COUNTRY RISK PROFILE KAZAKHSTAN

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

March 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

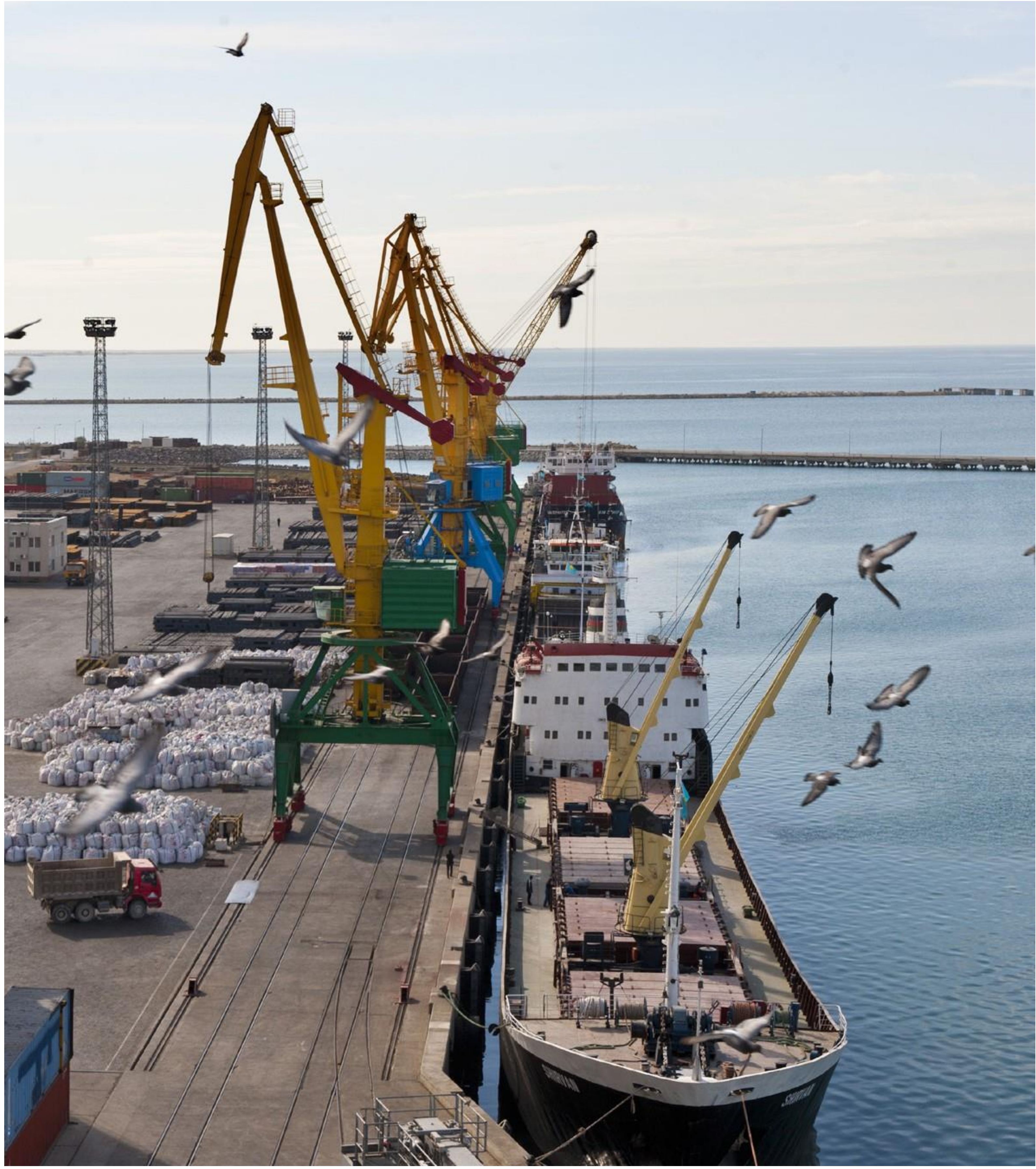
List of abbreviations

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 ($)

List of figures and tables



Profile summary

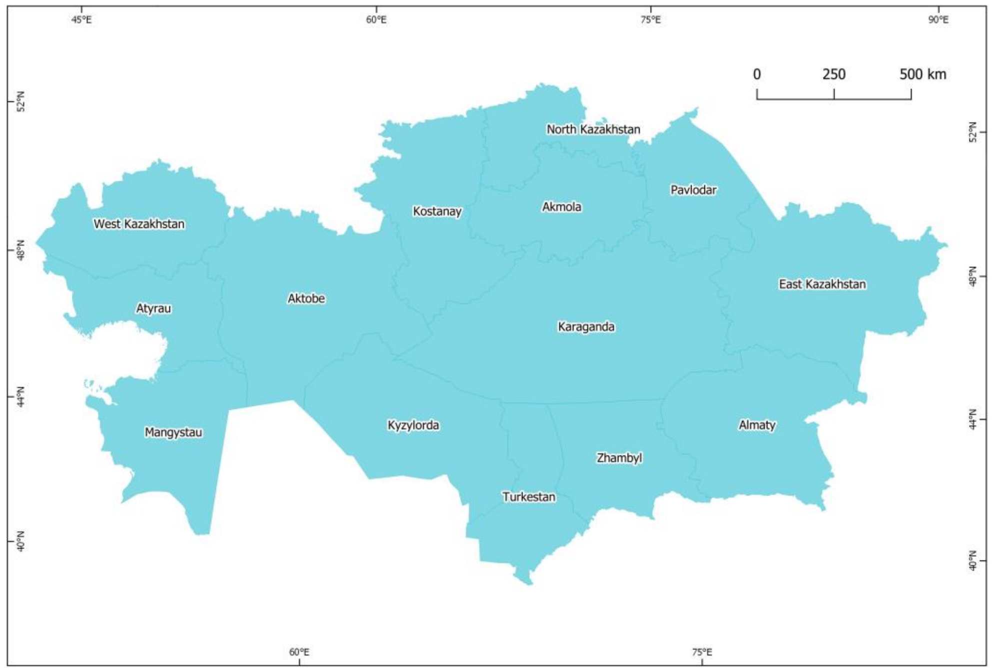
Kazakhstan spans some 2.7 million km2 and is largely landlocked except for its southwest border adjoining the Caspian Sea. Much of the country is semi-arid to arid steppe, except for the southeast which rises to the Tian Shan Mountains. Extensive economic reforms underpinned economic development and drastic reductions in poverty, though the spatial pattern remains varied.

Flood risk is much more pronounced than earthquake risk in Kazakhstan, with heavy rainfall and snow melt causing significant damage. Average annual loss (AAL) from flooding is estimated at $419 million, more than seven times higher than the $58 million for earthquake. Over the 100-year return period, flood loss is modelled at $1.8 billion, approximately 1% of Gross Domestic Product (GDP). The 100-year return period for earthquake is over $1 billion (0.66% GDP).

The significance of flood risk in Kazakhstan is further reinforced by estimates of average annual loss of life. At over 390 deaths per year, this is two-thirds higher than any other CAREC member state, whilst more than 156,000 people are expected to be affected by flooding on average each year. Earthquakes are estimated to cause an average of 42 deaths per year, in the middle of the range for CAREC countries, with more than 44,000 affected annually.

Historic events illustrate the potency of disaster events. Between 1990 and 2019, over 150,000 people were affected by flooding, and over 36,000 affected by earthquakes. Flooding caused at least $350 million of damage during the same period. In early spring 2010, heavy rainfall and melting snow breached the Kyzyl-Agash reservoir in the Almaty region and led to one of the worst flood events in the history of the country.

Figure 1: Regions of Kazakhstan



[1] World Bank Open Data 2019

[2] National Geophysical Data Center / World Data Service (NGDC/WDS): NCEI/WDS Global Significant Earthquake Database. NOAA National Centers for Environmental Information. doi:10.7289/V5TD9V7K.

Box 1: Key facts

GDP: 180,160,000,000 (2019) | **Population: 18,750,000 (2020)**

1 IN 100 YEAR FLOOD ECONOMIC LOSS	1 IN 100 YEAR EARTHQUAKE LOSS	AVERAGE ANNUAL LOSS FLOOD	AVERAGE ANNUAL LOSS EARTHQUAKE
$1,800,000,000	**$1,100,000,000**	**$419,000,000**	**$57,600,000**

AVERAGE ANNUAL PEOPLE AFFECTED FLOOD	AVERAGE ANNUAL PEOPLE AFFECTED EARTHQUAKE	AVERAGE ANNUAL PEOPLE AFFECTED INFECTIOUS DISEASE
156,000	**44,028**	**159,688**

EVENT FREQUENCY WHERE FLOOD LOSS EXCEEDS EXISTING COVER	EVENT FREQUENCY WHERE EARTHQUAKE LOSS EXCEEDS EXISTING COVER
1 IN 10	**1 IN 75**

**Note: Average annual losses (AALs) do not refer to the actual losses that the country has experienced yearly in the past. AALs refer to the potential impact that the country could experience on average every year in the future. These figures have been estimated based on global earthquake and flood models as well as taking into consideration other factors such as seismicity, precipitation patterns, and climate variability, among others. More information on the methodology for the modelled estimates can be found in the Technical Note.*

Prior to the COVID-19 outbreak, Kazakhstan has had no significant historic pandemic events since 1990. Most of Kazakhstan experiences little seismicity. Activity is generally concentrated on the southern border with PRC, Kyrgyz Republic and Uzbekistan. There have been reports of two events of notable magnitude (8.3 and 7.3) in 1887 and 1889 close to Almaty.

Since the 1960s, Kazakhstan has experienced significant warming. Average annual temperatures have increased each decade, with three of the hottest years on record since 2013. Precipitation scenarios for the 2050s indicate that mean annual precipitation is likely to slightly increase (between 10 and 20%) for much of the country. Heavy rainfall events are also likely to increase whilst high to medium frequency events could become more intense. For example, what was the 1-in-100-year event is likely to become a 1-in-50-year event by the 2050s.

There is no formal disaster risk financing policy. Reserves exist at a national and municipal level, though these tend to be insufficient for financing the recovery and reconstruction from floods and earthquakes. Funding gaps from recent flooding, such as in 2015, underscore the importance of formal risk financing.

Kazakhstan has a number of reserve funds and contingency arrangements to finance disaster risk. The National Reserve Fund and Contingency Reserve are anticipated to total $843 million, currently sufficient to cover the AAL of flood and earthquake combined. This is a promising position, particularly amongst CAREC member states. However, looking at the impact of more extreme events current financing arrangements might be exhausted by an earthquake event 1 in 75-year when considering indirect losses. For floods, a 1 in 10-year event might cause the exhaustion of existing financing mechanisms if all losses were to be met by these arrangements

Risk analysis

The extent and geographic pattern of earthquake, flooding, and infectious disease across Kazakhstan 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.

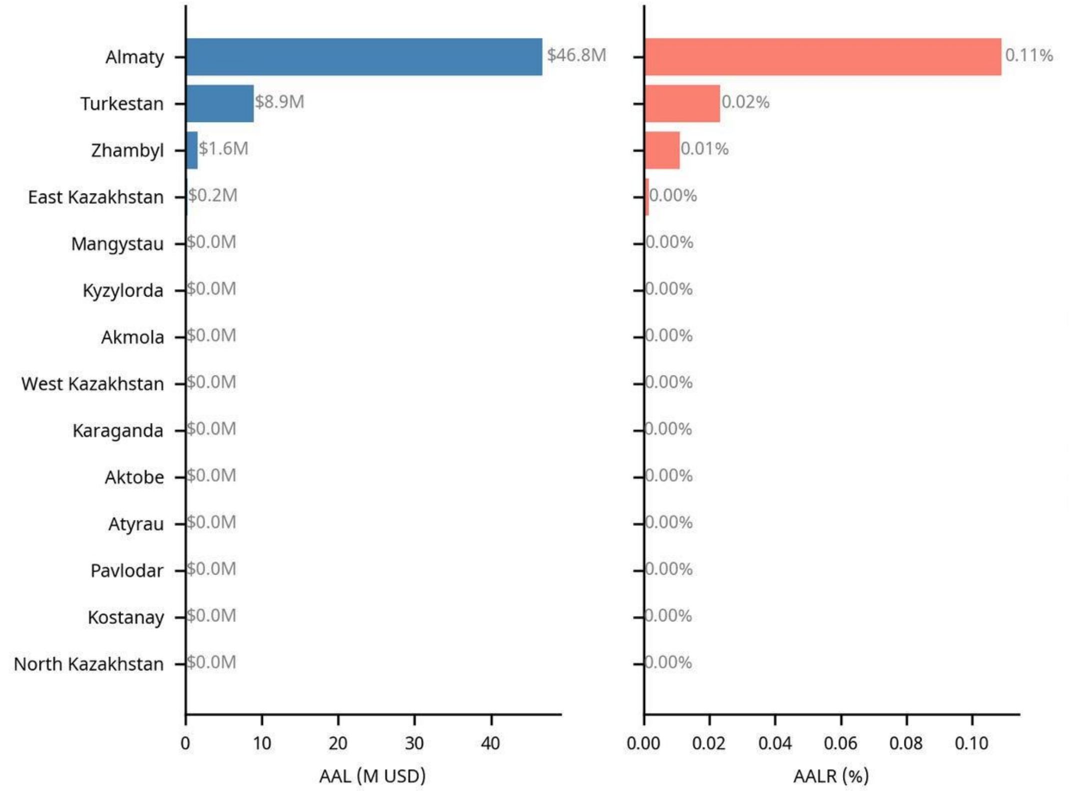
Earthquake Risk

Average annual loss due to earthquakes in Kazakhstan is estimated at $57.6 million. Almaty has the highest average annual loss (AAL) in the country at $46.8 million, followed by Turkestan and Zhambyl at $8.9 million and $1.6 million respectively. As illustrated in Figure 2, these three regions alone account for nearly 100% of the total AAL and earthquake risk is effectively non-existent across the rest of 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



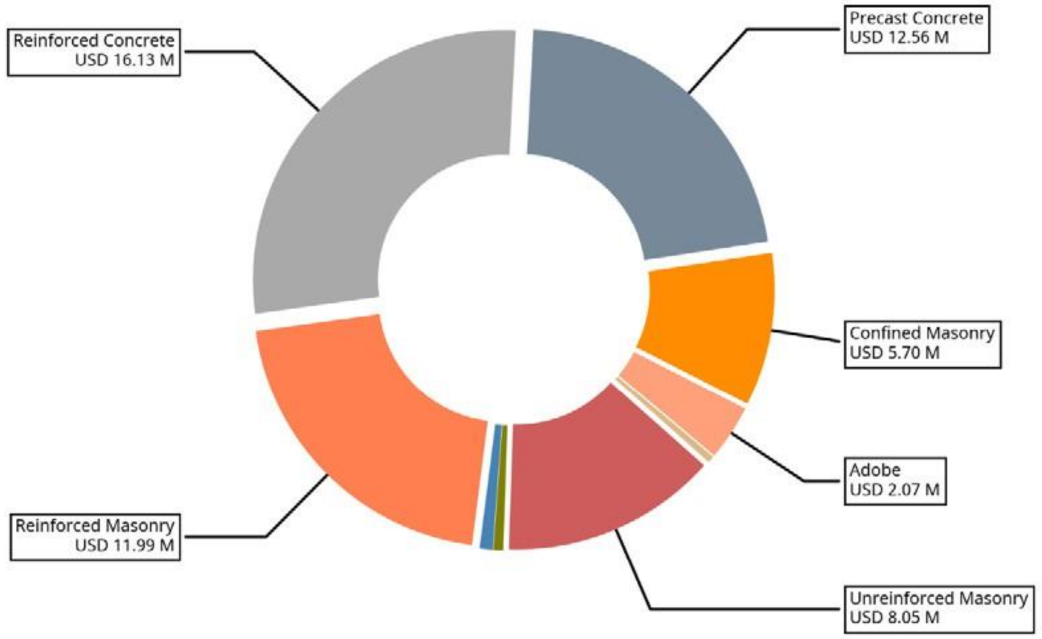
Source: Global Earthquake Model

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 for the different regions of Kazakhstan (left) alongside the AALR for each region (right), expressed as a percentage of the total replacement value of buildings in the respective regions.

Looking at the relative risk, Almaty is also the region with the highest AALR, followed again by Turkestan. The concentration of seismic risk is notable as well as the lack of risk across the rest of the country. The high level of economic development in Almaty combined with the seismic risk means this region dominates total loss

Figure 4: Average annual loss by asset types - earthquakes



Source: Global Earthquake Model

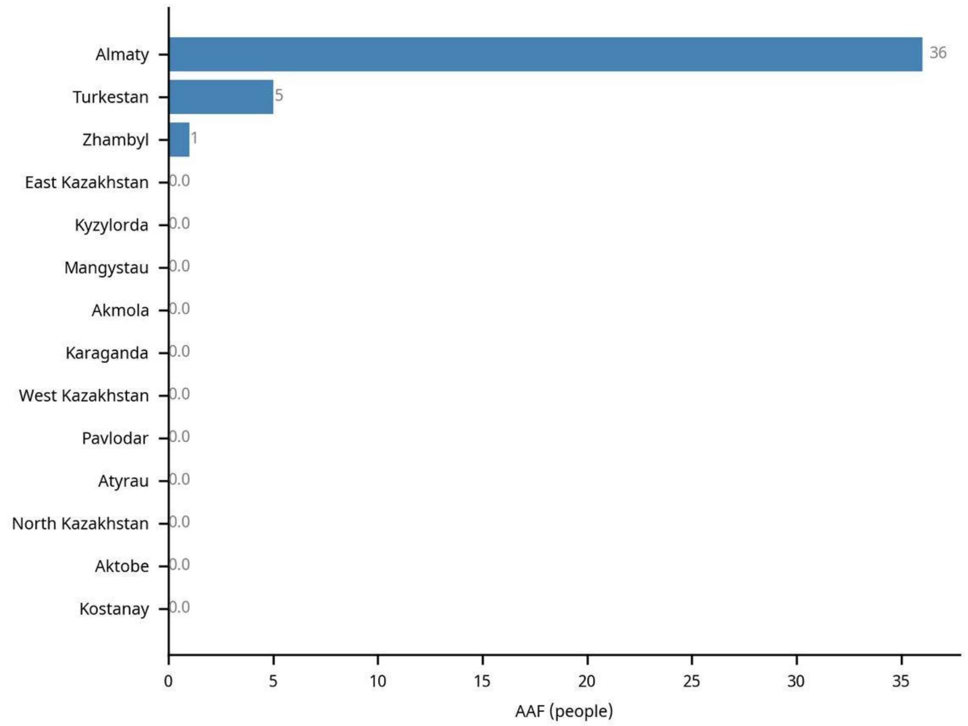
Figure 4 shows the disaggregation of the AAL due to earthquakes by primary construction type. Reinforced concrete structures contribute the most to the overall average annual loss at $16.1 million, followed by precast concrete structures with an AAL of $12.6 million.

THE REGIONS OF ALMATY, TURKESTAN AND ZHAMBYL ACCOUNT FOR NEARLY ALL SEISMIC RISK IN KAZAKHSTAN

Figure 5: Average annual fatalities - earthquake

Source: Global Earthquake Model

Figure 6: Breakdown of earthquake average annual fatalities by region



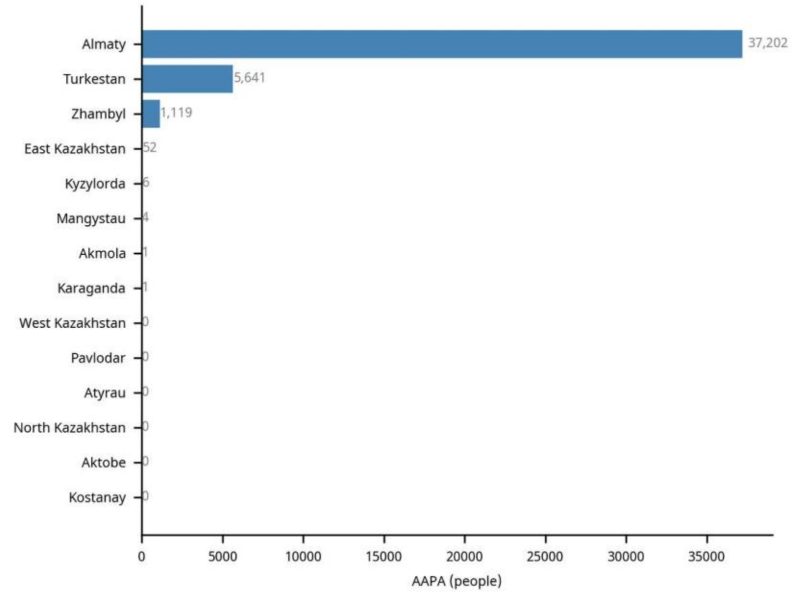
Source: Global Earthquake Model

Average annual fatalities due to earthquakes are estimated at 42 in Kazakhstan. The geographical distribution as shown in Figure 5 and Figure 6 mirrors that of the average annual economic loss. Almaty has the highest AAF in the country at 36, followed by Turkestan and Zhambyl at 5 and 1 respectively. The remaining regions have very low modelled AAF values.

Figure 7: Average number of people affected – earthquake

Source: JBA Risk Management

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

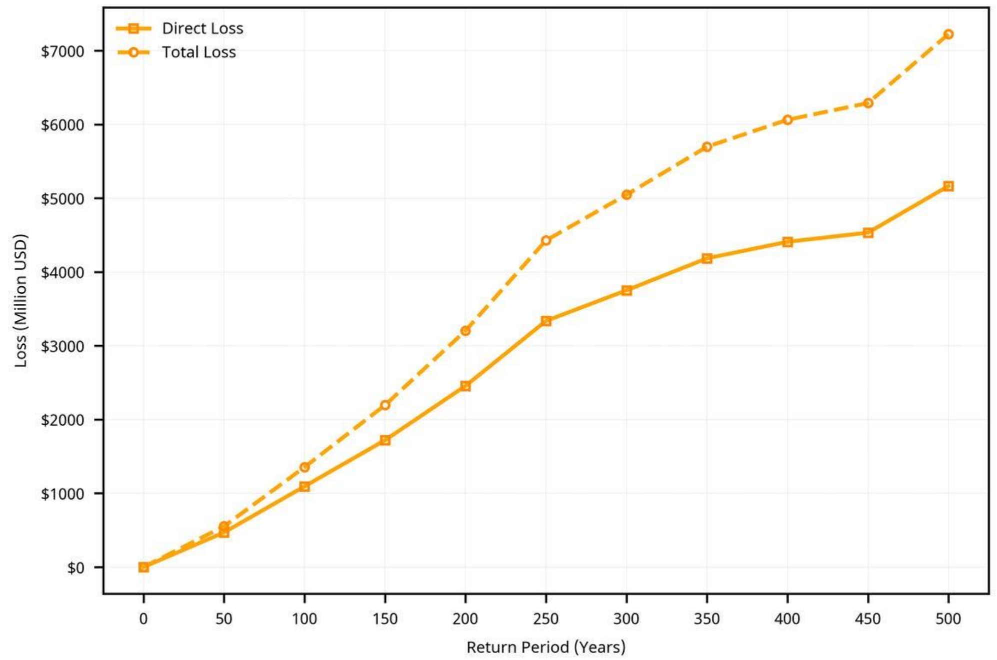


Source: Global Earthquake Model

The number of people affected by earthquakes is defined as the population that can be expectedto witness earthquake-caused ground shaking of Modified Mercalli Intensity (MMI) VI or higher (corresponding to strong shaking, capable of causing slight damage or higher). 44,028 people are estimated to be affected by earthquakes on an average annual basis in Kazakhstan. As expected, Almaty has the highest average annual number of people affectedin the country at 37,202, followed by Turkestan and Zhambyl at 5,641 and 1,119 respectively.

The average annual people severely affected by earthquakes is estimated at 6,421, where the number of people severely affected by earthquakes is defined as 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). Table 1 shows the AAL numbers on people impacted and fatalities.

Figure 9: Exceedance probability curves – earthquakes



Source: Global Earthquake Model

The exceedance probability curves in Figure 9 show the total direct and total overall loss from all earthquake events in any given year for the displayed return periods. Direct loss displays the modeled loss to residential, commercial and industrial units. Total loss accounts for secondary impacts from the onset of disaster events, accounting for the reconstruction time.

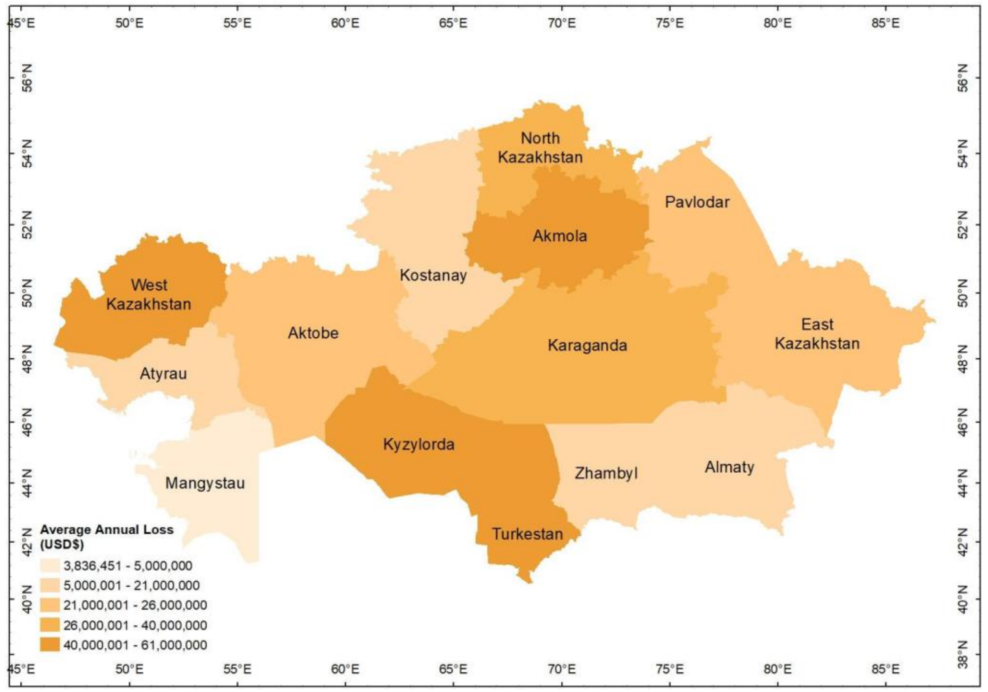
Direct loss increases from $482.8 million for the 50-year return period, to over $5 billion for the 500-year return period. The EP curve for direct loss shows that earthquake loss is modelled at around $1.1 billion at the 100-year return period for Kazakhstan, which is approximately 0.66% of the country's nominal GDP. Total loss levels are similar to direct loss up to the 50-year return period but increase more rapidly from that point on. At the 500-year return period total loss increases to over $7 billion.

Flood Risk

AAL from flooding is estimated at $419 million in Kazakhstan. As shown in Figure 10, the spatial pattern of flood risk is much more varied than that of earthquake. Damage is greater than $30 million across many provinces in north, south and central Kazakhstan. Kyzylorda records the largest AAL, at $60 million. In West Kazakhstan, Akmola and Turkestan, AAL exceeds $40 million annually.

ALL REGIONS OF KAZAKHSTAN EXPERIENCE SIGNIFICANT FLOOD RISK

Figure 10: Average annual loss – flood



Source: JBA Risk Management

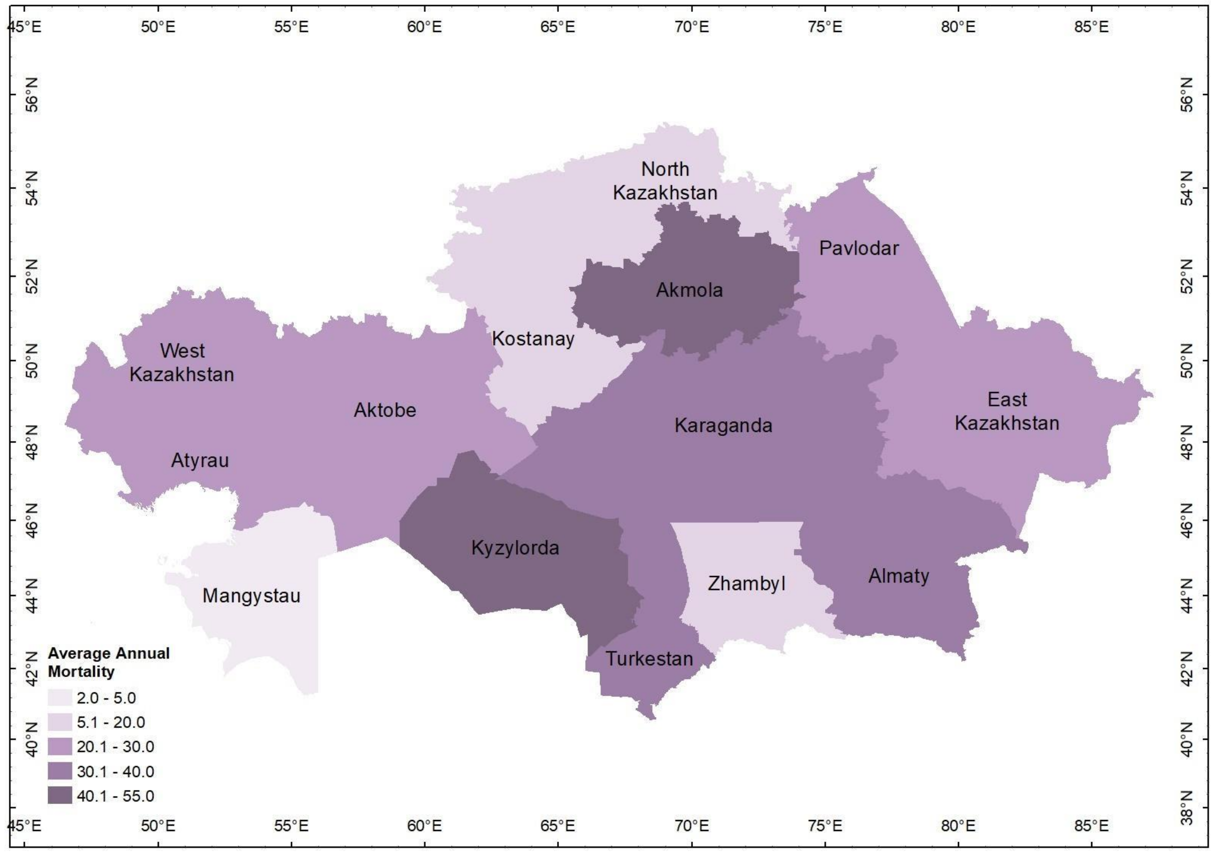
Source: JBA Risk Management

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

Source: JBA Risk Management

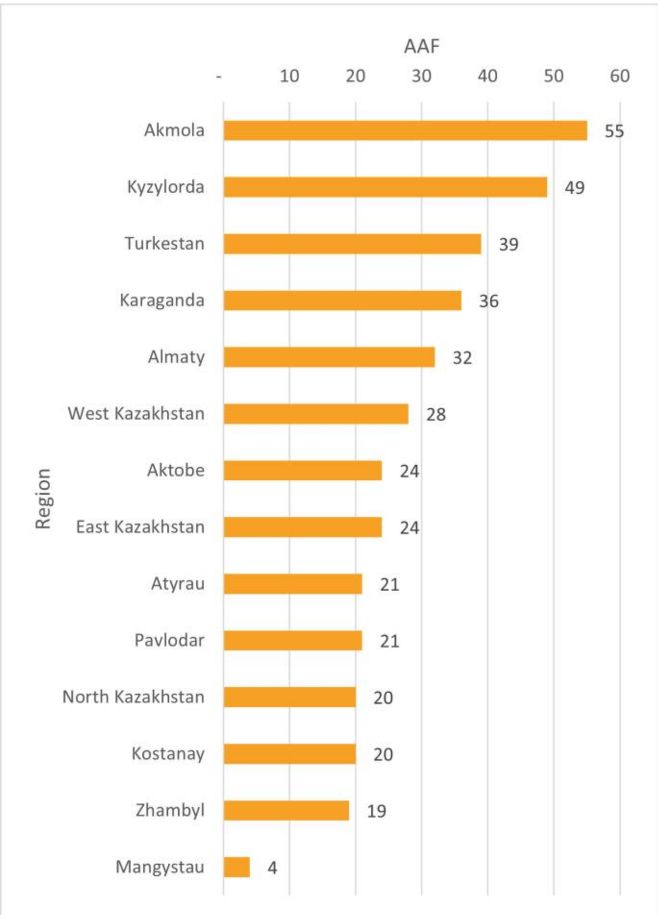
Figure 11 provides the breakdown of flood average annual losses including the average annual loss ratios by region. Larger loss ratios are apparent in Kyzylorda and West Kazakhstan, indicating higher losses as a proportion of total exposure. The Syr Darya River flows southeast to northwest through populated cities in Turkestan and Kyzylorda, creating potential for higher intensity flood events. The Syr Darya drains the mountains on the southern border with Uzbekestan and Kyrgyz Republic where greater annual precipitation is recorded. In West Kazakhstan, numerous rivers including the Ural River flow through several towns and cities before draining into the Caspian Sea.

Figure 12: Average annual fatalities – flood



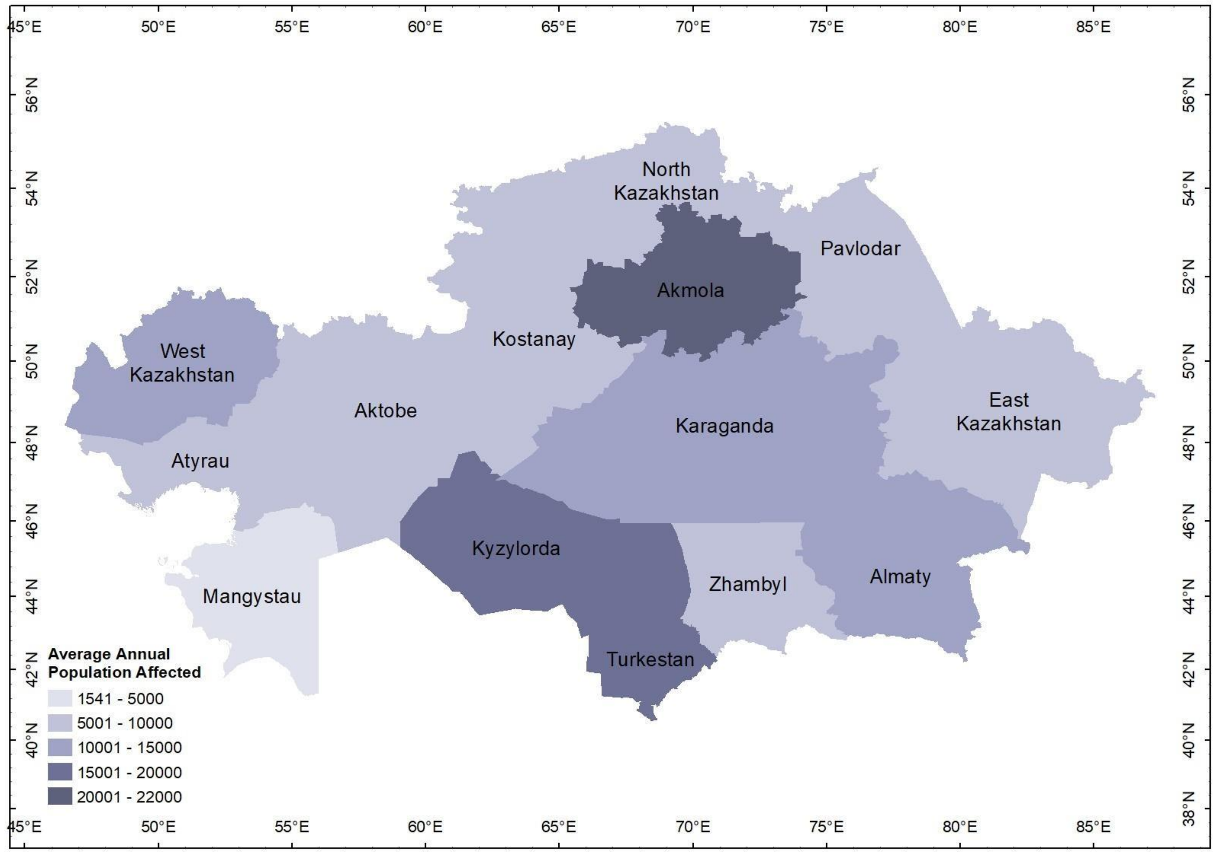
Source: JBA Risk Management

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



Kazakhstan has the largest average annual fatalities from flooding across all CAREC countries, at 392. As shown in Figure 12 and Figure 13, fatalities are distributed across Kazakhstan, with Akmola in the north and Kyzylorda in the south recording the highest figures at 55 and 49 respectively. The Ishim River flows through Akmola, including the populous capital city of Nur-Sultan. Average annual fatalities also exceed 30 in Turkestan, Karaganda, and Almaty. These provinces are some of the most populated in Kazakhstan.

Figure 14: Average annual people affected – flood

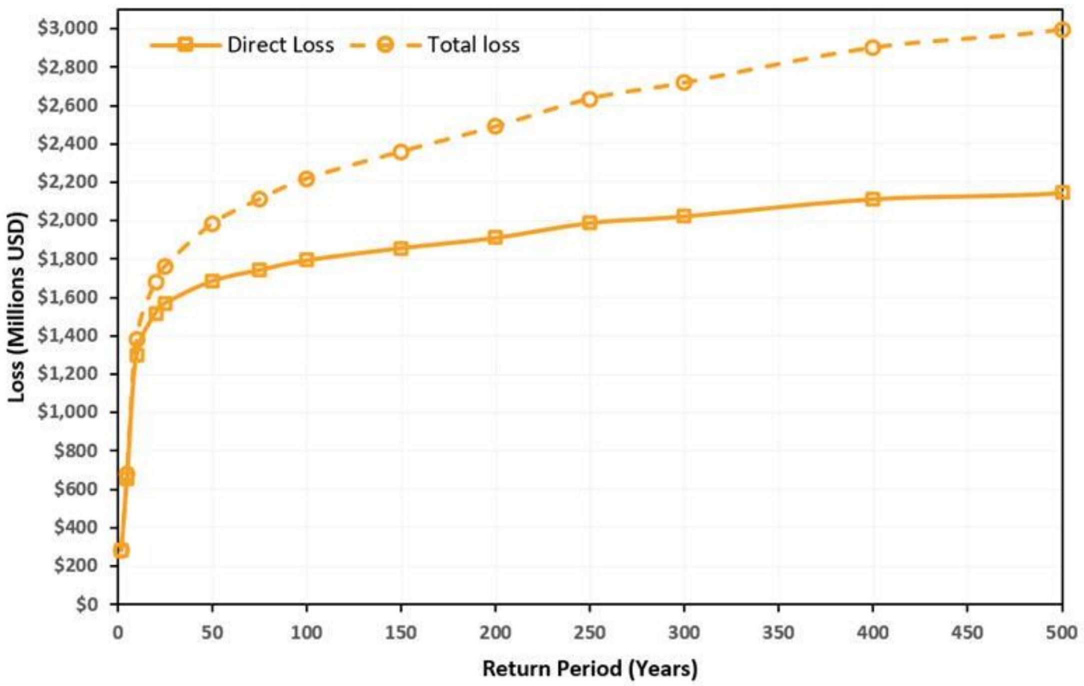


Source: JBA Risk Management

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

Average annual people affected (AAPA) by floods is around 156,000 in Kazakhstan. The geographical distribution is similar to that of average annual fatalities, with the greatest number of people affected in Akmola and Kyzylorda, where AAPA is over 19,000 in both provinces. Over 10,000 people are also affected annually in Turkestan, Karaganda, Almaty and West Kazakhstan.

Figure 16: Exceedance probability curves – floods



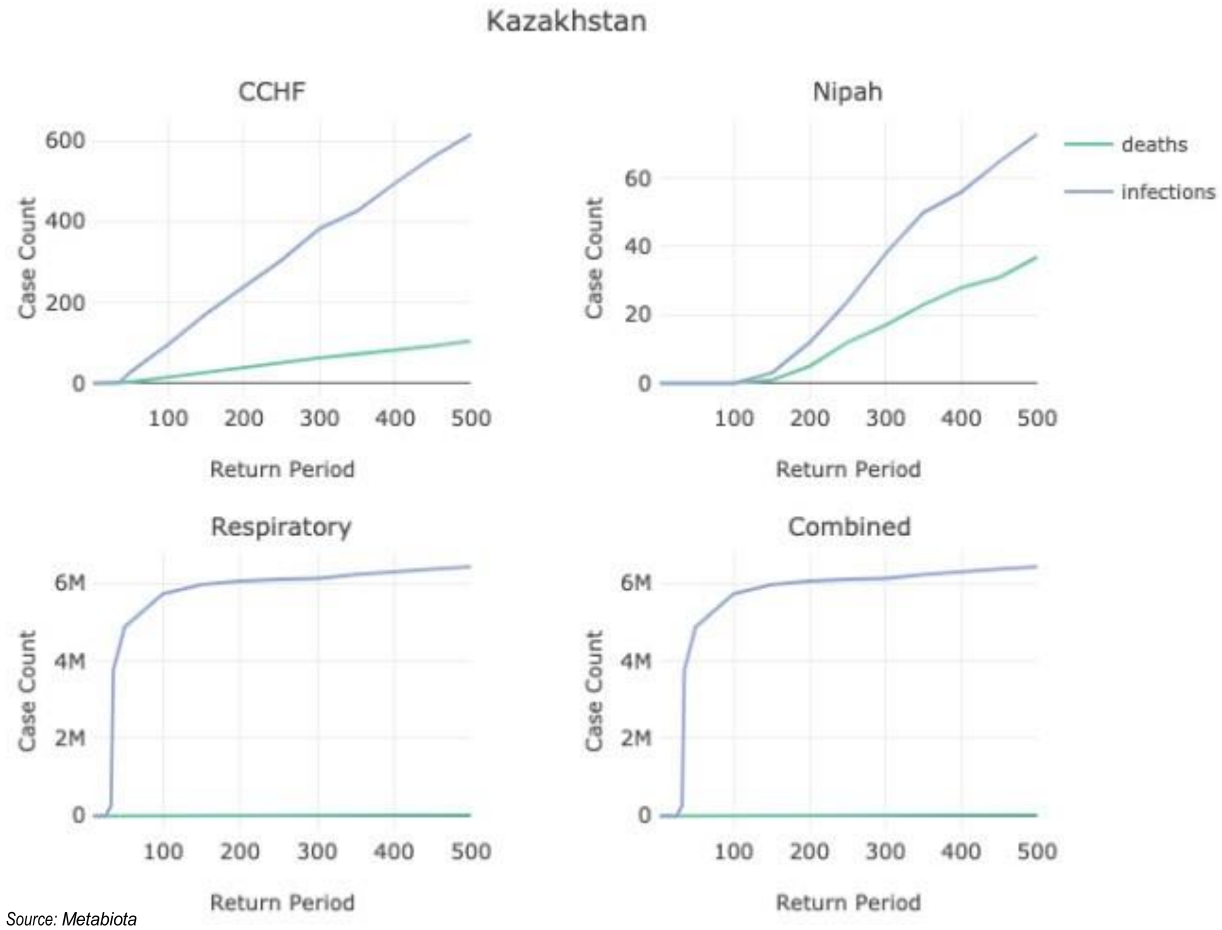
Source: JBA Risk Management.

The exceedance probability curves in Figure 16 show the direct and total loss from all flood events in any given year for the displayed return periods. Loss increases most significantly between the 2 and 25-year return periods, which indicates susceptibility to floods at these return periods. Loss increases at a slower rate between the 25-year and 500-year return periods. The EP curve shows that direct flood loss is modelled at nearly $1.8 billion at the 100-year return period for Kazakhstan, which is around 1% of the country's nominal GDP.

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 modelled 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 modeled as part of this analysis. The pathogen EP curves for Kazakhstan 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. Table 1 shows the AAL numbers on people impacted and fatalities

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	159,668	340
Respiratory	159,626	322
Nipah	34	17
CCHF	8	1

Source: Metabiota

[3]https://www.who.int/news-room/fact-sheets/detail/crimean-congo-haemorrhagic-fever
[4]WHO: https://www.who.int/news-room/fact-sheets/detail/nipah-virus

CHAPTER 2

Historical losses and impacts

Kazakhstan is prone to a number of natural hazards, particularly flooding and drought. These hydrometeorological hazards contribute substantially to agricultural losses, as well as other economic losses. Seismic activity is largely confined to the southeast of the country, but has contributed to losses in that region. Flooding and earthquake are responsible for loss of life, injuries and displacement.

Table 2 shows over 150,000 people were affected by flooding, and over 36,000 affected by earthquakes between 1990 and 2019. Floods caused over $350 million in estimated damages during the same period.

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

	Fatalities	Number of people affected	Total damage ($ million; constant 2019)
Flood	64	151,547	353.7
Earthquake	5	36,626	
Drought			

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.

Table 3 supports the modeling results, underlining that flooding is a significant problem in Kazakhstan. Floods from heavy rainfall and snow melt during spring frequently hit the country, with Akmola, East Kazakhstan, Turkestan, West Kazakhstan and North Kazakhstan most at risk.[3] In April 2015, unexpected warm weather caused flooding affecting ~15,000 people and damaging around 1,700 buildings.[4] A similar event in 2017 inundated 7 regions of the country, with 7,000 people affected and 1,500 buildings damaged.[5]

The costliest flood in recent years occurred in 2008, with total losses estimated at $130 million. A sudden rise in temperatures in February caused an increase in snowmelt that combined with heavy rainfall resulted in floods in Turkestan.[6] In 2010, floods caused 40 deaths and close to $ 40 million in losses, whilst floods in 2011 caused a further $70 million of losses.

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

Year	Location	Total damage ($ millions; constant 2019)	Fatalities	Number of people affected
Floods				
2008	Saryaghash, Ordabasy, Arys, ShymkentCity area, Shardara districts (Turkestan region), Kyzylorda region	154.4	1	13,000
2011	Uralsk city (Zelyenov district, West-Kazakhstan region), Akzhaiyk, Burlin, Kaztalov, Chingirlau, Taskaly, Terekty districts (West-Kazakhstan region)	76.1	2	16,000
1993	Embinskyi, Kzylkoga, Denizskiyi districts (Atyrau region), West-Kazakhstan region and Aktobe region	64.7	10	30,000
2010	Karasay, Karatal, Zhambyl, Ili, Panfilov, Koksu, Uigyr, Aksu, Kerbulak, Taldykorgan City area districts (Almaty region)	40.5	44	16,200
2005	Kyzylorda region	10.0		25,000
2015	Temirtaou city (Bukhar-Zhyrau district, Karaganda region), Karkaraly, Shet, Abai district (Karaganda region), Akmola, Pavlodar regions	5.7	2	12,670
2000	Denisov, Zhitikara, Taran, Kostanay districts (Kostanay region)	2.2	1	2,500
Earthquakes				
1911	Almaty, Turkestan		450	
2003	Zhambyl district (Zhambyl region)		3	
1990	Oskemen, Zaysan			36,626

Source: EM-DAT with validation from other sources including Asian Disaster Reduction Center (ADRC) and MedCraveOnline for floods; NOAA Significant Earthquakes database for earthquakes

[3] *UNESCAP (2018) Republic of Kazakhstan: Risk Profile https://www.unescap.org/sites/default/files/Kazakhstan%20Disaster%20Risk%20Profile.pdf*
[4] *UNESCAP (2018) Republic of Kazakhstan: Risk Profile https://www.unescap.org/sites/default/files/Kazakhstan%20Disaster%20Risk%20Profile.pdf*
[5] *FloodList (2017) Kazakhstan – 7,000 Evacuated After Snowmelt Causes Floods in 7 Regions http://floodlist.com/asia/kazakhstan-snowmelt-floods-april-2017*
[6] *ReliefWeb (2008) Kazakhstan: Floods Situation Report No. 2 - 19 Mar 2008 https://reliefweb.int/report/kazakhstan/kazakhstan-floods-situation-report-no-2-19-mar-2008*

Table 4: Notable infectious disease outbreaks, 1990-2021

Prior to the COVID-19 outbreak, Kazakhstan had no significant historic pandemic events since 1990

Pathogen	Date first case reported	Date last case reported	Total cases	Total deaths	Location of origin
2019 Novel Coronavirus (2019-nCoV)	3/14/20	10/20/20	145,473	2,178	People's Republic of China

Source: Metabiota's infectious disease database

Hazard

Kazakhstan is a large country, by far the largest by size of all CAREC member states, with a varying landscape across the 2000km from the Caspian Sea in the West to PRC in the east. Steppe grasslands, deserts and plateau form much of the centre of country, with the Tian Shan mountains forming part of the southern border with PRC and the Kyrgyz Republic and Altai mountains in the east with the Russian Federation.

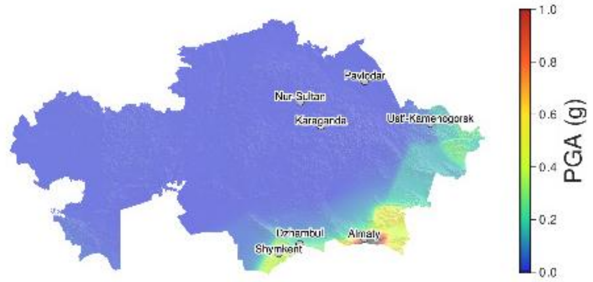
Seismic hazard

Most of the Kazakhstan belongs to a stable zone with little or no seismicity of significant size.[7] Seismicityin the country concentrates along the southernborder with PRC, Kyrgyz Republic and Uzbekistan.

The Global Historical Earthquake Catalogue reports two events of notable magnitude (8.3 and 7.3) that occurred in 1887 and 1889 close to Almaty. An earthquake of magnitude 7.2 in 1260 on the eastern coast of the Caspian Sea was also recorded. In the proximity of the border with Uzbekestan, the only earthquake of notable size was the 1929 magnitude 6.38 earthquake that happened in a desert area. As displayed in Figure 18 and Figure 19, the region with the highest values of the peak ground acceleration with a 10% probability of exceedance in 50 years (PGA10%50yr) on reference site conditions (Vs30 of 800 m/s) is close to the cities of Almaty and Taldykorgan. Here the PGA10%50yr is larger than 0.1g and can reach values over 0.5g. The rest of the country presents values of hazard lower than 0.05g.

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

[7] *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 Kazakhstan in Figure 20 show the structure of the hydrological basins across the country. There are relatively large areas in the central region, where the river network is very sparse. Smaller, narrower zones along the northern and south-eastern borders may be an indication of steep-sided valleys in which surface water (flash) flooding is more common. All of Kazakhstan's 7,000 rivers and streams are part of a landlocked system. They either flow to the Caspian Sea, the Aral Sea or other isolated water bodies (e.g. Lake Baikhash), or drain into the deserts of central and southern Kazakhstan. Much of Kazakhstan is arid and relatively flat, with few rivers and isolated population centres. The smaller HAZ polygons to the south and east reflect the more mountainous nature of the terrain in this region bordering the Kyrgyz Republic and PRC.

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 highlights the main rivers of Kazakhstan. This event severity is often used for planning purposes as a plausible extreme event.

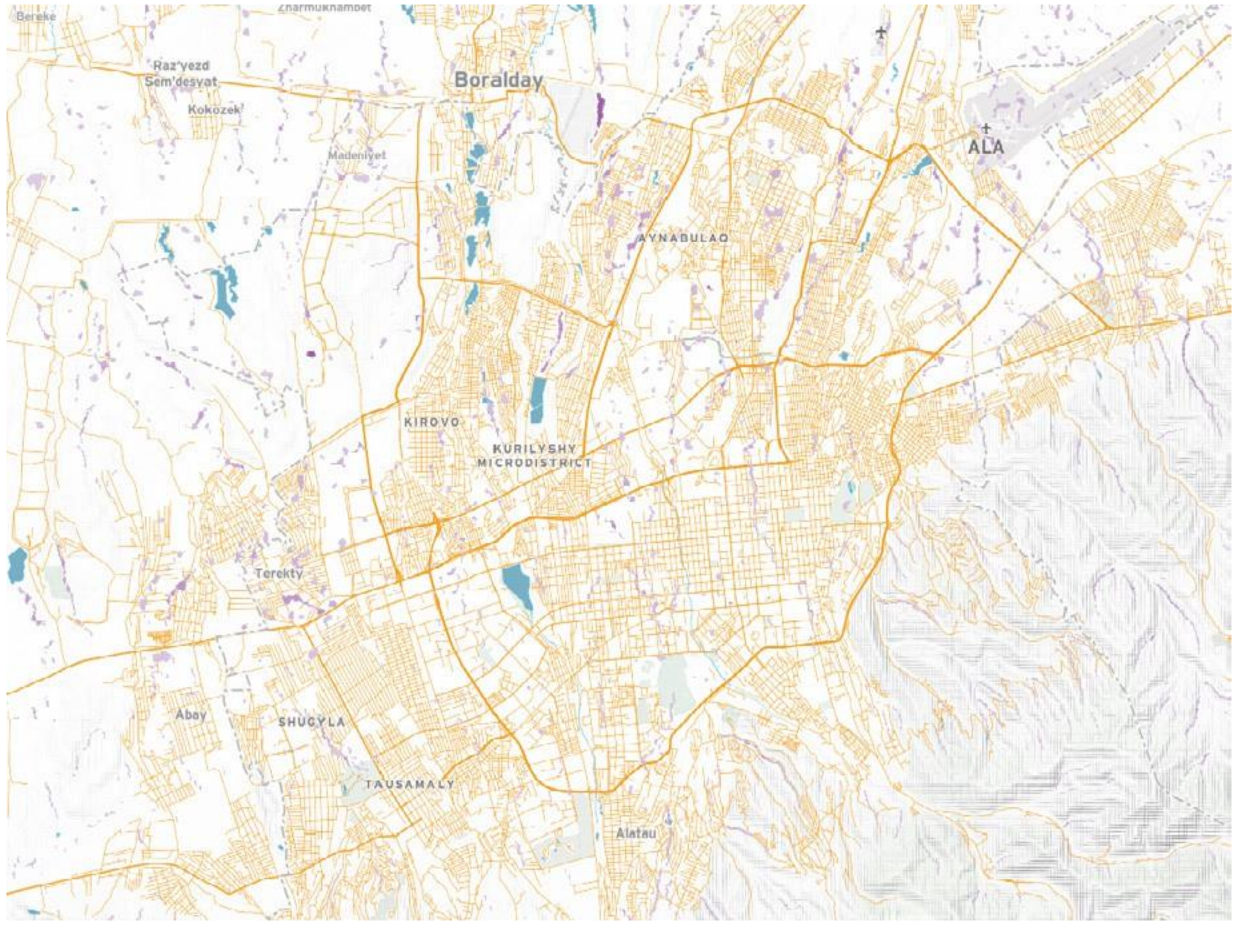
The flood map in Figure 21 shows the large number of rivers that drain into the Caspian Sea in western Kazakhstan. The Ural River runs south from the border with the Russian Federation through several towns and cities including Atyrau to meet the northern shore of the Caspian Sea. To the west of the Ural River valley is a large area of mainly flat agricultural land at risk from flooding but sparsely populated. There is a wide, shallow river valley running north through central Kazakhstan, which meets the Tobol River at the border with the Russian Federation. Although sparsely populated, there are small settlements within this area of flood risk.

To the south, Syr Darya flows from the mountains of Tajikistan and Uzbekistan through southern Kazakhstan in an arc to the Aral Sea. The city of Kyzylorda and several towns sit within the river valley. In eastern Kazakhstan, a number of small rivers drain into Lake Baikhash from the surrounding hills. In the northeast the main river is the Irtysh, which drains from high ground in PRC through Lake Zaysan and the cities of Oskemen, Semey and Pavlodor to the Russian border. The river is controlled by dams for hydroelectric power in at least two places.

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

Source: JBA Risk Management

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



Source: JBA Risk Management

The flood map of Almaty in Figure 22 shows some areas at risk to surface water flooding. Almaty is in the foothills of the Trans-Ili Alatau range of mountains on the border with the Kyrgyz Republic. Narrow valleys running south to north through the southern suburbs of the city present a risk from surface water flooding and mudflows, which have led to the construction of dams to minimise the risk (e.g. Medeu Dam).

FLOOD RISK IN ALMATY RUNS FROM NORTH TO SOUTH THROUGH THE CITY.

Climate conditions

Historic climate

Kazakhstan has diverse climate zones spanning arid desert in the southwest to mixed continental climates heading northeast. These climate zones are shaped by the country's varied topography. The average elevation of Kazakhstan is between 200 and 300m with broad swathes encompassing steppe ecosystems. The highest elevation of 7,010m is located in the Tian Shan Range on the south-eastern edge and the lowest point - 132m below the sea level - near the shore of the Caspian Sea.

There are stark temperature differences between the seasons. Mean maximum temperatures in July can rise as high as 40°C in the desert and low-elevation steppes, and drop to a mean January temperature of -15°C.

Likewise, there are distinct precipitation zones that can be roughly divided into: the northern semi-steppe and steppe zone; the mountainous zone; and the semi-desert and desert zone in the south central and west of the country.[8] Precipitation is concentrated in the northern/eastern third of the country – ranging from an average annual total of 250 to 350mm at lower elevations and up to 1000mm in the high mountain areas – and falling to <100 to 200 mm in the arid zones – as shown in Figure 23 and Figure 24. Precipitation falls predominantly in the summer season (~May through August) in the first zone, whereas winter and spring precipitation dominate the other zones.

Figure 23: Annual mean precipitation between 1951-2007

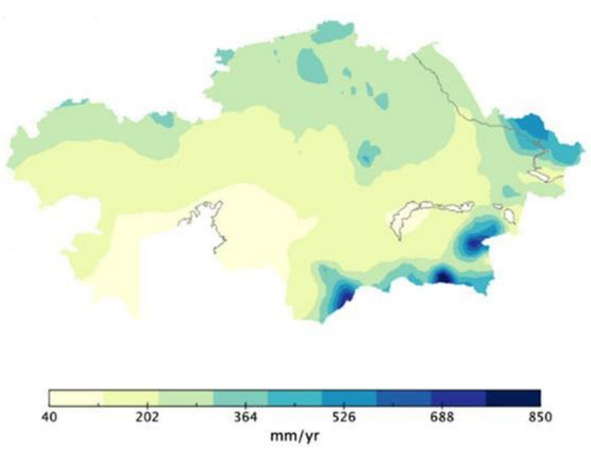
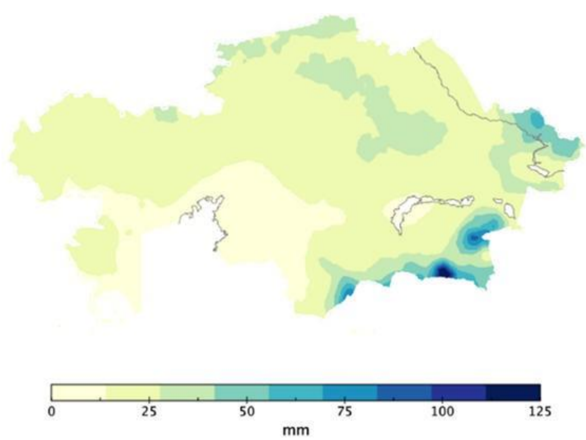


Figure 24: April-June (primary flood season) mean precipitation between 1956-1995

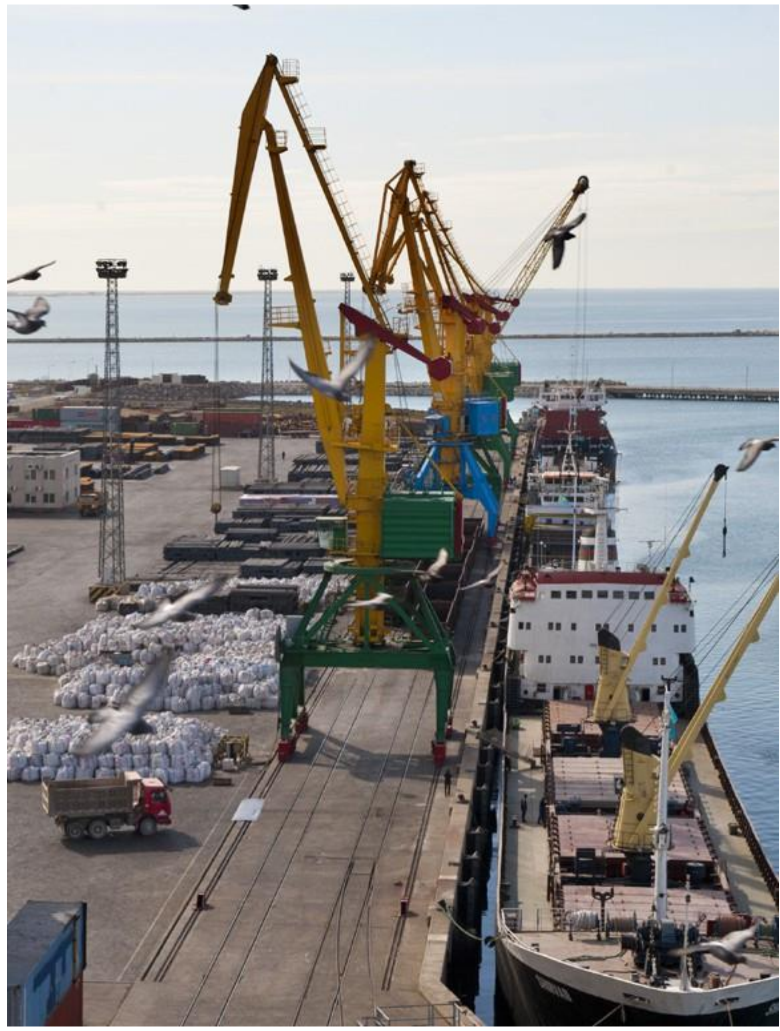


Note: the precipitation scales are different between the annual and seasonal means.
Source: ODI analysis using APHRODITE[9] Russia domain precipitation dataset.

[8]*Dubovyk, O., G. Ghazaryan, et al. (2019) 'Drought hazard in Kazakhstan in 2000-2016: a remote sensing perspective'. Environmental Monitoring and Assessment, https://doi.org/10.1007/s10661-019-7620-z*

Since the 1960s, Kazakhstan has experienced significant warming. Average annual temperatures have increased by approximately 0.28°C/decade over the period 1941-2011,[10] with three of the hottest years on record since 2013. High mountain areas are warming, leading to glacial retreat and loss of small glaciers in some areas of the Tian Shan mountains.[11] No statistically significant precipitation trends have been observed and there is considerable year-to-year variability. However, over the recent period 2000-2016, four near countrywide droughts have occurred, leading to widespread agricultural losses and coinciding with extensive fires in neighbouring Siberia.

Flooding is more likely during the spring and early summer months, when snowmelt swells river flows. Rapid onset temperature increases can trigger rapid snowmelt and flooding, as happened in the flash floods across Akmola, Karaganda and Pavlodar in April 2015. Short-duration, heavy rainfall events alone, such as the one impacting Almaty in 2016, can contribute to flooding and mudslides. Heavy rainfall events combined with rapid temperature increases can exacerbate flood magnitudes.



[9]*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*
[10]*Salnikov, V., G. Turulina, et al. (2014) 'Climate change in Kazakhstan during the past 70 years', Quaternary International, http://dx.doi.org/10.1016/j.quaint.2014.09.008*
[11]*Kaldybayev, A., Y. Chen and E. Vilezov (2016) 'Glacier change in the Karatal river basin, Zhetysu (Dzhungar) Alatau, Kazakhstan'. Annals of Glaciology, doi: 10.3189/2016AoG71A005*

Future precipitation projections

Box 3 describes the methodology behind the future climate calculations. There are spatial differences in projected changes to annual mean precipitation dependent on the emissions scenario. Under RCP4.5, annual mean precipitation could increase up to 20% for areas bordering the Aral Sea and a corridor extending into parts of Aktobe and western Kostanay. Slight annual mean precipitation increases between 10 to 20% are projected for two-thirds of the country (excluding the northcentral and northeast) under RCP8.5, with areas of Mangystau potentially experiencing increases between 30 and 60%. Likewise, late winter (January-March) mean precipitation increases are projected across a greater extent of the country under RCP8.5 than RCP4.5 (confined predominantly to northern semi-steppe and steppe zone). Over the semi-desert and desert areas of the southwest, mean precipitation increases are projected predominantly in the April to June period under both RCPs. The projections should be treated with caution, as they are only from two models. Temperature increases will offset any potential increases in precipitation and lead to greater evapotranspiration.

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

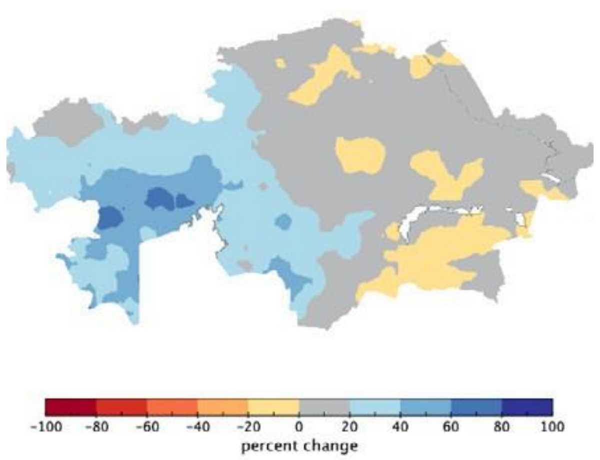
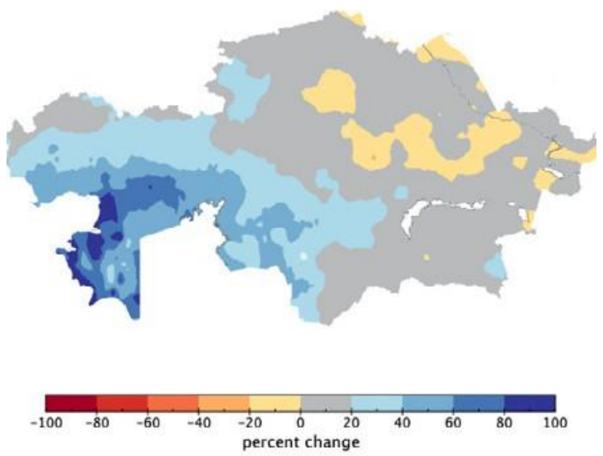


Figure 26: RCP 8.5 2050 April-June precipitation percentage change



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

Precipitation extremes from each model and RCP were individually used to calculate future precipitation intensities, which is relevant to estimating future flood risk. The area-averaged March to September annual maximum rainfalls for 24-hr duration for each province was extracted and analysed for different return periods (2, 5, 10, 20, 50, 100, 200-, 500-, 1000-, 1500-, 5000- and 10000-year events). Higher to medium frequency events (e.g., 1 in 2-yr to 1 in 100-yr) events are projected to increase across much of the country under RCP4.5 and RCP8.5. These are shown in Figure 25 and Figure 26. The multi-model projections indicate that what was once the 1 in 100-yr event is now more likely to be the 1 in 50-yr, and what was the 1 in 20-yr now shifted to the 1 in 10-yr event. There are some exceptions where extreme precipitation events might slightly decrease in intensity or only minimal increases are seen – the eastern regions of Karaganda and Kyzylorda, North Kazakhstan and Zhambyl and northern Turkestan. Extreme 24-duration events are likely to intensify most in Atyrau, the northern part of Mangystau and the eastern part of East Kazakhstan according to the multi-model projections.

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

Return period	1951-2007	2050s	
	Historical	RCP4.5	RCP8.5
20-year	0.63	0.73 (0.72, 0.74)	0.78 (0.77, 0.79)
100-year	0.79	0.89 (0.88, 0.90)	0.96 (0.95, 0.98)
200-year	0.86	0.96 (0.95, 0.96)	1.04 (1.03, 1.05)
500-year	0.94	1.05 (1.04, 1.06)	1.15 (1.13, 1.17)

Source: ODI
Projected changes in 24-hr duration extreme precipitation intensities in Almaty for 2031-2070 (the 2050s) as compared to historical 24-hr intensities for different return periods. The table shows the median of the multi-model ensemble and the 25th and 75th percentiles in brackets.

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.

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 respectively represent a medium and high (business-as-usual) emissions pathway. 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.

Further information on the approach is detailed in the Technical Documentation

CHAPTER 4

Exposure

Kazakhstan is a large Central Asian country that spans some 2.7 million km² and is largely landlocked except for its southwest border adjoining the Caspian Sea. It is bordered by the Russian Federation in the north; the Kyrgyz Republic, Turkmenistan and Uzbekistan to the south; and PRC in its east. Much of the country is semi-arid to arid steppe, except for the southeast which rises to the Tian Shan Mountains.

With abundant natural resources, Kazakhstan pursued an intensive program of industry and agricultural development before shifting to a liberalization agenda and attracting foreign investment. The economic and social development over the past thirty years has been impressive.

Population growth is moderate in Kazakhstan. Between 1992-2001, the country experienced a negative growth rate linked with increased outward migration. Population has since grown steadily from about 14.9 million people in 2000 to 18.8 million in 2020.[12] The rate of urbanisation has also grown steadily, reaching 59% by 2020. While migration continues, overall fertility rate remains above replacement levels at 2.76 children per woman.[13] The country has a sizeable proportion of children below the age of 15 (21%) and the majority (71%) are between the ages of 15-64 (Table 6).

Table 6: Population totals, distribution and trends (all data from 2020)

Population (thousands)	18,785
Population growth date (%/year)	1.21
Share of population living in urban areas (%)	59
Urbanisation rate (%/year)	1.5
% of total population age 0-14	21.6
% of total population age 15-64	71
% of total population ages 65 and above	7.4

Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms (Republic of Kazakhstan), Committee on Statistics of the Ministry of National Economy (Republic of Kazakhstan), World Bank Open Data

Kazakhstan's economy grew rapidly between 2000-2014, moving from a low-income to middle upper income country.[14] The Republic of Kazakhstan's economy grew at a slower, but steady pace between 2015-19, with 4.5% growth in GDP in 2019. Total 2019 GDP was USD 180 billion, or USD 9,731 per capita (Table 7). Its economy is dominated by extractive industries (e.g. crude oil, radioactive chemicals, metal ore and oxides) though export of grain is also important.[15] In 2019, agriculture contributed approximately 7.4% to GDP and is a source of employment for 15% of the working age population, mostly in rural areas.

[12]*The World Bank (2020) 'Kazakhstan: Open data'. (https://data.worldbank.org/country/kazakhstan)*
[13]*Committee on Statistics (2020) Kazakhstan in 2019: Statistical yearbook. Ministry of National Economy of the Republic of Kazakhstan.*
[14]*Whiteshield Partners (2016) Sustainable Development Goals and Capability Based Development in Regions of Kazakhstan. National Human [15]Development Report 2016. UNDP.*
[15]*OEC – the Observatory of Economic Complexity (2021) 'Kazakhstan - Economic Profile'. (https://oec.world/en/profile/country/kaz)*

Kazakhstan's economy is exposed to price fluctuations in the international commodities markets and disruptions to extractive industries and/or crop loss in the event of a natural hazard. The volatility of the oil markets, including during the pandemic, have caused a slow-down in economic growth. A drop in oil prices due to the pandemic had a negative impact on growth in 2020 and early 2021, with an average quarterly loss of -2.2% since the second quarter of 2020.[16,17] The country's economy is projected to grow again in late 2021 or 2022, contingent on lingering regional and global pandemic socioeconomic impacts.

Following the past decades of robust growth, there are concerns Kazakhstan might become stuck in a 'middle income' trap, particularly with digitalization advancing across the world . The government has noted these concerns and is pursuing economic diversification under its medium-term 2025 Development Plan, on the way toward reaching goals specified in its long-term plan Kazakhstan 2050 . This includes expansion into digital services and information and communications technology, as well as investment in infrastructure to connect economically disparate regions. There is also movement to place greater emphasis on green technologies and alternative energy to reduce its reliance on extractive industries.

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

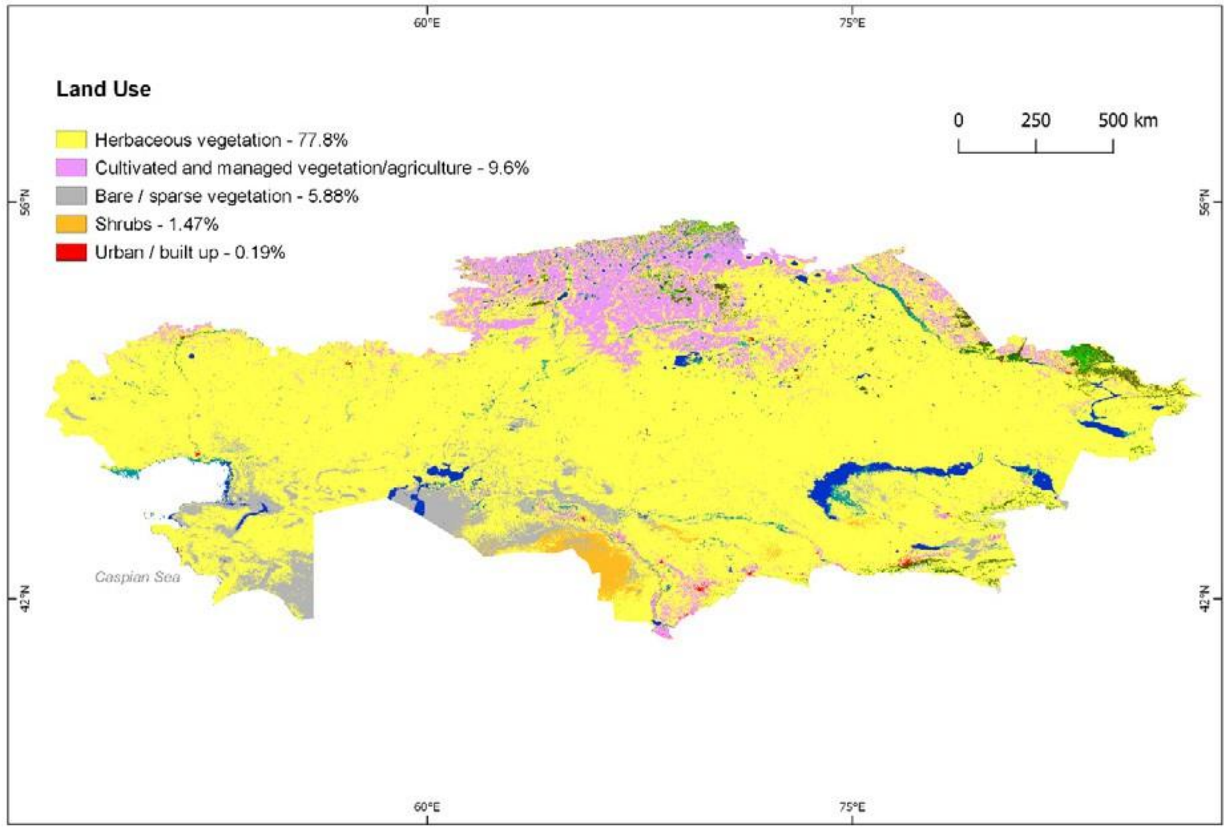
GDP (million USD, current)	180,161.74
GDP per capita (USD, current)	9,731.10
Country / territory economic composition	Country / territory economic composition
Agriculture, forestry and fishing, value added (% of GDP)	7.4
Employment in agriculture (% of total employment) (modelled ILO estimate)	15*
Industry (including construction, value added (% of GDP)	35.6
Employment in industry (% of total employment) (modelled ILO estimate)	20*
Services, value added (% of GDP)	59.7
Employment in services (% of total employment) (modelled ILO estimate)	64*

Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms (Republic of Kazakhstan), World Bank Open Data, ADB Key Indicators Database

[16]*Bureau of National Statistics (2021) 'Main socio-economic indicators'. (https://stat.gov.kz/)*
[17]*Rahardja, S. and Agaidarov, A. (2020) Kazakhstan Economic Update: A Slow Recovery Through the COVID-19 Crisis. The World Bank. (http://documents.worldbank.org/curated/en/792601609750238730/Kazakhstan-Economic-Update-A-Slow-Recovery-Through-the-COVID-19-Crisis)*
[18]*Office of the Prime Minister (2021) 'Стратегический план 2025' (https://www.primeminister.kz/ru/documents/gosprograms/stratplan-2025)*
[19]*Office of the Prime Minister (2021) 'Стратегический план 2025' (https://www.primeminister.kz/ru/documents/gosprograms/stratplan-2025)*

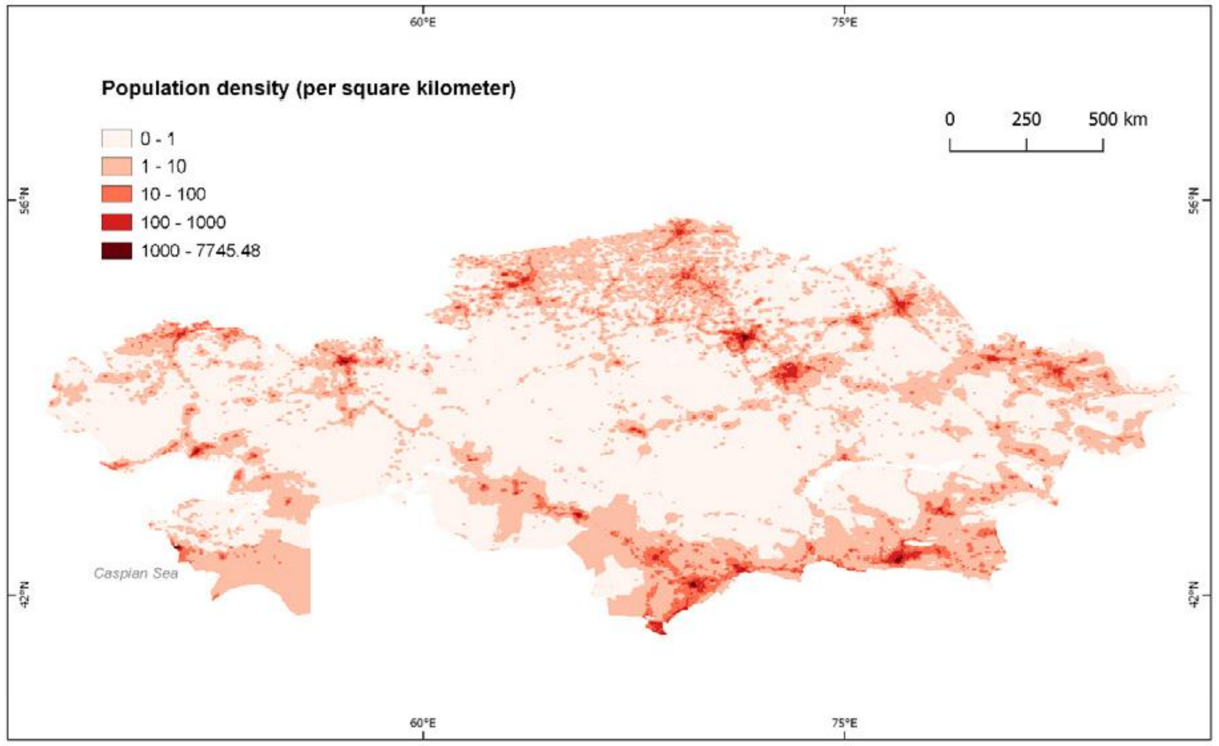
The majority (70%) of the country's hydrocarbon reserves and related extractive industries are located in the arid and semi-arid west/ southwest of the country in West Kazakhstan, Kyzylorda, Aktobe, Atyrau, and Mangystau[20]. Kazakhstan was considered the breadbasket of the former Soviet Union, with some 82% of the land area cultivated in 1991.[21] Following the breakup of the Soviet Union, the area of cultivated land decreased until about 2010. In 2018, 80% of the land area was cultivated.[22] Both agriculture and the extractive industries are vulnerable to growing water insecurity, caused by inefficiencies in water use and exacerbated by increasing temperatures and precipitation variability under climate change. Figure 27 shows the Land Use map for Kazakhstan.

Figure 27: Land use in Kazakhstan



Source: FAO GlobCover

Figure 28: Population density map



Source: WorldPop

The more populated areas and agricultural zones are located in areas of higher precipitation. North Kazakhstan, Kostanay, Akmola and Pavlodar are the primary grain and oilseed agricultural areas, growing 82% of the nation's wheat crop between 2015 and 2019.[23] Urban areas contain approximately 59% of the population, of these Almaty, Nur-Sultan, Karaganda and Shymkent cities have large proportions of urban populations. Migration from rural areas to urban areas is contributing to a moderate urbanisation rate. Almaty, with a population density of about 2,300 people per km^2, is exposed to seismic hazards. The central steppe grasslands are much more sparsely populated, as shown in Figure 28.

[20] *KazMunayGas (2021) 'About Kazakhstan: Oil and gas sector' (http://www.kmgep.kz/eng/about_kazakhstan/oil_and_gas_sector)*
[21] *The World Bank (2021) 'Kazakhstan: Agricultural land (% of land area)'. (*
[22] *OECD (2020) Agriculture Policy Monitoring and Evaluation 2020. Ch 17: Kazakhstan. (https://www.oecd-ilibrary.org/sites/d3c7bdcf-en/index.html?itemId=/content/component/d3c7bdcf-en)*

[23] *State Statistical Agency of Kazakhstan (2020) 'Kazakhstan: Wheat production by Oblast'. Foreign Agricultural Service, US Dept. Of Agriculture. (https://ipad.fas.usda.gov/rssiws/al/crop_production_maps/Kazakhstan/Kazakhstan_Wheat.jpg)*

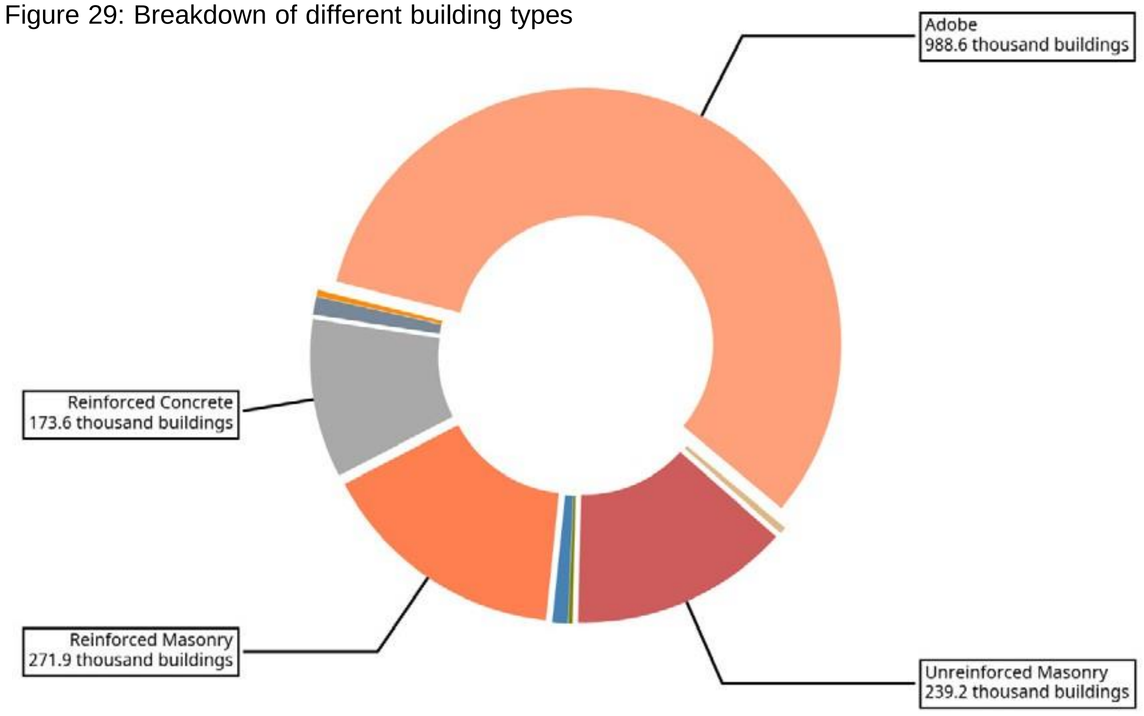
Table 8: Asset replacement cost (billion USD) for residential, commercial and industrial buildings

Asset replacement cost (billion $)	
Residential buildings	116.3
Commercial buildings	84.8
Industrial buildings	20.1
Total buildings	221.2

Source: Bureau of National Statistics, Agency for Strategic Planning and Reforms (Republic of Kazakhstan); Global Earthquake Model database for residential, commercial and industrial buildings.

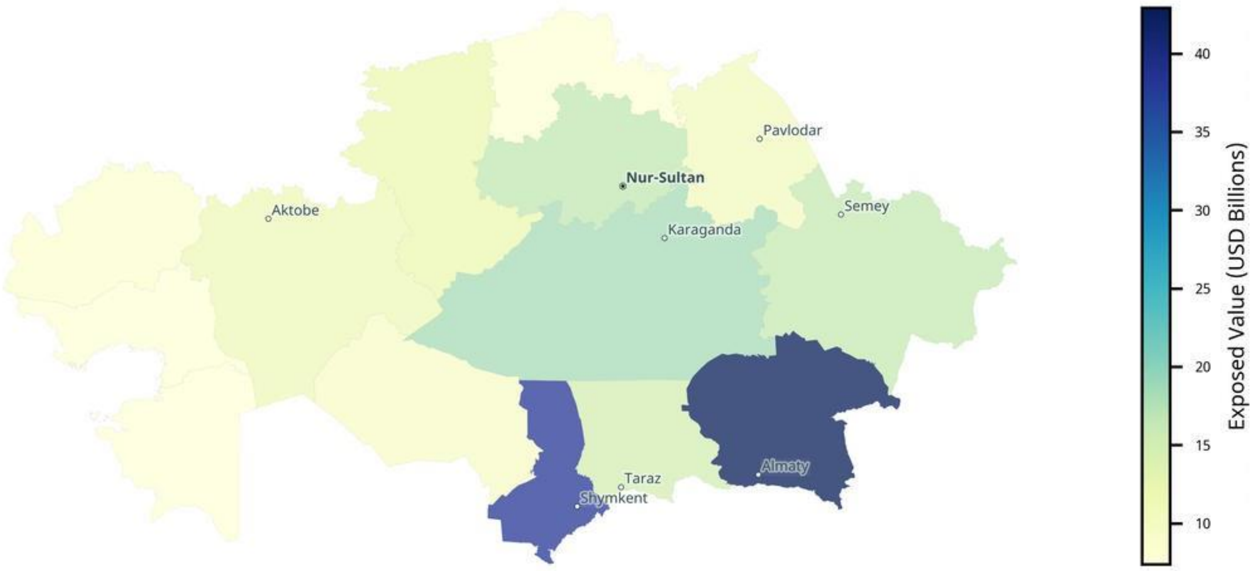
The breakdown of replacement values by asset type in Table 8, shows the predominant value of residential buildings across the country. Residential housing stock is concentrated in urban areas such as Karaganda, Almaty and Nur-Sultan. As seen in Figure 29, adobe structures with an estimated total of 988,643 buildings make up the largest fraction (57.2%) of the total building stock. This is followed by reinforced masonry structures (271,922 buildings, or 15.7%) and unreinforced masonry structures (239,166 buildings, or 13.8%).

Figure 29: Breakdown of different building types



Source: Global Earthquake Model

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



Source: Global Earthquake Model

Almaty and Southern Kazakhstan account for the largest amount of replacement cost value. As seen in Figure 30 assets at risk are concentrated in the south, across the urban areas of Almaty and Shymkent. Interestingly enough, the extent of development in Nur-Sultan is not yet sufficient to rank as highly, though this is anticipated to change over time. Large areas of Kazakhstan are not developed and do not have much value at risk.

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

Kazakhstan is classified as a low-risk country under the 2020 World Risk Report, with lower vulnerability to suffering negative impacts arising from natural hazards, including those influenced by climate change.

The Kazakhstan 2020 Human Development Report indicates that the country's human development index increased from 0.69 to 0.825 between 1990 and 2019, reflecting improvement in key indicators (Table 9).[24] Over that period, the country strengthened healthcare, access to education and poverty reduction under its long-term Strategic Development Plan 2030.

The 2020 Report indicates that gender inequality is lower compared to the other countries in Central

Table 9: Socio-economic vulnerability indicators

Poverty headcount ratio at national poverty lines (% of population)	4.3 (2019)
Human Capital Index	0.6 (2020)
GINI index	29.0 (2019)
Gender Inequality index	0.35 (2019)
Household size	3.5 (2019)
Age dependency ratio (% of working age population)	58 (2019)
Unemployment rate	4.9 (2021)
General government gross debt (% of GDP)	23.4 (2020)
Under five child mortality (per 1000 live births)	11 (2019)
Life expectancy at birth (female)	73 (2019)
Life expectancy at birth (male)	69 (2019)
% of population using at least basic sanitation services	68.7 – urban/ 8.6 - rural (2018)
% of population using at least basic drinking water services	94.5 – urban/ 84.6 - rural (2018)

Source: Bureau of National Statistics and Committee on Statistics (Gov. Kazakhstan); World Bank Open Data; United Nations Population Division; UNDP; IMF World Economic Outlook Database

[24]UNDP (2020) The Next Frontier: Human Development and the Anthropocene. Briefing note for countries on the 2020 Human Development Report: Kazakhstan. (http://hdr.undp.org/sites/default/files/Country-Profiles/KAZ.pdf)

Asia. Life expectancy at birth is higher for women than men (Table 9). There are some discrepancies in mean years of schooling, with males averaging a year longer at 11.9 years compared with 10.9 for females.

The greatest gender inequalities are apparent in GNI per capita – in 2019, Kazakhstani women earned on average $12,500 less than men and 62.7% of working age women participated in the labor force compared to 75.5% of working age men.[25]

Kazakhstan significantly reduced poverty levels countrywide prior to the COVID-19 pandemic, though progress was much faster in urban areas than rural. Regional disparities persist. The regions of Mangystau, Kyzylorda, Zhambyl, West Kazakhstan, Turkestan and the Shymkent City lag behind other areas in terms of average per capita incomes.[26,27] Rural areas close to, but outside of major urban areas lag behind in terms of human development such as regular access to water supplies and coverage and reliability of transportation and communications infrastructure.

Poverty rates are likely to increase as a result of the economic downturn triggered by the pandemic, possibly to 12-14% of the population[28] compared with 4.3% in 2019. Rural areas are likely to suffer more than urban. Poverty increases are driven by aggregate shocks - loss of employment, reductions in remittances and disruption of basic services. At the same time, inflation has risen, driven by increasing food prices that were 10.8% higher in August 2020 compared with the prior year. Gender inequalities are being exacerbated by the economic downturn triggered by the pandemic. Women disproportionally lost their jobs (26%) compared to men (22%) and some 40% reported decreases in working hours.[29] Nearly 46% of women also experienced decreased earnings (ibid). These challenges have the potential to setback poverty reduction gains, particularly for women and women-headed households.

[25]UNDP (2020).
[26]Committee on Statistics (2020) Living standards in Kazakhstan 2015-2019: Statistical compilation. Ministry of National Economy, Republic of Kazakhstan.
[27]Whiteshield Partners (2016).
[28]Agaidarov and Rahardja (2020).
[29]Ross, J. and Taylor, K. [eds] (2020) The Impact of COVID-19 on Women's and Men's Lives and Livelihoods in Europe and Central Asia: Preliminary Results from a Rapid Gender Assessment. UN Women. (https://www.preventionweb.net/files/74028_theimpactofcovid19onwomensandmensli.pdf)

Coping capacity

Coping capacity is the ability of people, organizations and systems, using available skills and resources, to manage adverse conditions, risk, or disaster events. The capacity to cope requires continuing awareness, resources, and good management, both in normal times as well as during disaster events or adverse conditions. Coping capacities contribute to the reduction of disaster risks.

Table 10 shows key coping capacity indicators for Kazakhstan. Kazakhstan has established a Coordinating Council on Sustainable Development Goals comprised of 5 interagency working groups and adopted 280 SDG indicators.[30] The development strategy of Kazakhstan 2030 describes that the goal for 2025 will be economic growth, while minimizing the negative human impact on nature and the implementation of the UN Sustainable Development Goals. The country also provides some social assistance and there is a pension programme. In the first few months of the COVID-19 pandemic in 2020, some 6.2% of the population accessed government assistance.[31]

Table 10: Key coping capacity indicators

Financial inclusion (% of population aged 15+ with access to bank account)	58.7% (female pop: 60.3%) (2017)
Insurance coverage	0.5% (2019)
Share of population covered by public safety nets	50% (bottom income quintile: 58.8%) (2015)
Internet coverage (% of population using the internet)	82 (2019)
Metabiota Epidemic Preparedness Index score (100 = maximum score, 0 = minimum score)	71 (2019)
Public and private health expenditure (% of GDP)	3.13
Number of physicians (per 1,000)	74 (2019)
Number of hospital beds (per 1,000)	96.3 (2019)
Government effectiveness (-2.5 to +2.5)	0.12 (2019)
Corruption Perception Index	34 (2019)

Source: Government of Kazakhstan National Statistics Bureau; 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[32]

[30] *Agency for Strategic planning and reforms of the Republic of Kazakhstan, Bureau of National statistics (2021) 'Monitoring of the Sustainable Development Goals until 2030' (https://stat.gov.kz/official/sustainable_development_goals)*
[31] *Ross and Taylor (2020)*
[32] *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).*

Disaster risk management of both natural and human-made hazards at the national level are regulated through the 1997 Law on Civil Protection and the 1996 Law Providing for Management of Natural and Technological Disasters. The Order of the Minister of Internal Affairs of the Republic of Kazakhstan dated November 7, 2015 No. 890 specifies the situations under which resources can be mobilized in disaster response. International cooperative mechanisms include: Resolution No. 677 (2005) between the Kazakh Ministry of Agriculture and the Ministry of Water Resources of the PRC for notification of natural hazard events on transboundary rivers and the 2015 Resolution No. 491 between the governments of Kazakhstan and the Kyrgyz Republic to establish the joint Center for Emergency Situations and Disaster Risk Reduction.

The Ministry for Emergency Situations is tasked with natural and manmade hazard management, with an emphasis on reducing disaster risk through prevention. The Crisis Management Center of the Ministry of Emergency Situations of the Republic of Kazakhstan carries out operational management of forces and means of civil protection, collection and processing of information about emergencies of a natural and man-made nature. The Ministry of Emergency Situations, which had been in charge of monitoring hazard events, was dissolved in 2014 and newly reformed in 2020 by prime ministerial decree.

However, multi-hazard event monitoring and loss data has not been systematically collected. The Nation Data Center monitors seismic activity in Central Asia and up into the Russian Federation in support of the international Comprehensive Nuclear Test Ban treaty, but does not report losses. The Ministry of Digital Development, Innovation and Aerospace Industry is in charge of monitoring disaster events, agricultural and water conditions. Some ecological data and disaster data are published by the Ministry of Ecology, Geology and Natural Resources in its State of the Environment reports. The lack of a single agency to serve a coordinating role in disaster impact tracking means that data and definitions can vary. Droughts for instance, are one hazard without a standardized definition, including demarcation of beginning or end, and so impacts might continue to be felt after the end has been officially declared.

Kazakhstan has a number of reserve funds and contingency arrangements for dealing with the financial consequences of disaster events. There is a national reserve fund dedicated explicitly for supporting livelihoods after a man-made or natural catastrophe, with annual allocations capped at 2% of total budget. In addition, a contingency reserve helps cover disaster response and recovery costs, while local governments benefit from access to local government reserve funds.[33] These are estimated to total $843m.

These arrangements are underpinned by a robust overall fiscal position, albeit one that is vulnerable to fluctuating oil prices. Yields on its sovereign debt have increased significantly since the COVID crisis began in March 2020.[34]

> KAZAKHSTAN HAS REASONABLY SIGNIFICANT FINANCIAL RESOURCES ESTIMATED TO BE SUFFICIENT TO COVER AVERAGE ANNUAL LOSSES EXPECTED FROM FLOODS AND EARTHQUAKES. HOWEVER , FOR FLOODS, A 1 IN 10-YEAR EVENT MIGHT CAUSE THE EXHAUSTION OF THOSE FUNDS

[33] *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*
[34] *https://www.ceicdata.com/en/indicator/kazakhstan/long-term-interest-rate*

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 11 provides the details underpinning this assessment for Kazakhstan.

The AAL for floods is estimated to be $419m, more than seven times higher than for earthquake risk ($58m) with total losses around $447m a year. The combined AAL as a proportion of GNI excluding indirect costs is 0.11%, which is the 8th highest of all countries/provinces in the CAREC region.

Table 11: Key Protection Gap indicators

AAL as % of GNI[35]	0.11%	
Un-funded AAL, ($m, %)	AAL covered	
Average annual human losses from flood and earthquakes	Flood	EQ
	392	42
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 75
Event frequency where direct damage, less (assumed) insured losses, exceed existing ex-ante risk retention	Flood	EQ
	1 in 10	1 in 100
Event frequency where estimated emergency response costs exceed current risk retention mechanisms	Flood	EQ
	> 1 in 200	> 1 in 200
Macro-economic context and ability for sovereign to borrow	Only country other than PRC with investment grade credit rating. Medium-term structural challenges	
Ability of individual and households to access resources after an event	Relatively high financial inclusion but with inequality across income groups. Social protection measures not well-targeted	

Source: Consultant team modelling

[35]*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.*

The non-life insurance penetration rate in Kazakhstan is around 0.5%, placing the country in the middle third of CAREC region countries. Of this, around one quarter non-life insurance premiums are attributed to property insurance, which includes earthquake, flooding, and fire coverage. Property insurance premia as a percentage of AALs from flood and earthquake events are among the highest in the CAREC region (63%). Calibrating this datapoint against other countries where more information on insurance penetration is available suggests the combination of insurance and retention instruments is sufficient to cover the expected annual damage from the combination of flood and earthquake events.

However, there may be value in considering risk transfer mechanisms associated with more extreme (flood) events in particular, although given the investment grade credit rating of the country, the cost efficiency of such mechanisms compared to ex-post borrowing would need to be assessed carefully. Given the concentration of flood risk in areas of the country where poverty is more pronounced, there may be value in exploring opportunities for boosting the financial inclusion and targeting of social protection towards these vulnerable populations.

CAREC

Central Asia Regional Economic Cooperation Program