', Bangkok, Thailand, United Nations Office for Disaster Risk Reduction (UNDRR), Regional Office for Asia and the Pacific.*

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 used as a fundamental input into the design of risk management and arrangement of risk financing. By understanding the 'Protection Gap' we can better understand the current approach to disaster risk finance in Mongolia and identify opportunities to strengthen financing arrangements. Table 12 shows key protection gap indicators for Mongolia.

Table 12: Key Protection Gap indicators

AAL as % of GNI[52]	0.07%	
Un-funded AAL, ($m, %)	AAL covered[53]	
Average annual human losses from flood and earthquakes	Flood	EQ
	92	1
Event frequency where direct & indirect loss and damage, less (assumed) insured losses, exceed existing ex-ante risk retention	Flood	EQ
	1 in 10	>1 in 200
Event frequency where direct damage, less (assumed) insured losses, exceed existing ex-ante risk retention	Flood	EQ
	1 in 10	>1 in 200
Event frequency where estimated emergency response costs exceed current risk retention mechanisms	Flood	EQ
	1 in 20	>1 in 200
Macro-economic context and ability for sovereign to borrow	Moderate to weak. External debt: GDP among highest in CAREC, low credit rating	
Ability of individual and households to access resources after an event	High rates of financial inclusion and significant social protection	

Source: Consultant team modelling

[52] *G 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.*
[53] *Note that, for consistency with the analytical approach taken in other countries, it is assumed that all of the reserve funds in Mongolia are available for covering the costs associated with flood and earthquake events. However, when events have occurred historically, the funds in these reserves have not always been used for this purpose.*

The combined AAL risk across flood and earthquake of around $24.6 million is equivalent to approximately 0.07% of GNI in the country, which is one of the lowest of all the countries/provinces in the CAREC region.

There are two main risk retention instruments in Mongolia – The Government Reserve Fund and The Contingency Fund. In addition, local Governors have a Local Governors' Reserve Fund (or Disaster Protection Fund) although the combined size of funds is unclear. Mongolia's non-life insurance penetration is 0.6%, around the median for the CAREC region, and insurance density is $23/person.[54] Property insurance premiums account for 28% of all non-life premiums, leading to a property insurance penetration rate of 0.17%.[55] Earthquake, windstorm, and flood cover are all included in property insurance. However, market reports suggest that there have never been any notable insured losses, indicative of the low coverage rate, and the same reports suggest that there is a lack of sophisticated accumulation monitoring of exposure to these threats. Almost all property insurance is in Ulaanbaatar.[56]

Precise data on the extent to which insurance might cover AAL is difficult to ascertain. In the base case, it is assumed that 20% of the losses associated in Ulaanbaatar and 3% of the losses experienced elsewhere in the country are insured. This amounts to insurance covering just under 5% of the total losses caused by flood and earthquake risk.

The amount from the Government Reserve Fund meant to cover disaster events in 2013 and 2014 was $26 million. If it is assumed that this is the total amount in the government's contingency and reserve funds, then the available funding is just sufficient to cover the average annual losses. Correspondingly, it would only take a 1 in 10-year flood event to cause the risk retention mechanisms less insurance provision to be exhausted. The sharp increase in losses between a 1 in 10-year and 1 in 20-year flood event also means that a 1 in 20-year flood event would also be sufficient to exhaust the risk retention mechanisms if their intention was only to cover emergency response costs.

Mongolia's contingent liabilities from disaster events, especially those associated with floods, are inadequately addressed by its current disaster risk financing strategy. Private insurance markets are currently likely to pick up a very small proportion of the associated losses, and virtually none of the losses outside the capital city. At the same time, the country's existing policy framework towards financial inclusion and social protection, some of which are being explicitly supported by the ADB, may give greater confidence that sovereign-level support will trickle down to vulnerable households.

[54] Data taken from Swiss Re Sigma, https://www.swissre.com/institute/research/sigma-research/World-insurance-series.html. Insurance density refers to the premia amount divided by population.
[55] Market reports from Willis Towers Watson.
[56] Market reports from Willis Towers Watson.

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