

REGIONAL OVERVIEW OF DISASTER RISK IN CENTRAL ASIAN COUNTRIES

PART 1: GENERAL INFORMATION

The Central Asian region comprises the Republic of Kazakhstan, the Kyrgyz Republic, the Republic of Tajikistan, Turkmenistan, and the Republic of Uzbekistan. The region covers an area of approximately 4 million square kilometers, with a total population exceeding 75 million people. Population density in the region is low, averaging only 18 persons per square kilometer.

From a geographic perspective, Central Asia is an extremely extensive subregion, encompassing significant mountain systems such as the Tian Shan, large deserts, and expansive steppe areas. The region's major rivers include the Amu Darya and Syr Darya, while the largest bodies of water are the Caspian Sea, the Aral Sea, and Lake Balkhash, all part of the West-Central Asian closed basin.

Being landlocked within the Eurasian continent, Central Asia experiences a sharply continental climate with limited and unevenly distributed precipitation. The region is characterized by wide diurnal and seasonal temperature fluctuations, high solar radiation, and relatively low humidity. Significant variations in geography and elevations—from 0 to 7,500 meters above sea level—explain the diversity of local microclimates.

The mountains, located in the east and southeast, serve as centers for water formation and runoff. While this area often receives moist winds, much of the moisture is absorbed by the mountains, leaving limited precipitation for the remainder of the basin. Temperature extremes are substantial, ranging from -40°C to $+40^{\circ}\text{C}$. Annual precipitation in lowlands and valleys averages 80–200 mm, mostly falling during winter and spring. In the foothills, precipitation increases to 300–400 mm, and on the southern and southwestern slopes of mountain ranges, it reaches 600–800 mm.

The region possesses abundant natural resources, including significant hydrocarbon reserves, and has well-developed mining, energy, and chemical industries. In addition, due to its extensive transport and communications networks, the countries of the region utilize their transit potential to the fullest.

Socio-economic development in Central Asia has historically depended on water and land resources. Agriculture plays a significant role in the regional economy, with crop production and livestock farming being predominant.

Rapid population growth and expansion of irrigation over the past 40 years have substantially increased demand for land and water in the region. At the same time, more than 46% of the population resides in urban areas.

| Country | Area (thousand km ²) | Population (million) | Population Density (per km ²) | Annual Population Growth (%) | Urban Population (%) |
|--------------|----------------------------------|----------------------|---|------------------------------|----------------------|
| Kazakhstan | 2 724,9 | 20,1 | 6,9 | 1,5 | 57,5 |
| Kyrgyzstan | 199,9 | 6,9 | 33,5 | 1,7 | 36,6 |
| Tajikistan | 142,6 | 10,2 | 66,6 | 2,3 | 27,3 |
| Turkmenistan | 488,1 | 6,3 | 12,6 | 1,3 | 52,0 |
| Uzbekistan | 447,4 | 36,8 | 77,5 | 1,5 | 50,4 |

| | | | | | |
|----------------------------|---------|-------|------|-----|------|
| Total (Region-wide) | 4 002,9 | 72, 5 | 18,1 | 1,6 | 46,9 |
|----------------------------|---------|-------|------|-----|------|

Table 1. Overview of Central Asian Countries¹

PART 2: KEY INDICATORS OF REGIONAL DISASTER RISK CHARACTERISTICS

The Central Asian region is exposed to nearly all types of emergencies, including natural, technological, environmental, and biological-social in nature.

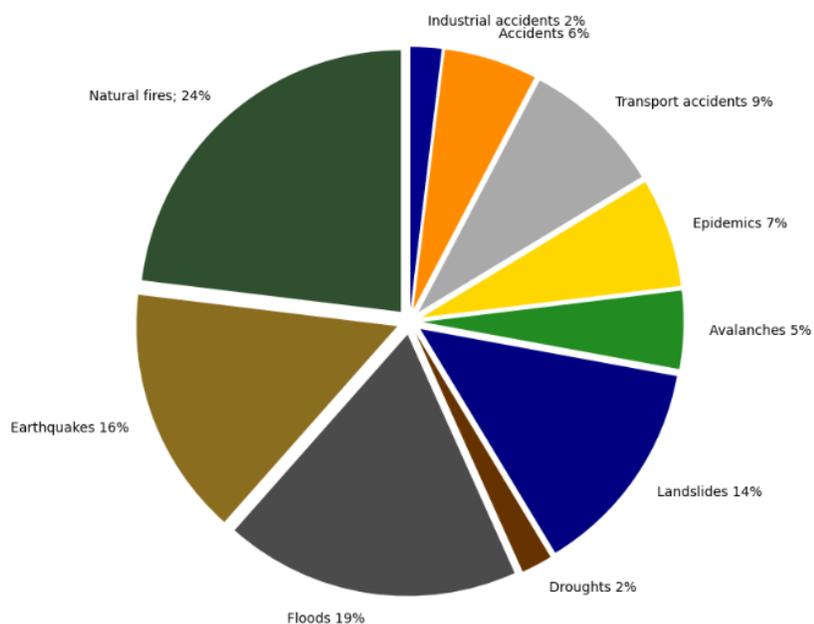


Figure 1. Percentage Distribution of Recorded Disasters in the Central Asian Region²

| Date | Type of Disaster | Number of Affected People | Economic Loss (million USD) |
|------------|--|---------------------------|-----------------------------|
| 3/01/1911 | Kemin Earthquake, Kazakhstan, Kyrgyzstan | 450 | 20 |
| 5/10/ 1948 | Ashgabat Earthquake, Turkmenistan | 176 000 | 6 000 |
| 26/04/1966 | Tashkent Earthquake, Uzbekistan | 100 000 | 300 |
| 13/10/1985 | Tajikistan Earthquake | 8 080 | 200 |
| 25/05/1992 | Flood in Tajikistan | 63 500 | 300 |
| 19/08/1992 | Jalalabad Earthquake, Kyrgyzstan | 86 806 | 130 |
| 8/05/1993 | Flood in the Dushanbe Area, Tajikistan | 75 357 | 149 |
| /06/2000 | Drought in the Central Asian Region | 3 600 000 | 107 |

Table 2: Major Disasters in Central Asia over the Past 120 Years³

The region is characterized by extensive areas of high seismic activity, with potential for strong earthquakes measuring 7–9 or more on the MSK-64 scale and magnitudes of 5–8 on the Richter scale, as well as mudflows, floods, flash floods, landslides,

avalanches, inundations, hurricane-force winds, and even tornadoes; desertification; dust storms; prolonged and heavy rains; hail; snowfalls and blizzards; droughts; frost; extreme temperatures; failures of artificial reservoirs; the presence of nuclear and chemical waste storage facilities; industrial enterprises handling highly toxic substances, hazardous waste, and complex technological processes; environmental and technological industrial and transport accidents; explosions; dam breaches and hazardous substance releases; major fires; epidemics; mass infectious diseases affecting humans and animals; and agricultural crop damage caused by diseases, weeds, and pests.

According to the 2021 subnational INFORM Risk Index for Central Asian countries, Tajikistan falls into the high-risk category, followed by Kyrgyzstan in the medium-risk category, Uzbekistan in the low-risk category, and Kazakhstan and Turkmenistan in the very low-risk category.

The INFORM subnational risk index for this region combines 62 different indicators, measuring three dimensions of risk: hazards and exposure, vulnerability, and lack of coping capacity.

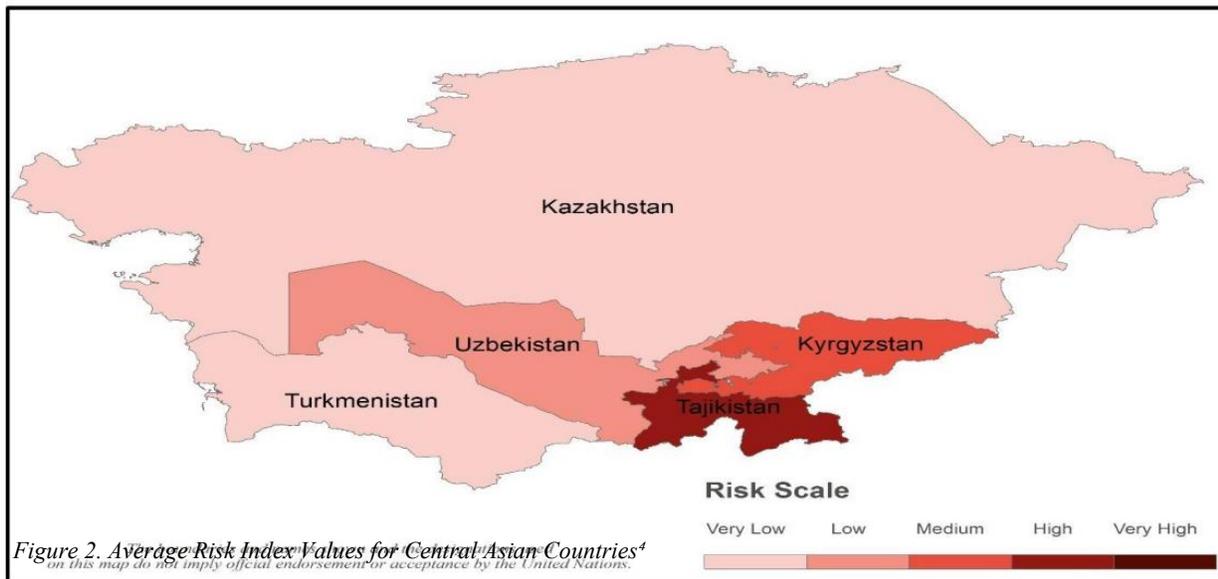


Figure 3. Hazard and Exposure: Average National Values for Central Asian Countries⁵

2.1. Natural Hazards

2.1.1. Earthquakes

Earthquakes constitute a predominant disaster risk factor in Central Asia across almost all major indicators, particularly affecting cities and densely populated areas.

The housing sector, services, finance, industry, and trade are most vulnerable to earthquake impacts, with the highest concentration of risk in urban centers and large settlements.

Seismological services in most countries of the region record approximately 3,000 underground tremors of varying intensity each year.

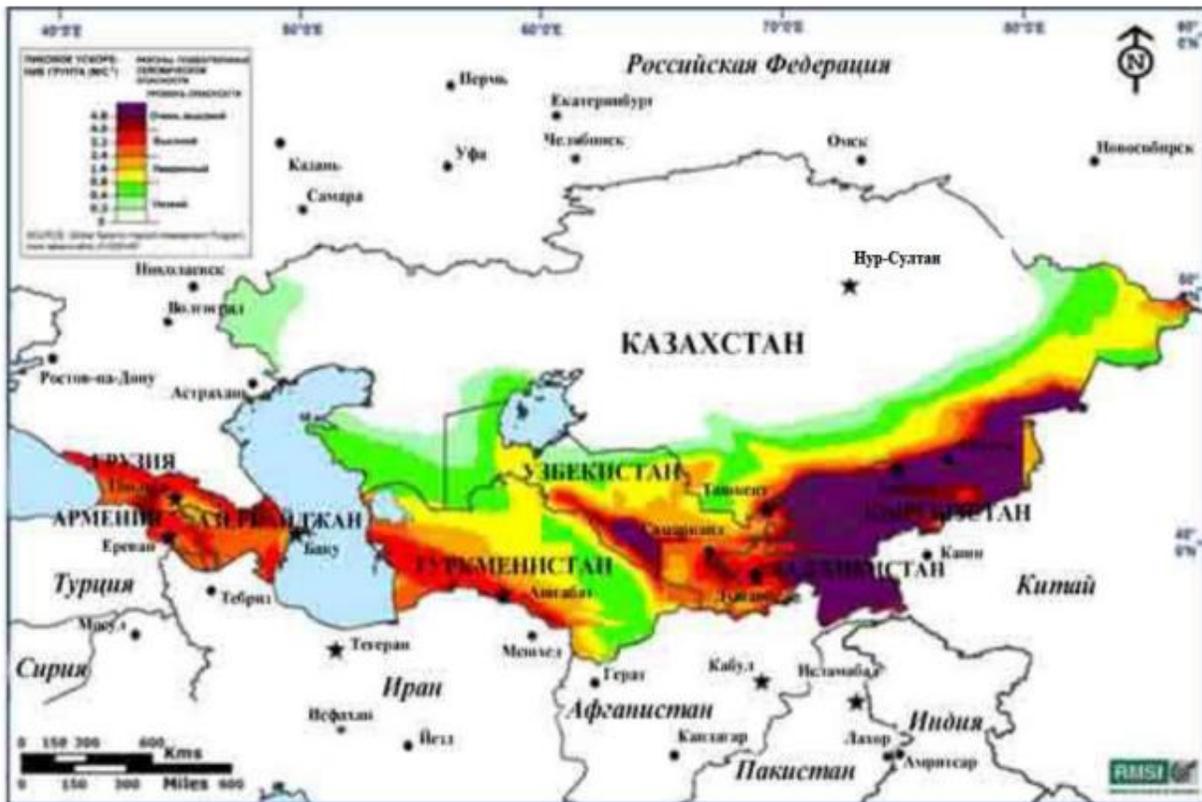


Figure 4. Seismic Hazard Map for the Central Asian Region⁶

Secondary effects of earthquakes can be highly destructive. Seismic activity may trigger or accelerate the occurrence of other hazards, including landslides, rockfalls, mudflows, soil liquefaction, glacial lake formation, and flooding.

Many of these secondary hazards (such as floods and mudflows resulting from dam failures, high-mountain lake breaches, and toxic substance spills) can have significant transboundary impacts.

There is substantial evidence of the destructive power of earthquakes and their induced secondary effects. For example, landslides, mudflows, and debris flows were the primary causes of fatalities during earthquakes in Kazakhstan (Almaty, 1887, 1889, and 1911), Kyrgyzstan (Jalalabad, 1992), Tajikistan (Khait, 1949; Gissar, 1989), Turkmenistan (1948), and Uzbekistan (Tashkent, 1966).

2.1.2. Floods, Flash Floods, and Mudflows

The threat of mudflows, flash floods, and floods constitutes the second most significant hazard in the Central Asian region. The region features mountainous terrain and is crossed by several hundred large and small rivers and their tributaries. Flooding along these rivers is frequently accompanied by major mudflows.

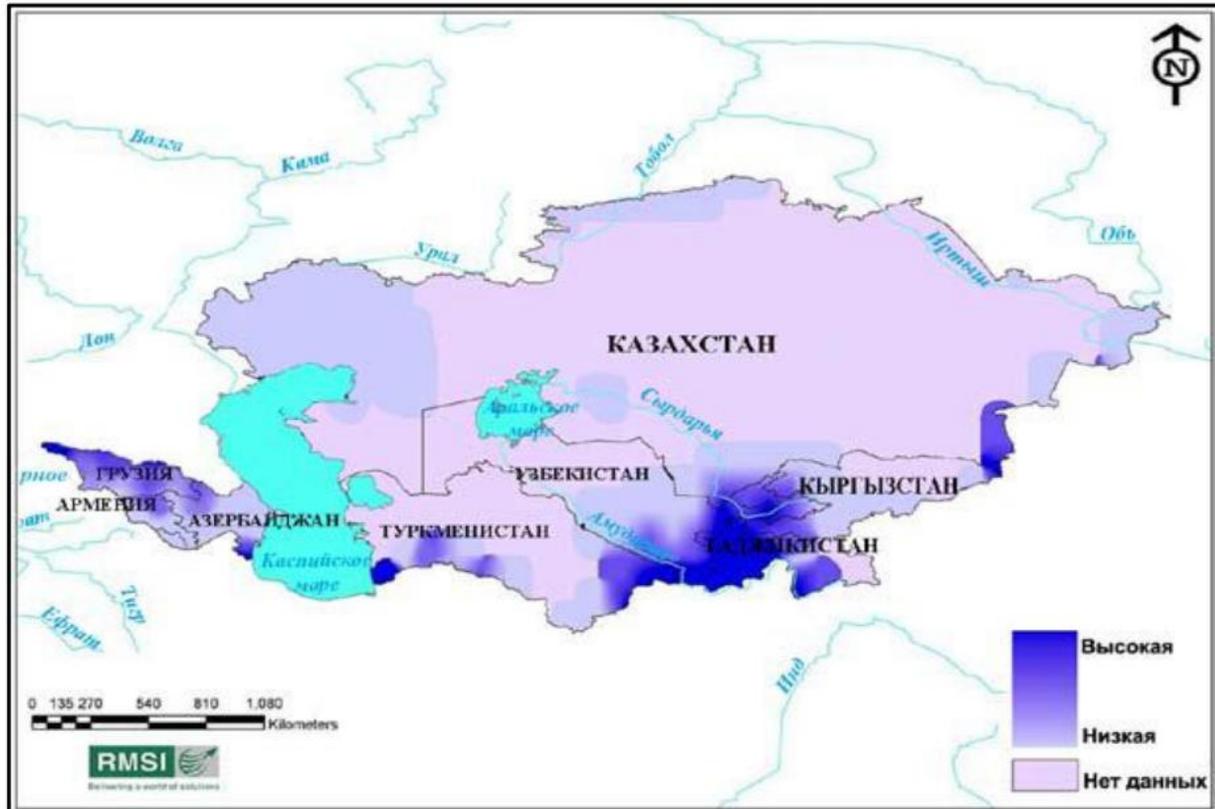


Figure 5. Flood Hazard Map for Central Asia⁷

Floods, flash floods, and mudflows are the most frequent natural hazards in Central Asia, particularly in the basins of the region's largest rivers, the Amu Darya and Syr Darya. These events cause significant damage to housing, infrastructure, and agriculture, primarily in rural areas.

Although the overall volume of water resources has remained relatively stable, annual and seasonal hydrological variability in these river basins has become more pronounced. Since 2005, the number of years with high water levels has increased by 1.2–1.4 times, while years with excessively high water levels have increased by 2.0–2.5 times.

In recent decades, the frequency of mudflows has increased, closely linked to cycles of wet and dry years. Central Asia's mountains contain thousands of lakes and artificial reservoirs. Damage to their dams and levees can trigger floods, mudflows, and flash floods caused by rapid snowmelt or glacial lake outbursts, often resulting in damage to settlements and infrastructure in downstream areas.

The large volumes of water released from dam and reservoir failures, including high-mountain glacial lakes and major reservoirs, can lead to floods, flash floods, and mudflows, frequently resulting in large-scale and transboundary emergencies.

2.1.3. Droughts

Droughts represent the next most significant hazard in the Central Asian region. Drought occurs at varying scales almost every year. Severe meteorological droughts (precipitation deficits of 50% or more) occur in foothill areas approximately three times per century, whereas moderate droughts (seasonal precipitation deficits of 20–25%) occur every three to four years. In desert and semi-desert areas, droughts are more frequent (precipitation deficits of 50% or more every ten years; deficits of 20% every five years).

A severe meteorological drought affected Central Asia in 2000–2001, when most countries experienced precipitation deficits of 30–70% combined with above-average temperatures. The 2000 drought impacted approximately 60 million people across Central and Southeast Asia and the Caucasus and caused significant economic losses.

The consequences of drought are more acutely felt in rural areas. The region’s socio-economic vulnerability to drought is largely associated with rural development, agriculture, and water management.

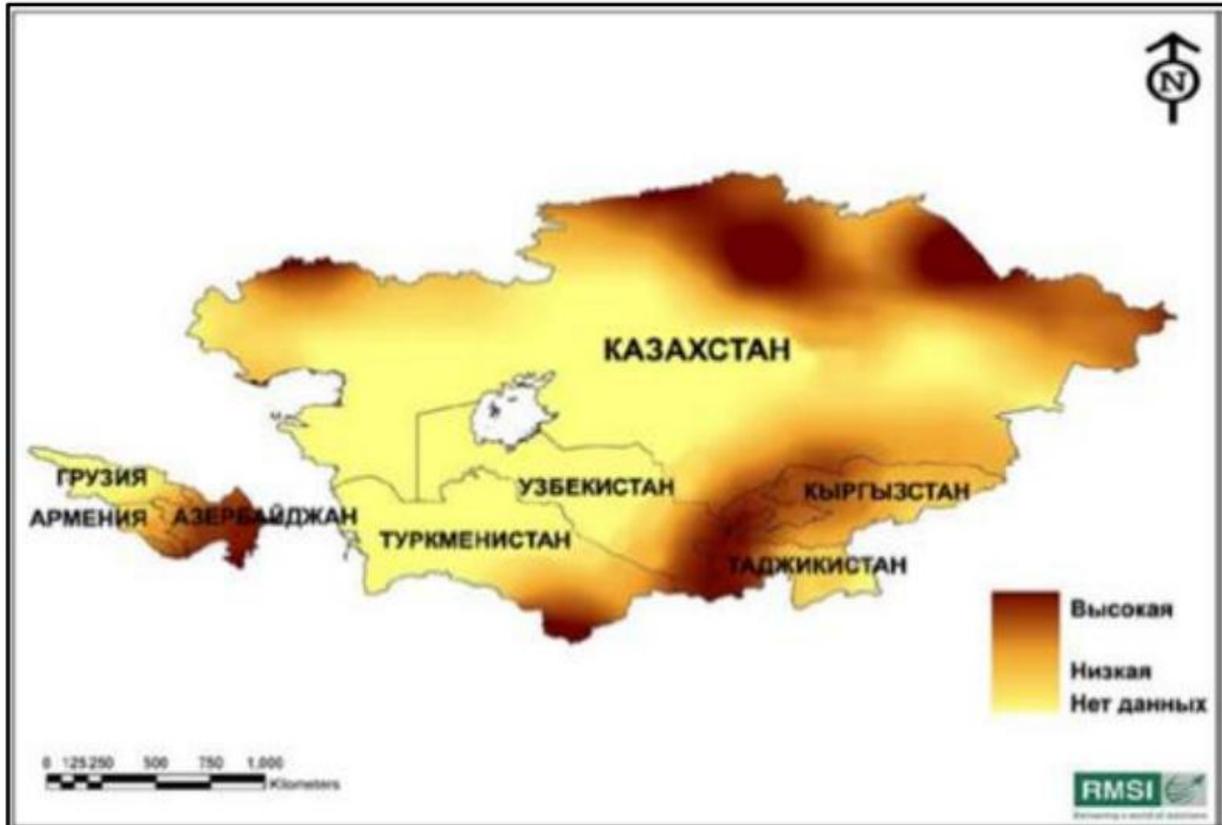


Figure 6. Drought hazard map in Central Asia

2.1.4. Landslides

Landslides are common in the mountainous areas of Central Asia and represent one of the most widespread natural disaster risks (Fig. 8). The largest landslides are often triggered by earthquakes and floods. They occur due to increased slope steepness, seismic events, meteorological and hydrological anomalies, as well as various anthropogenic processes. Landslides most frequently happen in foothill and mountainous areas at elevations between 1,000 and 2,400 meters above sea level on slopes of 19 degrees or more.

Landslides mainly affect housing and infrastructure in rural areas. Landslide events can lead to cross-border consequences due to the destruction of tailings, mountain dumps, and the release of contained toxic substances, particularly in the Fergana Valley.

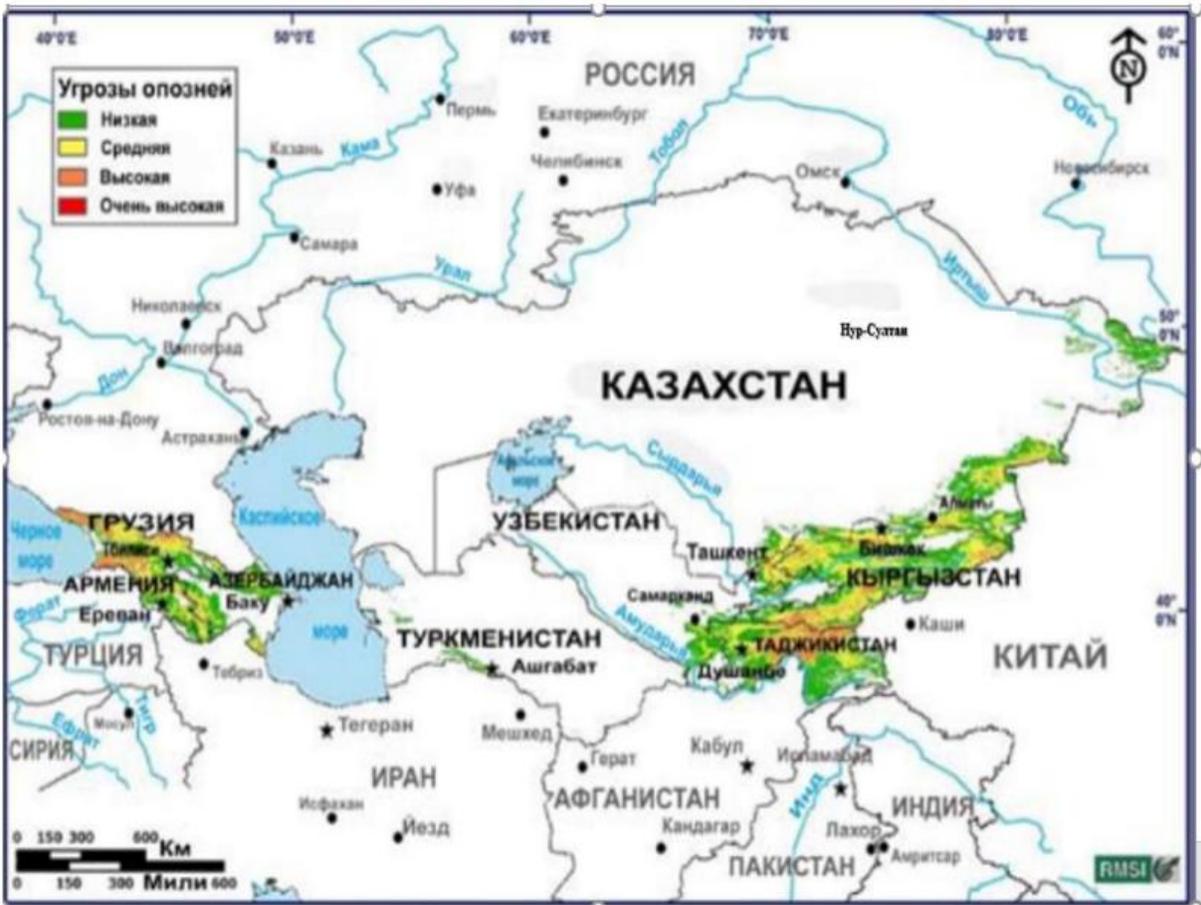


Figure 7. Landslide hazard map in Central Asia⁹

2.1.5. Snow Avalanches, Landslides, Rockfalls

Snow avalanches are particularly dangerous hydro-meteorological natural events that pose threats to humans, buildings, transport routes, energy infrastructure, bridges, and communication lines.

Modern mountain roads in Central Asia are often poorly planned and designed due to difficult terrain, sparse population, and limited state budgets for road construction. This is especially true for the Tian Shan and Pamir ranges, which cover large parts of Kyrgyzstan and Tajikistan, where many local transport corridors consist of dirt roads, trails, animal paths, and motorcycle routes.

Snow avalanches, landslides, and rockfalls block roads, frequently causing emergencies. Road cuts through mountainous terrain increase rockfall hazards, especially where bedrock has natural cracks along which the road is built. These dangers exist not only for roads cut into mountain slopes. Roads in the valleys of the Pamir and Tian Shan often cross large alluvial cones that periodically collapse onto major sections of the road network, blocking them.

2.2. Technological Hazards

The region contains numerous tailings dams, mining dumps, poorly managed urban landfills, pesticide storage facilities, and hazardous chemical waste sites, most of which are located in densely populated areas. Some of these facilities are situated near borders, thus creating risks of transboundary soil, air, and water contamination.

Water management infrastructure in Central Asia consists of hundreds of reservoirs, dams, irrigation systems, pumping stations, numerous canals, and dozens of multipurpose hydraulic structures. The region is home to the world's tallest embankment dam – the Nurek Dam, 300 meters high on the Vakhsh River in Tajikistan – and one of the longest canals in the world – the Karakum Canal, over 1,100 km long, which delivers about half of Turkmenistan's water from the transboundary Amu Darya River.

Of the more than 1,200 dams in the region, 110 are classified as large hydraulic structures. Many are located in the basins of transboundary rivers such as the Amu Darya, Syr Darya, Ili, and Irtysh, and have interstate significance. For countries located downstream, the failure of any dam could have catastrophic consequences.

The presence of industrial facilities in the region – including metallurgical, oil, and coal industries, mining operations, as well as the rapid increase in passenger and freight vehicles – has sharply increased the occurrence of technological emergencies: traffic accidents, fires and explosions, accidents involving hazardous chemicals, sudden structural collapses, failures in power and utility systems, industrial wastewater incidents, and transport accidents.

2.3. Environmental Hazards

The region's most serious environmental risks are linked to inefficient water use, challenges in managing transboundary water resources, high levels of energy and resource consumption, extensive industrial development, and water scarcity as a direct consequence of climate change.

Climate change has become a real threat to human livelihoods and economic activity, inevitably affecting the social sphere through reduced living standards, loss of property, and forced displacement. The worsening degradation of biodiversity, natural habitats, and ecosystems due to climate stressors increases the vulnerability of poor and rural areas, which often lack the financial or political capacity to address growing problems, especially slow-onset risks associated with climate change.

Over the past 50 years, rising temperatures have noticeably reduced both snow cover in the mountains and glacier volume. The region's climate has become significantly warmer. In all countries, the average annual temperature has increased by 0.10°C to 0.31°C per decade, far exceeding the global trend of 0.06°C.

One of the largest modern ecological catastrophes experienced by Central Asia is the Aral Sea disaster, which has direct ecological, climatic, socio-economic, and humanitarian impacts, posing a serious threat to sustainable development, public health, genetic resources, and the future of the region's population. The drying of the sea has caused dramatic climate changes, affecting not only Central Asia but also other regions. The crisis zone of the Aral Sea directly affects territories in Turkmenistan, Kazakhstan, and Uzbekistan, and indirectly Tajikistan and Kyrgyzstan.

2.4. Biological and Social Hazards

The region is susceptible to localized outbreaks and epidemics of infectious diseases in humans and animals, as well as crop losses due to diseases, weeds, and pests. Some countries experience minor outbreaks of infectious diseases such as cholera, malaria, anthrax, meningococcal meningitis, measles, and others.

The COVID-19 pandemic, which affected all countries in the region except Turkmenistan, was the most serious disaster in 2020, causing human casualties, health impacts, environmental damage, significant material losses, and disruptions to the livelihoods of tens of millions of people.

PART 3: VULNERABILITY

The results of the vulnerability assessment show that only Tajikistan falls into the higher-risk category, while the other countries face lower vulnerability risk.

The elevated vulnerability risk in Tajikistan is due to high risk in the “vulnerable groups” dimension (extremely low food accessibility), whereas the risk in socio-economic vulnerability is lower.

Kyrgyzstan falls into the high vulnerability risk zone because of very high dependency on aid (remittances and international assistance), which gives a high value to the socio-economic vulnerability component.

On the other hand, Uzbekistan and Turkmenistan are in the medium vulnerability risk zone due to significant increases in both dimensions of vulnerability, while Kazakhstan's values indicate a low vulnerability risk.

National-level vulnerability risk classes are shown on the map (Figure 8), and the values are presented in the table below.

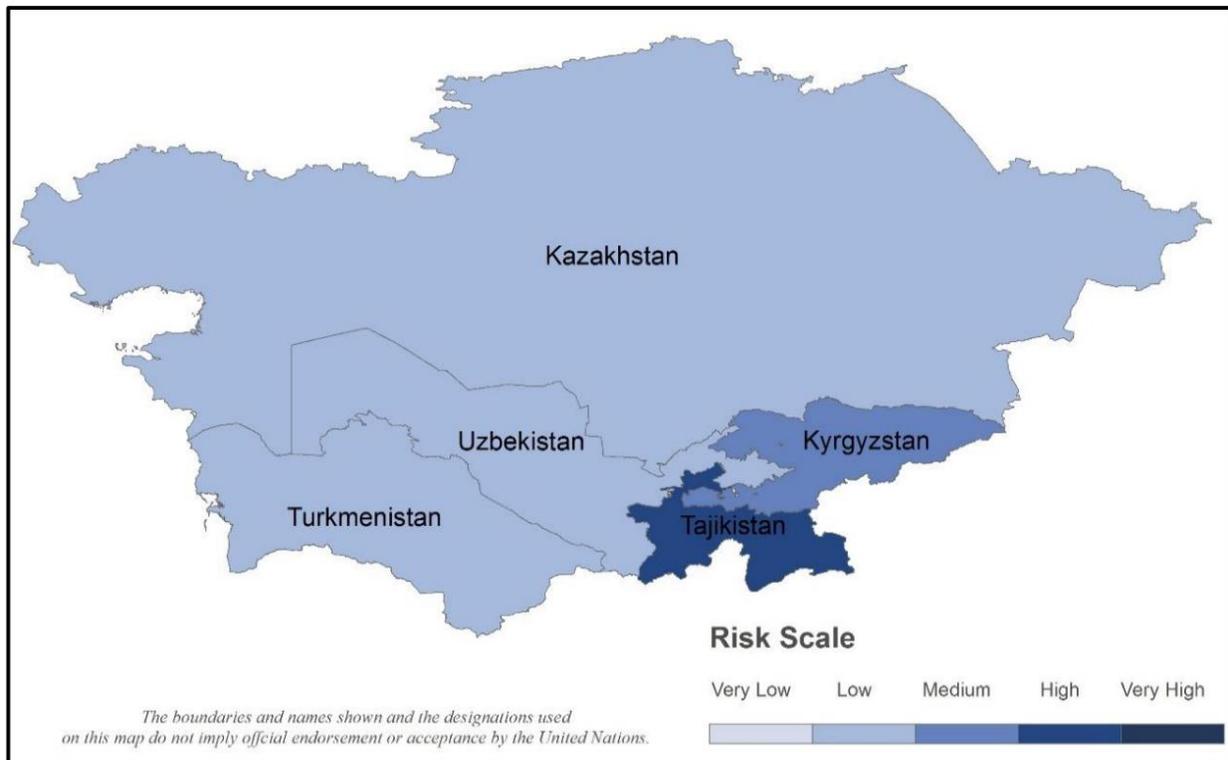


Figure 8. Vulnerability of Central Asian Countries¹⁰

3.1. Economic Vulnerability

The economies of Central Asia are highly vulnerable to natural disasters. The World Bank estimates potential losses for Central Asian countries at between 5% and 70% of GDP.

Several factors increase the vulnerability of Central Asian economies to disasters. Most countries have specialized, export-dependent economies that are sensitive to external shocks. This exacerbates the funding gap for implementing comprehensive disaster risk reduction measures.

According to the subnational INFORM model, the socio-economic vulnerability category includes indicators of development, inequality, and dependence on social assistance. The following population groups are considered vulnerable: stateless persons, applicants for citizenship, ethnically diverse groups, people with various diseases (HIV, tuberculosis, COVID-19), children under 5 years old, food accessibility, and populations affected by disasters in the past three years.

The region's economy is particularly vulnerable to meteorological hazards related to climate change. The climate has noticeably warmed across all countries, with average annual temperatures increasing by 0.10–0.31 °C per decade, exceeding the global trend of 0.06 °C.

As a result, drought conditions have intensified, and variability in precipitation—both yearly and seasonal—has increased. Intense rainfall events (15–20 mm or more within 24 hours) have become more frequent and irregular.

Weather-dependent sectors, such as agriculture, contribute 40–60 % of GDP in Central Asian countries. Their importance is amplified by the fact that most of the population lives in rural areas and has limited employment opportunities outside agriculture, making them highly dependent on farming for livelihoods.

In 2020, alongside the COVID-19 pandemic, Central Asian countries faced a massive locust invasion—the largest such disaster in the past 20 years. Favorable weather conditions affected Turkmenistan, Uzbekistan, Kazakhstan, and Tajikistan. Locusts destroyed crops across regions, and the damage, combined with reduced food production and global trade slowdowns due to the pandemic, raised concerns about potential food shortages. According to FAO, one square kilometer of locust swarms can contain “around 40 million locusts, which can consume as much food in a day as 35,000 people.”

3.2. Structural Vulnerability

Structural vulnerability mainly concerns housing stock and infrastructure. Strong earthquakes can severely damage homes and utilities. Infrastructure for water diversion, distribution, and storage remains fragile. Across the region, dams and other hydraulic structures built during the Soviet era have significantly deteriorated, as governments have only been able to afford emergency repairs, and protective structures along river channels have largely worn out.

Buildings are considered vulnerable to seismic shocks if their construction lacks elements capable of withstanding such forces. The high vulnerability of the population and territories to major earthquakes and their secondary effects is often not due to the seismic hazard itself but to the physical condition and earthquake resistance of residential, public, and utility structures. People are injured or killed not by the earthquakes themselves, but by non-seismic-resistant buildings and structures that collapse as a result.

For example, many major cities in the region are located in high seismic hazard zones, where strong earthquakes could trigger catastrophic situations. The issue stems from the prevalence of old, non-seismic-resistant housing built in the 1940s–1960s, including both single-story homes and multi-story buildings (Stalinka and Khrushchyovkas). Experts also note that some newly constructed modern multi-story buildings by certain private companies may also be built in violation of building codes (SNiP).

References:

1. Caucasus and Central Asia-Subnational INFORM 2021
2. World Bank, Europe and Central Asia Country Risk Profiles for Floods and Earthquakes, 2017.html
3. Central Asia and Caucasus Disaster Risk Management Initiative