



# Climate change: water shortage, land use and communities challenges

## SDSN Kazakhstan Policy Brief

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### Abstract

Every year in Kazakhstan, talks about the consequences of climate change, including water shortages in the near future, are getting louder. Due to the uneven distribution of water resources on the territory of Kazakhstan and water dependence on neighboring countries, the situation is sensitive. All this is superimposed by the lack of a clearly directed water policy, since water shortage will affect all sectors of the economy and the population. Kazakhstan is already suffering from salinization, desertification, and recurrent spring floods. And Integrated Water Resources Management and Sustainable Land Management, which are the main tools for sustainable development, can mitigate these consequences.

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## 1. Introduction

From 1950 to 2020, air temperatures in Kazakhstan increased by 0.31°C every ten years. The greatest increase in temperature is felt in the southwest of the country, from 0.32 °C to 0.50 °C per decade, less significant increase in the north, northeast and center from 0.19 °C to

0.23 °C per decade (Karatayev et al., 2022). However, the climate can change naturally, but since the 1800s, anthropogenic influence on the environment has been the main cause of global warming. But rising temperatures are just the tip of the iceberg of the effects of climate change. Other consequences of climate change include: drought, water scarcity, floods, desertification, degradation of glaciers, water systems, land, and much more.

Central Asia is the region with the largest water load, which is increasing every year. Kazakhstan is also no exception among the countries of Central Asia. According to the forecast of the World Resources Institute (2015), water stress in Kazakhstan will be extremely high (>80%) in 2040 (Maddocks et al., 2015). Kazakhstan has already begun to experience a shortage of water resources. The reasons for this are: uneven distribution of fresh water sources, transboundary uncertainty and mismanagement. First of all, the southwestern regions of the country suffer from a lack of fresh water, as they are prone to droughts. Water is involved in all sectors of the economy, it is used in production, agriculture and in everyday life. Accordingly, the reduction of water resources will affect all areas of life. Water shortages in Kazakhstan will lead to degradation of pastures and negative impacts on crops, including spring wheat, which is an important export commodity of the country (Sembayeva et al., in press). Growing water scarcity and climate change in general are negatively impacting land and vegetation in Kazakhstan, leading to soil erosion and degradation. By 2085, areas with rich topsoil may shrink and move north. Under such a scenario, the largest part of the territory will be occupied by arid zones, which is confirmed by some studies (Sembayeva et al., in press). Such consequences cannot but affect people's lives and their health, as they limit access to drinking water and drastically reduce the amount of water for irrigation (Xenarios et al., in press).

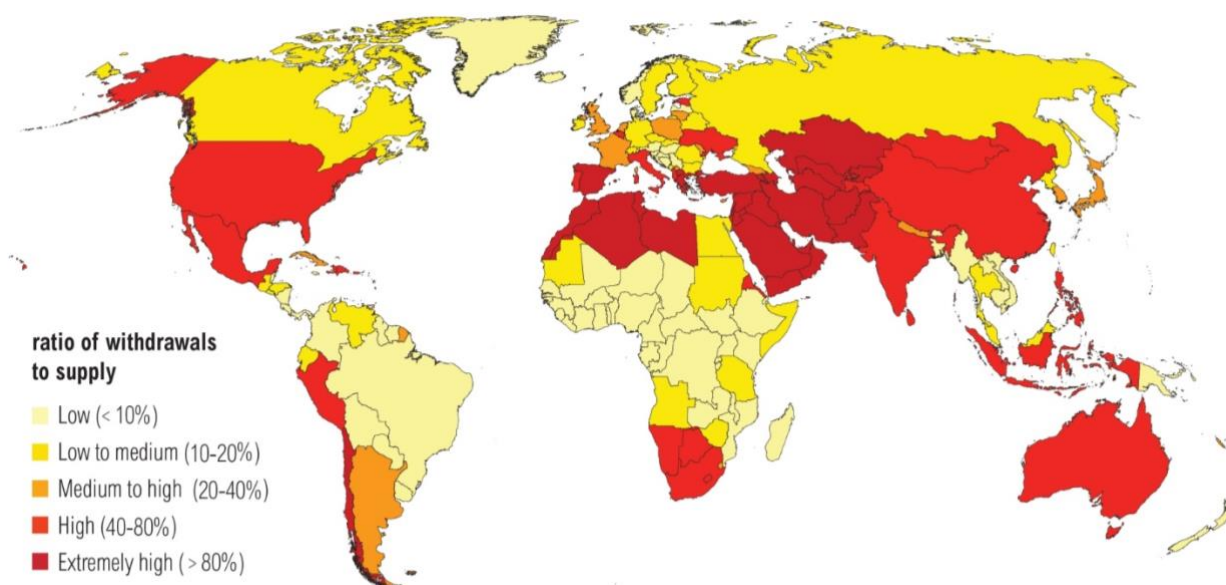


Figure 1. Forecasting of Water Stress by country for 2040 (Source: Maddocks et al., 2015)

## 2. What can lead to water shortage in Kazakhstan?

One of the consequences of climate change is a decrease in the water level in the Caspian and Aral Seas. The growth of greenhouse gas emissions in the Caspian region due to the

increasing volumes of production in the energy sector, industry and agriculture leads to a simultaneous increase of water and air temperature above the Caspian Sea and, as a result, to a decrease in sea level. However, it is known that the Caspian and Aral Seas, as closed water bodies, are characterized by significant fluctuations in sea level. This is their natural rhythm, but global warming has disrupted it, and as a result, in the period 1996-2015 dry years coincided with warm ones. The period 2006-2015 was especially unfavorable (Tehran Convention, 2019).

And today, the main omission in water management is the obsolescence of sanitary equipment, outdated Soviet water purification technologies, and the underdevelopment of the water supply network, especially in rural areas. Worn-out equipment leads to losses during water transportation, which amounted to 15.3% of the total water withdrawal in 2020 (Bureau of National Statistics, 2021). A huge part of water losses during transportation falls on servicing agricultural consumers and is about 70%, on utilities - about 50%, in industry - 40% (Karatayev et al., 2017). According to the Bureau of National Statistics of the Republic of Kazakhstan, in 2020, the volume of fresh water used for irrigation, watering and agricultural water supply amounted to 12.361 cubic km or 61% of the total water withdrawal. Industry is in second place, and in 2020, 5.685 cubic km or 28% of fresh water was used for production needs (Bureau of National Statistics, 2021).

An equally important issue for Kazakhstan is the transboundary nature of the main watercourses of the country. 44.7 km<sup>3</sup> per year out of 100.6 km<sup>3</sup> per year of Kazakhstan's renewable water resources are transboundary and come from neighboring countries - China (19.2 km<sup>3</sup> per year), Uzbekistan (14.7 km<sup>3</sup>), Kyrgyzstan (3.1 km<sup>3</sup>) and Russia (7.6 km<sup>3</sup>) (FAO, 2016). Therefore, Kazakhstan in this matter depends on and is interested in promoting a mutually beneficial water policy in the region. At the moment, the states of Central Asia manage to negotiate and not use preferential access to water as a political weapon. However, this issue for Kazakhstan remains relevant and very important.

Table 1. Provision of water basins

Basin name	Local water resources, km <sup>3</sup>	Transboundary water resources, km <sup>3</sup>	Groundwater, km <sup>3</sup>	Other sources, km <sup>3</sup>	Total, km <sup>3</sup>
Aral-Syrdarya	3.4	14.6	0.2	3.2	21.4
Balkhash-Alakol	15.4	12.2	0.4	0.4	28.4
Yertis	25.9	7.8	0.2	0	33.9
Yessil	2.5	0.1	0.1	0	2.6
Zhaiyk-Kaspi	4.1	7.1	0.2	0.3	11.7
Nura-Sarysu	1.4	-	0.1	-	1.5
Tobyl-Torgay	1.6	0.3	0	0	1.9
Shu-Talas	1.6	2.6	0.1	0	4.3
Total for the country	55.9	44.7	1.3	3.9	105.8

*Source: Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan, 2020*

In addition to access to water resources, the quality of these water resources is an important element of sustainable development. However, 30.2% of the surface waters of Kazakhstan are suitable for irrigation and industry, but for the use of domestic and drinking needs,

methods of deep water treatment are required, 26.4% of surface waters are not suitable for all types of water use (Kazhydormet, 2021).

### **3. What is the communities of the land, taking into account climate change and water shortage?**

Inefficient use of water resources has a negative impact on land use. And taking into account the fact that Kazakhstan is a water dependent country (only 2.8% of its territory is covered with water (UN News, 2022), the country faces corresponding difficulties, which is superimposed on the negative legacy of the Soviet era and climate change.

Decades of aggressive development of agricultural land during the Soviet era led to consequences that are still felt today. In the northern and central parts of Kazakhstan, agricultural land was expanded through the development of pastures, and in the south of the country, moisture-loving cotton and rice moisture-loving crops such as cotton and rice were intensively grown on lands with a high degree of perspiration. Due to the development of pastures in the north and center of the country, the soil structure was disturbed and the humus content is only 5-30% (Yan et al., 2020). And overgrazing, which occurred as a result of driving cattle to unproductive lands and at the same time increasing the number of livestock, led to the degradation of pastures and hayfields.

In the south, mainly in the Aral Sea area, secondary salinization of soils and watercourses has occurred due to massive water withdrawal and inadequate drainage. Today, 33% of all irrigated lands in Kazakhstan are subject to soil salinization, especially in the south of the country (Zan et al., 2022). According to FAO, both non-irrigated lands and rangelands are affected by salinity (FAO, 2022a). The process of salinization leads to the abandonment of land, devoid of vegetation. The development of agriculture in the border lands of the Aral Sea led to its drying up, and subsequently to an increase in air temperature, the frequency of “dry” cyclones and drought (Aleksandrova et al., 2014).

In addition, the impact of climate change is superimposed on existing problems. In particular, the northern regions of the country suffer from climatic changes, since these phenomena are traditionally not typical for them in terms of climatic and natural features and, accordingly, are not adapted to them. For example, due to early warming in the spring of 2019, which came 7-10 days earlier, only 400-500 c/ha of grain were harvested in the Kostanay region, which is significantly below the regional average (Rashid, Isakodzhaev, 2021). Also, due to the drought in 2014, 95.6% of the crop in the Aktobe region (Khobdinsky district) and 18% in the Pavlodar region were affected (Rashid, Isakodzhaev, 2021). In turn, regions that are initially prone to drought and low water are experiencing extreme weather conditions under the influence of climate change, which leads to an increase in the reduction of surface runoff and the depletion of groundwater (Sembayeva et al., in press). For example, in the southern and western regions, strong heatwaves were observed from 2018 to 2021 (Reliefweb, 2021), which led to low water with soil drying up to 50 cm. This drought led to crop failure and massive loss of livestock, which affected agriculture and livestock nationally (IFRC, 2021).

All this, taking into account the process of depletion of water resources, leads to desertification, a decrease in land productivity, and degradation. And this causes instability of land use for agricultural purposes. Fertilizer use has increased due to low soil productivity in Kazakhstan. So, in 2013, up to 0.409 kg of pesticides were used per 1 ha, and in 2020 - up to 0.640 kg of pesticides (Bureau of National Statistics, 2022). The increasing use of pesticides leads to chemical pollution of water and through the filtration process and pollution of groundwater.

In addition to the use of pesticides, chemical contamination of soils and groundwater occurs when industrial waste is disposed of and wastewater is discharged. The greatest pollution is created by mining and processing enterprises, chemical and other industries that have toxic waste. Only 5.7% of all surface water resources in Kazakhstan are assessed as “best quality” and only 8.5% require simple treatment (Kazhydormet, 2021). At the same time, only 7% of all wastewater is completely purified, the rest is discharged into rivers (Karatayev, Kapsalyamova et al., 2017).

The lack of measures taken to properly treat wastewater, renew used equipment, prevent drought and land desertification endanger sustainable land use. And climate change only worsens the picture and damages the national economy and the living conditions of the country's population. Therefore, sustainable development of land use and food systems is of paramount importance for Kazakhstan.

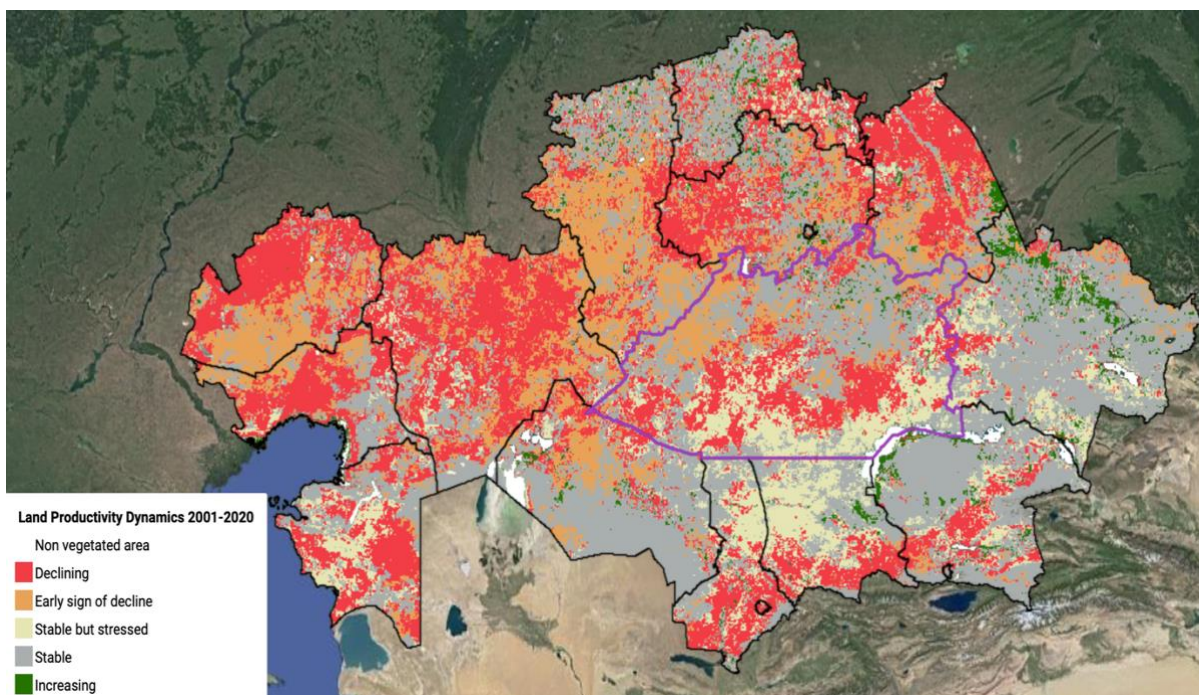


Figure 2. Land productivity dynamics 2001-2020 (Source: FAO, 2022b)

#### 4. How does climate change affect the development of communities in terms of water scarcity?

The geographical position of Kazakhstan increases the country's susceptibility to abnormal weather events, the intensity and number of which is increasing due to climate change.

Phenomena such as droughts and floods complicate the life of the population, namely, they limit access to drinking water and drastically reduce the amount of water for irrigation (Xenarios et al., in press). Most of the agricultural systems in Kazakhstan are stretched to the limit and additional stress comes from the effects of climate change. And this puts pressure on the food security of the country.

Also, the lack of drinking water in many settlements and their inadequate treatment affects the health of the people who live there. A progressive increase in the incidence of diseases of the genitourinary system and oncological diseases (primarily of the digestive system) was revealed, especially among the population that lives close to the Aral Sea, where drinking water has an increased mineralization. It is known that a high level of mineralization leads to urolithiasis, cholelithiasis and hypertension, as well as bronchial asthma and coronary heart disease (Institute of Ecology and Sustainable Development, 2020).

In addition to the consequences of drought and desertification associated with water scarcity, there are also floods, which have become an annual natural spring event for Kazakhstan. In 2015, Akmola, East Kazakhstan, Karaganda and Pavlodar regions suffered from severe floods, where about 15 thousand people were evacuated. In 2022, after the first wave of warming, 3 sections of roads were flooded in East Kazakhstan, West Kazakhstan, Atyrau regions. And as a result of the second wave, 2 houses in Pavlodar region, 25 houses and 2 social facilities in West Kazakhstan and 3 sections of roads in Aktobe and West Kazakhstan regions were flooded with melt water (Zakon.kz, 2022).

The problem is that the annual recurring problem in most of the country the government is working not to prevent disasters, but to eliminate the consequences. Every year, the authorities announce their general readiness to meet possible floods, but in reality they are not ready. In addition to the fact that water floods people's homes to a greater extent in rural areas, roads, kills livestock, water also washes out the contents of street toilets, septic tanks and animal burial grounds (Radio Azattyq, 2019). Thus, water is a distributor of various infections. And this pollutes soils, groundwater, and when it enters rivers and reservoirs, surface water, which becomes a new source of pollution. According to some reports, 1.5% of all deaths in Kazakhstan are related to diseases caused by poor water quality, compared with 0.4% in the US and 0.1% in the UK (Karatayev, Kapsalyamova et al., 2017). Water can cause transmission of cholera, typhoid, dysentery, leptospirosis, tularemia, infectious hepatitis, adenovirus infections, tuberculosis and helminthiasis (UNECE, 2017).

That is, the consequences of climate change always lead to stress on the economy and the social sphere.

## **Policy Recommendations and Implications**

- **Take measures to reduce water losses in transboundary water bodies.** Cross-country monitoring of climate change patterns associated with water evaporation, measures to conserve water resources, the introduction of common water quality standards, data sharing and consistency in designation will help reduce the effects of depletion of water bodies.

- **Implementation of complex management approaches.** Integrated Water Resources Management and Sustainable Land Management will allow addressing the problems of land degradation, droughts, and water shortages, floods and approaching the solution to combat them in an integrated manner. This will allow the efficient use of water

resources for all sectors of the economy and the needs of the population, and thus the sustainable management of land and water resources will become a priority in national policy. For example, updating the equipment used in water transportation will save the lost volume of water, or updating water treatment technologies, including wastewater, will prevent their pollution, and hence the negative impact on the environment and public health.

- **Improving the state of irrigation systems and existing technologies using melt water.** This will make it possible to efficiently consume the waters of the rivers and will make it possible to prevent floods in settlements.

- **To restructure the policy aimed at eliminating the consequences, to the policy of preventing the consequences.** Adapting to possible consequences is always cost-effective, but timeliness of action is important. Research in the field of predicting the effects of climate change on all spheres of life will enable policy makers, large enterprises, and farmers to assess possible risks. And SDSN Kazakhstan can contribute to such research by activating the country's network of universities and research institutes.

- **Public education.** Unfortunately, climate change is still something incomprehensible for many people, and knowledge about its consequences is superficial. To address this issue, SDSN Kazakhstan can stimulate education and organize courses for students of various specialties.

### **Annex: The state of surface water quality in Kazakhstan according to the Unified System of Classification of Water Quality in Water Bodies**

Table 1. State of surface water quality in Kazakhstan for 2021

<b>Quality Class</b>	<b>Characteristics of water by types of water use</b>	<b>Water bodies</b>
1 <sup>st</sup> Class (best quality)	water is suitable for all types of water use	6 water bodies (5 rivers, 1 reservoir): Kara Ertis, Ertis, Usolka, Urzhar, Bettibulak, Aksu rivers (Turkestan region), Ust-Kamenogorsk Reservoir
2 <sup>nd</sup> Class	water is suitable for fish breeding, recreation, irrigation, industry; drinking water supply requires simple water treatment methods	9 water bodies (9 rivers): Buktyrma, Oba, Bayankol, Kaskelen, Karatal, Ulken Almaty, Lepsi, Turgen, Shilik
3 <sup>d</sup> Class	water suitable for recreation, irrigation, industry; the water is suitable for breeding cyprinids; undesirable for salmon; for domestic drinking water supply, methods of conventional and intensive water treatment are required	18 water bodies (15 rivers, 3 reservoirs): the rivers - Breksa, Krasnoyarka, Glubochanka, Ulbi, Ile, Tekes, Aksu (Almaty region), Esentai, Talgar, Korgas, Temirlik, Karkara, Kishi Almaty, Arys, Badam  the reservoirs - Shortandy, Vyacheslavskoye, Kapshagay
> 3 <sup>d</sup> Class	water suitable for irrigation and industry	5 water bodies (4 rivers, 1 reservoir): Zhaiyk (WKO), Derkol, Shagan, Shu rivers, Sergeevskoye Reservoir
4 <sup>th</sup> Class	water suitable for irrigation and industry; - for domestic drinking water supply methods of deep water treatment are required	32 water bodies (26 rivers, 3 channels, 3 reservoirs): the rivers Emel, Peretaska, Yaik, Zhaiyk (Atyrau region), Elek (Aktobe region), Emba (Aktobe region), Or, Oiyl, Aktasty, Kosestek, Kargaly, Ulken Kobda, Temir, Elek (WKO), Saryozen, Torgai, Yesil (North Kazakhstan), Zhabai, Shagalaly, Siletty, Nura (Karaganda region), Esik, Sharyn, Sarykau, Syrdarya (Kyzylorda region), Keles, Koshim canal, canal

		named after K.Satpaev, Nura-Esil canal, reservoirs Buktyrma, Samarkan, Kengir
5 <sup>th</sup> Class (worst quality)	Water is suitable only for certain types of industry - hydropower, mining, hydrotransport	8 water bodies (7 rivers, 1 reservoir): Ayagoz, Kara Kobda, Ayet, Togyzak, Uy, Karabalta, Yesil rivers (Akmola region), Amangeldy reservoir
>5 <sup>th</sup> Class	Water is not suitable for all types of water use	28 water bodies (24 rivers, 4 reservoirs): Tikhaya, Sharonova, Kigash, Emba (Atyrau region), Yrgyz, Shyngyrlau, Karaozen, Tobyl, Obagan, Zhelkuar, Akbulak, Sarybulak, Aksu (Akmola region), Kylshykty, Nura (Akmola region), Kara Kengir, Sokyr, Sherubainura, Talas, Assa, Toktash, Aksu (Zhambyl region), Syrdarya (Turkestan region), Katta-Bugun, reservoirs Karatomar, Zhogargy Tobyl, Tasotkel, Shardara

Source: Adapted from Kazhydormet, 2021

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