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ANALYSIS OF THE DISTRIBUTION AND FORMATION OF DESERTIFICATION PROCESSES IN KAZAKHSTAN AND MEASURES FOR PREVENTION

Desertification is a consequence of a number of important processes occurring in arid and semi-arid conditions. As a rule, the process of desertification of the territory of Kazakhstan and Central Asia is considered in connection with the changes that occurred in its geological periods. The article discusses the problems of desertification and measures to prevent it, since the desert zone occupies most of the territory of Kazakhstan. Thus, it is one of the most susceptible regions of the world to desertification. In our research work, we analyzed the main features of the desert and semi-desert zones of Kazakhstan, the spatial distribution of the sensitivity to desertification of the territories of Kazakhstan, the processes of the history of formation, the negative consequences of desertification and measures to prevent desertification processes. The results of the analysis that most of the territory of Kazakhstan, especially in densely populated southern and western regions, has a large number of desert and semi-desert lands, while these regions are prone to desertification. As can be seen from the discussion of the negative consequences of desertification, desertification and drought in Kazakhstan cause not only environmental, but also economic and social problems. We also noticed that although measures to prevent desertification in Kazakhstan were well applied in Soviet times, little time has been devoted to this issue since independence. However, the results of the differentiation of materials show that over the past ten years a number of measures to combat desertification at the international and state levels have begun in Kazakhstan. One of the urgent problems identified in the article is the incomplete implementation or suspension of some projects to prevent desertification in Kazakhstan, a phenomenon that requires further in-depth study.

Key words: desertification, formation, distribution, prevention, measures

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Қазақстандағы шөлейттену үрдістерінің таралуы мен қалыптасуын талдау және алдын алу шаралары

Шөлейттену – құрғақ және жартылай құрғақ жағдайда болатын бірқатар маңызды процестердің салдары. Әдетте Қазақстан мен Орталық Азия аумағының шөлейттену үрдісін оның геологиялық кезеңдеріндегі болған өзгерістерге байланысты қарастырады. Мақалада шөлейттену проблемалары және оның алдын алу шаралары қарастырылады, себебі шөлді аумақ Қазақстан территориясының көп бөлігін алып жатыр. Сондықтан әлемдегі шөлейттенуге бейім аймақтардың бірі болып табылады. Зерттеу жұмысымызда біз Қазақстанның шөл және шөлейт зоналарының негізгі ерекшеліктерін, Қазақстан аумақтарының шөлейттену сезімталдығының кеңістікте таралуын, қалыптасу тарихының процестерін, шөлейттенудің кері әсерлерін және шөлейттену процестерінің алдын алу шараларын талдадық. Талдау нәтижелері көрсеткендей, Қазақстан аумағының басым бөлігі, әсіресе халқы тығыз орналасқан оңтүстік және батыс аймақтарында шөл және шөлейт жерлер өте көп, сонымен бірге, бұл аймақтар шөлейттенуге бейім. Шөлейттенудің жағымсыз әсерлерін талқылаудан, байқағанымыздай Қазақстандағы шөлейттену мен құрғақшылық тек экологиялық ғана емес, сонымен бірге экономикалық және

әлеуметтік мәселелерді де туындатып отыр. Тағы бір байқағанымыз Қазақстанда шөлейттенудің алдын алу шаралары Кеңес одағы кезінде жақсы қолға алынғанымен, егемендік алған жылдардан бастап оған аз көңіл бөлінген. Дегенмен, материалдарды саралау нәтижесі соңғы он жылдарда Қазақстанда бірқатар халықаралық және мемлекеттік деңгейдегі шөлейттенумен күресу шаралары бастау алғанын көрсетеді. Мақалада анықталған өзекті мәселелердің бірі – Қазақстандағы шөлейттенудің алдын алуға арналған кейбір жобалардың толық орындалмауы немесе орта жолда тоқтап қалуы, бұл құбылыс одан әрі тереңдей зерттеуді қажет етеді.

Түйін сөздер: шөлейттену, қалыптасу, алдын алу, топырақ деградациясы, тұздану, шаралар.

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Анализ распространения и формирования процессов опустынивания в Казахстане и меры по предупреждению

Опустынивание является следствием ряда важных процессов, происходящих в засушливых и полусушливых условиях. Как правило, процесс опустынивания территории Казахстана и Центральной Азии рассматривается в связи с изменениями, произошедшими в его геологические периоды. В статье рассматриваются проблемы опустынивания и меры его профилактики, так как пустынная территория занимает большую часть территории Казахстана. Поэтому он является одним из наиболее подверженных опустыниванию регионов мира. В своей исследовательской работе нами были проанализированы основные особенности пустынных и полупустынных зон Казахстана, пространственное распределение чувствительности опустынивания территорий Казахстана, процессы истории формирования, негативные последствия опустынивания и меры профилактики процессов опустынивания. Результаты анализа показывают, что большая часть территории Казахстана, особенно в густонаселенных южных и западных регионах, имеет большое количество пустынных и полупустынных земель, при этом эти регионы подвержены опустыниванию. Как видно из обсуждения негативных последствий опустынивания, опустынивание и засуха в Казахстане вызывают не только экологические, но и экономические и социальные проблемы. Мы также заметили, что, хотя меры по предотвращению опустынивания в Казахстане хорошо применялись в советское время с момента обретения независимости этому вопросу было мало уделено время. Однако результаты дифференциации материалов показывают, что за последние десять лет в Казахстане начался ряд мер по борьбе с опустыниванием на международном и государственном уровнях. Одной из актуальных проблем, выявленных в статье, является неполное выполнение или остановка некоторых проектов по предотвращению опустынивания в Казахстане, явление, которое требует дальнейшего углубленного изучения.

Ключевые слова: опустынивание, формирование, профилактика, деградация почвы, засоление, меры.

Introduction

Desertification is the process of depletion of the Earth's Crust due to a significant reduction in soil fertility. Of course, desert areas are primarily dry, sub-arid and arid climates, which are very sensitive to human and animal activity, as well as climate change. In areas affected by desertification, the soil is eroded and saline, they lose their ability to retain moisture, groundwater levels fall, and vegetation is reduced or completely lost. Desertification, soil erosion and drought are global problems. According to the United Nations, arid lands cover more than 100 countries and 30% of the Earth's surface. The United Nations Environment Program (UNEP) notes

that desertification has affected 36 million square km of land and is a major international concern. According to the United Nations Convention to Combat Desertification, the lives of 250 million people are affected by desertification, and as many as 135 million people may be displaced by desertification by 2045, making it one of the most severe environmental challenges facing humanity.

Desertification is particularly prevalent in arid and semi-arid regions because these areas are prone to water shortages and are relatively sensitive to climate change and human activities. (Huang, Yu, Guan, Wang, & Guo, 2016). Desertification has become a key ecological problem that hampering the sustainable development of human society in the 21st

century (Liang et al., 2021). It is known that desert areas have rich natural and labor resources, so their rational, gradual development should be considered as the main, strategic reserve for the development of society (Babaev, 2012). Drought leads to desertification, and the lack of rain is an additional factor, there is a common belief that the main causes are related to human overuse of the environment (Aguirre-Salado et al., 2012). Depending on the ecological situation, the presence or absence of vegetation in the areas and the degree of humidity indicate the degree of soil degradation and susceptibility to desertification (Yessenamanova, Yessenamanova, Tlepbergenova, Abdinov, & Ryskalieva, 2020). It has long been said that desertification is mainly due to anthropogenic factors such as the extensive development of irrigation networks, overuse of water for cotton, insufficient drainage, and degradation of ecosystems. In addition, the desertification of large areas was accompanied by soil and groundwater pollution and a decrease in the biological potential of the entire region (Eisfelder, Klein, Niklaus, & Kuenzer, 2014). The main natural factors of these processes are plain areas high degree of the dry climate, soil salinity, carbonate, lack of structure and low natural soil fertility. However, in recent decades, anthropogenic factors of desertification and soil degradation have prevailed (Issanova, Saduakhas, Abuduwaili, Tynybayeva, & Tanirbergenov, 2020). The serious problem of land degradation has prompted all Central Asian countries to ratify the UN

Convention on Desertification, develop national action plans (NAPs) to address the problem, and seek resources for the NAPs' realization (Simonett & Novikov, 2010). Constant drought is a major factor in the degradation and desertification of meadows in Central Asia (Zhang et al., 2018). Desertification in Kazakhstan has a negative impact on the country's ecology, agriculture and livestock. Prompt and accurate identification of desertification areas is very important in understanding the root causes of desertification in different regions of Kazakhstan (Hu, Han, & Zhang, 2020).

The aforementioned problems also exist in the territories of Kazakhstan. This is because desertification is directly related to the natural areas of the country. The territory of the Republic of Kazakhstan is occupied by four natural zones. They are: forest-steppe – 2.5%, steppe – 26%, desert – 14% and semi-desert – 44% zones (Beisenova, 2014). Deserts and semi-deserts cover a large part of the country (Figure 1). In turn, the impact of these natural areas on the process of desertification can be proved by focusing on their climatic features. This research work will build a new technical framework for identification the process through a comprehensive analysis of the main features of desert and semi-desert zones in Kazakhstan, spatial distribution of desertification sensitivity in Kazakhstan, the formation processes history, analysis of the negative effects of desertification and measures to prevent desertification processes in Kazakhstan.

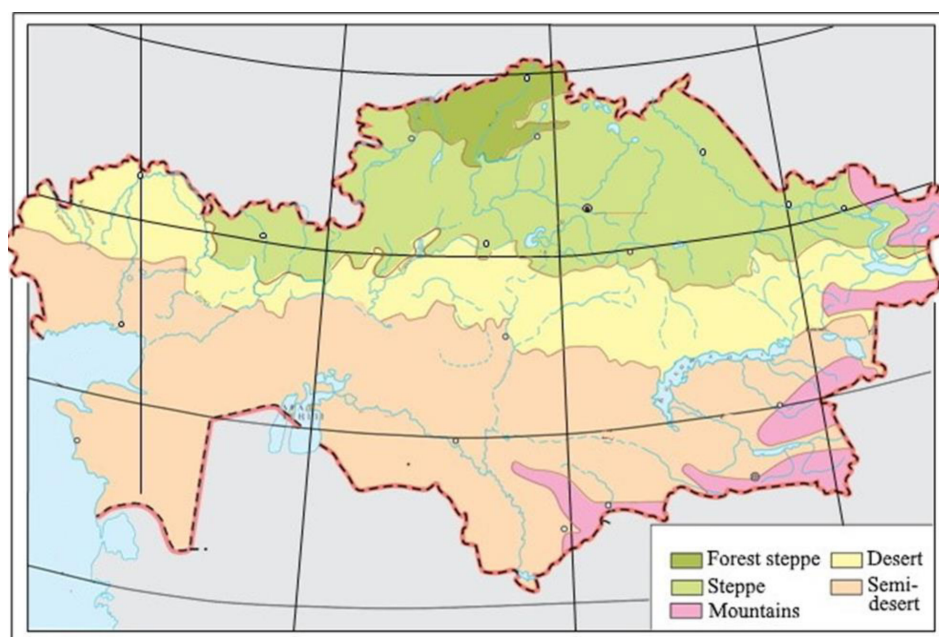


Figure 1 – The overall distribution of the desertification in Kazakhstan territory

Materials and methods

In this article, we analyzed the main features of desert and semi-desert zones in Kazakhstan, spatial distribution of desertification sensitivity in Kazakhstan, the formation history processes, the negative effects of desertification and measures to prevent desertification processes in Kazakhstan. First of all, we described the main characteristics of desert and semi-desert zones in Kazakhstan. Secondly, we analyzed the spatial distribution of desertification sensitivity in Kazakhstan by using the results from the former researchers. Then we discussed the negative effects of desertification from the perspective of Kazakhstan and the whole World. Finally, we listed some effective measures to prevent desertification processes in Kazakhstan and abroad. The methodological basis of the research presented in this article is comprised from information from periodicals, reference sources and data from the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, Central Asia and China. The research was carried out mainly using the methods of descriptive, content analysis of documents. At the same time comparative, geographical methods were also used. Spatial maps were created using the QGIS Desktop 3.14.1 with GRASS 7.8.3.

During analyzing the distribution and formation of desertification processes, a number of online databases were reviewed. The review of documents included all general reports, mission reports and periodic reports produced in recent years as well as some documents dating further back. News and articles related to the topic of “desertification and degradation” were also selected by using GOOGLE CHROME BROWSER.

Results and discussion

The main features of desert and semi-desert zones in Kazakhstan

Desert zone: It covers about 44% of the territory of Kazakhstan - from the shores of the Caspian Sea to the foothills of the highlands in the south - 120 million hectares. In this zone, mainly sandy and loamy, rocky deserts are widespread. Rocky deserts are not typical for Kazakhstan, they are found only in small areas, for example, in the low mountains of Mangistau. The desert zone is divided into northern and southern parts. The northern deserts include the northern slopes of the Ustyurt and Turan lowlands, the Betpakdala plateau, the Moinkum and Balkhash sands, and the southern deserts include the southern Ustyurt and the southern half of the Turan lowland, which includes the Kyzylkum.

Table 1 – Types of deserts in the territory of Kazakhstan and features of their distribution. (Beisenova, 2014)

Main types	Distributed areas	Description and features
Sandy desert	Sands of Kyzylkum, Aral Karakum, Moinkum, Saryesik-Atyrau and Caspian lowlands, etc.	The sands here formed thousands of years ago on the site of rivers and lakes.
Loamy desert	It is found on the southern banks of the Ustyurt, Betpakdala and Syrdarya rivers, between sandy deserts or adjacent to them.	The lowlands of the Ustyurt are occupied by salt lakes, brackish, saline and barren lands. They are formed mainly by surface runoff.
Rocky desert	It is found in the south of Saryarka, east of Betpakdala and in the Ustyurt and Mangistau	There are not many rocky or rocky deserts in Kazakhstan. The vegetation of the rocky deserts is similar in composition to the plants of the neighboring desert.

The climate of the desert zones. The desert climate here is also very continental and very dry. Precipitation is very low, the average annual precipitation does not exceed 200 mm. In some areas of the desert, such as the Kyzylkum, annual precipitation is less than 100 mm. Most of the precipitation falls in the spring, and in summer there is very little rain (mostly dry rain). Winters are cold, January frosts reach -40 °C. Summer is very hot and dry. The average temperature in July is + 24 °C in the north, + 26 °C, + 28 °C in the south, + 30 °C, sometimes

up to + 45 °C. The surface of the sand heats up to + 70 °C in summer. Therefore, evaporation is predominant here. Pits and depressions are filled with melted snow in the spring and dry in the summer heat. No plants grow because thick salt scales form at the bottom.

The soil of the desert zones. In the northern part of the desert there is a brown soil with a 2.5% humus content, formed on a light loam. The thickness of such soil is 30-35 cm. Gray-brown soils, which contain only 1.0-1.2% of humus, are typical of the

southern desert. Gray-brown soil is rich in minerals. If the land is irrigated and fertilized, cotton, wheat, and orchards can be harvested (Beisenova, 2014).

Semi-desert zone: The desert zone is a transitional zone between the steppe and the desert zone. The desert zone in Kazakhstan covers 2,900 km from the banks of the Ural River to the Altai Mountains. The main soil of the desert zone is light dark brown. The amount of humus in the soil is 2-3%. Decreased fertility compared to soils of other zones. The desert areas of the country stretch for 2,900 km from the Urals to the Altai, between the steppe and desert zones. Constantly flowing rivers - Oil, Zhem, Turgai, Sarysu, Ayagoz, most of the remaining rivers are withdrawn in the summer. There are more than 3,000 lakes, large and small. Most water is hard or bitter.

The climate of the semi-desert zones. The climate of the desert is dry, with little precipitation, with a sharp continentality. Annual precipitation ranges from 180 to 300 mm. Most of the precipitation falls in late spring and early summer. In summer it is hot all over the zone. The average temperature in July is + 22 °C, + 24 °C, sometimes up to + 40 °C. Winters are cold, clear and frosty. The average January tem-

perature is -15 °C, -17 °C, the lowest temperature (-50 °C) is recorded at the east of the zone.

The soil of the semi-desert zones. The main soil of the desert is light brown soil with only 2-3% of humus in the surface layer. To the south of the zone it turns into brown and gray-brown soils. The soil in the plains and depressions is saline (Beisenova, 2014).

Spatial distribution of desertification sensitivity in Kazakhstan and formation processes

Kazakhstan is the largest landlocked country in the world and it is a dry and low-rainfall country far from the oceans. The main types of land cover in Kazakhstan: dry meadows, deserts and semi-deserts. As we know, the annual changes in these natural areas, their climatic features and the results of human activities in them are one of the factors in the process of desertification in the country. Since the outbreak of the “Black Storm” in the 1960s, Kazakhstan has been regarded as a typical country suffering from land desertification. The land desertification process has had a significant negative impact on Kazakhstan’s agricultural production, people’s livelihoods and regional sustainable development.

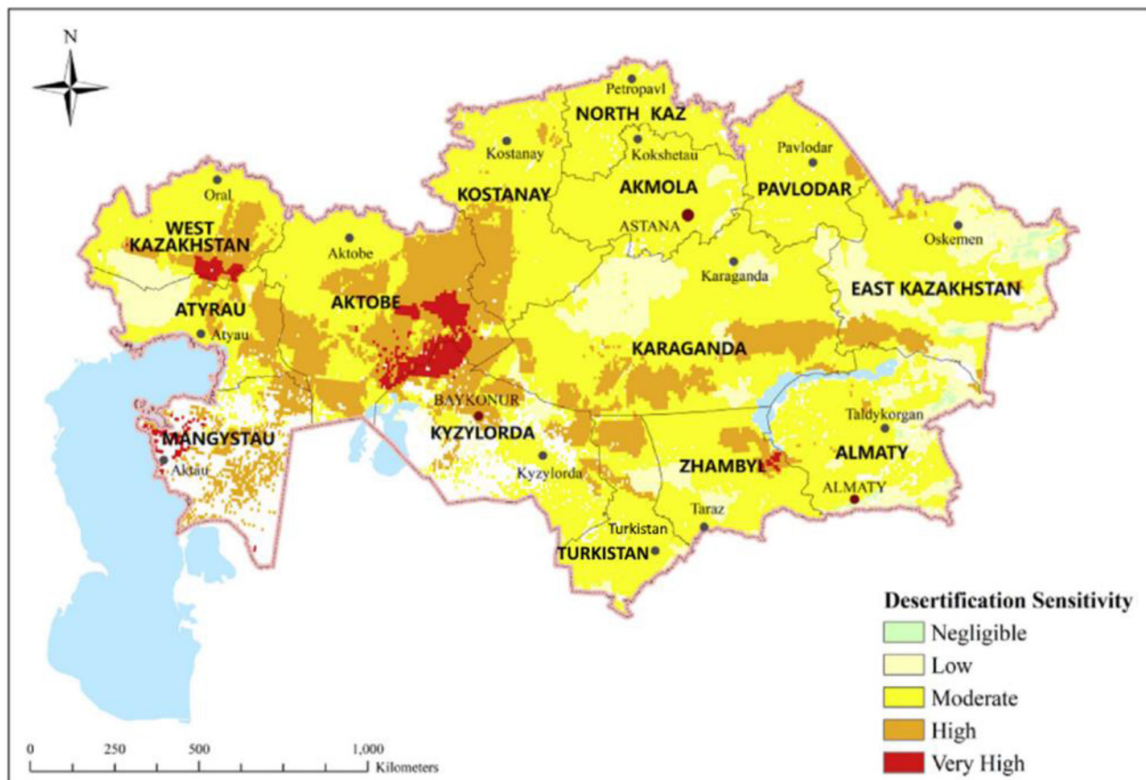


Figure 2 – Spatial distribution of desertification sensitivity in Kazakhstan (Hu et al.,

2020)

The spatial distribution of desertification sensitivity in Kazakhstan is shown in Figure 3. Approximately 76.1% of the land ($2.07 \times 10^6 \text{ km}^2$) in Kazakhstan belongs to moderate and above desertification sensitive areas, of which 18.3% ($0.50 \times 10^6 \text{ km}^2$) are high and very highly sensitive areas. Additionally, 12.7% ($0.35 \times 10^6 \text{ km}^2$) are areas with low sensitivity to desertification. From the perspective of spatial distribution, most areas of Kazakhstan are moderately sensitive, and the areas with high sensitivity are mainly concentrated in the western and central-southern regions, while the desertification sensitivity in the northern, eastern and southern regions is relatively low. Specifically, in western and northern Kazakhstan, most of West Kazakhstan, central Atyrau, most of Aktobe, eastern Mangystau and southwestern Kostanay are highly sensitive areas. The surface ecosystems of these regions are mainly grasslands or deserts, and the surface vegetation coverage is relatively low. Under the influence of climate change and inordinate human activities, desertification is prone to occur. Although 76.1% of the land belongs to moderate or above desertification sensitive areas, these areas are still cultivated lands, grassland and sandy land, or desert. As long as adverse climate changes or inordinate human disturbance occurs, the above sensitive areas will not become ecological degradation areas; that is, the transformation from cultivated land and grassland to desert will not occur (Hu et al., 2020).

Of course, the state uses environmental resources for production and food. However, it lacks proper use and restoration. The causes of land degradation are complex and varied in many countries, but in general are the overuse of natural resources, in particular unsustainable agricultural practices, overgrazing, deforestation, neglect and natural disasters. The root of the problem of desertification in Kazakhstan can be explained by a review of its geological history.

According to archeological sources, the nature of Kazakhstan was once unique. An example of this is the goose flight - a paleontological monument. The monument is located in Pavlodar, on the right bank of the Irtysh River. It is the most famous in the world, as well as the largest monument of the Neogene period. The first excavations were carried out in the 1930s, this place was discovered in 1928 by Yu.A. Orlov opened. The site itself has been explored since 1929. Fossils of about 60 animal bones were found here. The goose flight is the largest and

most famous place of hipparion fauna in all of Central Asia, the estimated age of this object is about 4 - 4.5 million years (<https://wildticketasia.com/>). Looking at this monument, we can see that there were savanna plants and animals in our country. In addition, the study of desertification in Kazakhstan also draws attention to the formation of soil layers. To understand it, we decided to consider the stages of formation of the deserts of Kazakhstan, located from the northern region of modern Kazakhstan to the south. About it Professor Belgibaev ME, Mazbayev OB studied.

In the Ob-Irtysh basin there is a process of formation of relict pine forests with the outflow of glacial waters. The flooding of the Ob River, which is covered with glaciers from 300 to 500 m in height, caused a lot of water flow in the south-west, forming striped pine forests: Kulundin, Kasmalin and Barnaul belts. In these depressions, after 2-3 thousand years, the common pine (*Pinus sibirika*) moved to the right bank of the Irtysh River. On the right bank of the Irtysh River, sandy sediments mixed with the old stream from the left bank of the Ob River are collected. Pine forests appeared in these sandy sediments (Mazbayev OB, 2020).

Pine forests grow on ancient Aeolian sands and gravels. Deforestation as a result of annual fires and loss of solid mass leads to the movement of sand by wind: deflation and aeolian processes. Thus, we can see another factor influencing the problem of desertification.

Analysis of the negative effects of desertification

Desertification is serious environmental and socio-economic problem encompassing huge territories at a global, and regional and local scale. The features of the process of desertification and its end result are devastating for the environments, economies and political stability of the countries they occur (UNEP, 2010). Central Asia (CA) is a core area of global desertification, but the effect of the intensifying “global greening” policy on the desertification process under global warming scenarios in CA remains unclear (Ma, Zhu, Yan, & Zhao, 2021). Desertification is an invisible crisis that threatens the global community. Desertification exacerbates economic, social and environmental problems such as poverty, deteriorating health, declining food security, loss of biodiversity, water scarcity, reduced resilience to climate change and forced migration. Among them are several issues:

- One of the causes of poverty is desertification. Ninety percent of people living in

arid regions live in developing countries. And with climate change, increasing desertification could lead to famine in less developed countries.

– According to the WHO, the potential impact of desertification is reflected in the reduction of food and water resources, fresh water, the risk of respiratory diseases caused by atmospheric dust, as well as the spread of infectious diseases during forced migration due to desertification.

– Desertification has a direct impact on food security: given that the goal is to increase food production by 70% by 2050 to ensure global food security, it is clear that land degradation is a threat to global food security.

– Desertification has a negative impact on biodiversity as a result of loss of biodiversity, reduced activity of ecosystems, the emergence of new species, as well as changes in biomass production.

– Desertification and drought negatively affect the availability, quantity and quality of water resources and lead to water shortages.

– The reduction of productive land, especially in rural areas, contributes to human migration. As a result of desertification and drought, about 135 million people are expected to be relocated by 2045. This has a direct impact on education, health, housing and other social problems in cities.

An example of the cases discussed above is that desertification and drought in Kazakhstan are not only environmental, but also economic and social problems. Although the share of agriculture in Kazakhstan's economy is small, but a sector with great potential for the country's economy, it currently accounts for about 5 percent of GDP and about 60 percent of employment. Due to desertification, food, trade, market access have a negative impact on prices and lead to an increase in farmers and unemployment. The situation in Central Asia has a direct impact on desertification in Kazakhstan, as the desert areas are interconnected, and the main rivers flowing into the desert areas of Kazakhstan come from Kyrgyzstan, Uzbekistan and Tajikistan. Therefore, Kazakhstan is considering ways to work together. Recognizing that desertification and drought are cross-border issues that require joint action, and guided by the UN Convention, Central Asian countries adopted the Subregional Action Plan to Combat Desertification in 2003. The purpose of the program is to coordinate the implementation of subregional interests, exchange information and experience in this area, attract donors against desertification, guide joint programs in the implementation of com-

mon environmental conventions, thus improving the socio-economic situation. The United Nations is currently working with Central Asian countries on this issue.

Measures to prevent desertification processes in Kazakhstan

Monitoring the long-term desertification process and assessing the relative roles of its drivers is very important for the prevention and elimination of desertification problems (Jiang et al., 2019). The development of measures to prevent desertification and combat its consequences is crucial for sustainable development on a global scale (Liang et al., 2021). Accordingly, the issue of how to effectively slow down and prevent the process of desertification has become a priority in research in the field of ecology and the environment. It is known that measures to combat desertification in Kazakhstan date back to the Soviet era. As a result, the governments of the Soviet Union and Kazakhstan at that time made great efforts to prevent and combat desertification and achieved excellent results (Assanova, 2015). However, after the 1990s, when the country gained independence and the economy diversified, there was a widespread trend of rehabilitating hayfields and abandoning arable land, resulting in an increased threat of desertification.

Next, we will discuss a number of important preventive measures taken to prevent desertification in the Republic of Kazakhstan, as well as give an example from the experience of neighboring China, an economically strong country that is successfully working to combat desertification. The strategic goals of the state policy of the Republic of Kazakhstan are to ensure and maintain an optimal level of human-friendly environment based on the accelerated development of production, sustainable management of natural resources and environmental protection (Akiyanova, Abitbayeva, Baratovna Yegemberdiyeva, & Temirbayeva, 2014). Kazakhstan is also taking a number of measures to address the above issues. With regard to measures to prevent desertification in Kazakhstan, the Government of Kazakhstan has signed a number of fundamental documents at the national and international levels, directly or indirectly aimed at addressing the problem of desertification of natural and economic systems.

Kazakhstan ratified the UN Convention to Combat Desertification in 1997. In the same year, the Government of the Republic of Kazakhstan adopted a National Action Plan to Combat Desertification. In January 2005, the Government of the Republic of

Kazakhstan also approved a program to combat desertification in the Republic of Kazakhstan for 2005-2015. In 2008, due to the optimization of the number of sectoral programs of the Government, this program was terminated, and some of its items were included in the "Green Development" program for 2010-2014. The concept of transition of the Republic of Kazakhstan to a "green economy" confirms the complexity of the problem of desertification and proposes the following principles of "green" agriculture: a) prevention of land degradation and restoration of degraded lands; b) prevention of further trampling of pastures; c) efficient use of water; d) rational use of resources; e) waste reduction and recycling; e) non-distribution of carbon dioxide. As part of the implementation of the UN Convention to Combat Desertification in Kazakhstan, a document "Strategic measures to combat desertification in the Republic of Kazakhstan until 2025" was prepared. Kazakhstan also ratified the UN Convention on Biological Diversity in 1994 by Resolution №918 of the Cabinet of Ministers of the Republic of Kazakhstan. In order to jointly solve the Aral Sea problem, Kazakhstan and Uzbekistan have launched the GreenAralSea project and are planting drought-tolerant saxaul on the dried bottom of the Aral Sea. The Aral Sea directly affects the ecosystems of the Amu Darya and Syr Darya rivers. Today, 75 million tons of toxic salt and sand are spread through the air from the bottom of the Aral Sea, and the incidence of cancer and tuberculosis in the sea is 50% higher than elsewhere. Therefore, this project, which is a shining example of international cooperation, makes a significant contribution to the landscaping of the Aral Sea. However, this does not mean that the problem of desertification and drought in the country has been solved.

We also reviewed foreign experience in addressing this issue. For example, the local government has made efforts to curb the spread of the Mu-Uss desert in the Inner Mongolia Autonomous Region of China, and today 70 percent of the sandy lands in Ordos are under control. Today, the sandy sea of Mu-Uss has virtually disappeared and become a lifeless place. "In the past, there were more than 100 mu of grassy pastures, and now there are more than 6,000 mu of willow and tree plantations. After the construction of roads and water supply in these areas, subsidies will be allocated for the settlement and economic activity of the population. Many foreign

and Chinese tourists come to the desert areas, so the local population is also engaged in entrepreneurship. Today, millet, corn, watermelons, peaches, and prunes grow on the barren sands. China is investing heavily in artificial desertification. For example, in 2010, China invested 480 million yuan in afforestation of about 70,000 hectares in the Alashan area of the Inner Mongolia Autonomous Region. The Badan-Zhareng and Tengri deserts have expanded this forest area to prevent it from merging. The Badan-Jarang Desert with an area of 44.3 thousand square kilometers is the third desert in China. It is located mainly in the Alashan region in the western part of the Inner Mongolia Autonomous Region. Tengri Desert, with an area of 42.7 thousand square kilometers, is the fourth largest in China.

Conclusion

Land degradation is a gradual deterioration of biological, chemical and physical properties of soil due to natural causes or irrational use of land (water and wind erosion, soil salinization, floods, overgrazing, fires, felling, deforestation, etc.) circumstances. Land degradation and desertification in arid, semi-arid and arid sub-humid zones is a global environmental problem. Although Kazakhstan has tried to design and implement many preventive measures at the international and national levels since independence, in reality, some preventive measures are not implemented or are stalled in the middle. It is better to tell the truth, because many good initiatives in Kazakhstan for the benefit of the country face obstacles such as corruption and injustice, which protect the interests of certain groups in society. Our recommendations for solving this problem are to reduce the process of sand migration through the cultivation of resistant plant species in the desert regions of the country, to create an association between Central Asian countries on this issue, to jointly address the problem, to consider ways to provide water to desert areas. In general, Kazakhstan should take into account the experience of neighboring countries, like China, in combating drought and desertification.

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