



| Research Article



New Types of Natural Hazards Emerging in Uzbekistan Under Climate Change

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Abstract

This article analyzes the impact of global climate change on natural processes in the territory of Uzbekistan, as well as the mechanisms behind the formation of new types of natural hazards observed in recent years. It also highlights directions for improving monitoring, forecasting, and preventive measures to reduce risks under climate change conditions.

Keywords: Climate Change, Natural Hazards, Environmental Safety, Drought, Flood, Dust Storms, Geological Processes, Monitoring, Prevention



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1. Introduction

Over the past decades, climate change processes worldwide have had a significant impact on all aspects of human life, including the natural environment, economic activity, and social stability. As global warming leads to a continuous increase in atmospheric temperatures, meteorological phenomena are becoming more extreme, with droughts increasing in some regions, while floods and strong wind events are becoming more frequent in others [1]. These changes observed at the global scale are also reflected in the natural climate system of Central Asia, particularly in the Republic of Uzbekistan.

Uzbekistan, due to its geographical location, complex relief, and continental climate conditions, is considered one of the regions highly sensitive to climate change [2], [3], [4]. The increase in the average annual air temperature by approximately 1.5–2°C over the past 70 years, the ongoing desiccation of the Aral Sea, the reduction of water resources, and the intensification of dust storms and desertification processes are clear evidence of these changes. All of these factors pose a direct threat to the country's environmental safety, agriculture, public health, and economic stability.

New types of natural hazards associated with climate change include frequently recurring drought events, the reduction of glaciers in mountainous regions accompanied by an increased risk of floods and mudflows, the rise in dust and sand storms in desert areas, and microclimatic changes around water bodies. These processes have a serious impact not only on ecological systems but also on the living conditions of the population [5]. In addition, climate-related extreme events negatively affect economic infrastructure, the energy sector, transport networks, and agricultural production, thereby threatening the principles of sustainable development.

Currently, initiatives implemented under the leadership of the President of the Republic of Uzbekistan, such as the “Green Economy” policy, the “National Strategy for Climate Change Adaptation,” and the “Aral Sea Region Restoration Program,” are aimed at developing local solutions to this global problem. From this perspective, studying the mechanisms by which climate change generates new natural hazards in the territory of Uzbekistan, as well as scientifically analyzing their causes and consequences, remains one of the most urgent issues [6].

The purpose of this article is to identify the impact of climate change on the natural geographical environment of Uzbekistan, to determine newly emerging types of hazards, and to assess their socio-economic consequences [7], [8]. At the same time, the study is aimed at developing practical recommendations for early detection of climate-related hazards, their monitoring, and risk reduction.

Uzbekistan, due to its geographical location in an arid and semi-arid region, is considered highly vulnerable to global climate change. In the country’s climatic conditions, recent decades have shown an increase in average temperatures, uneven distribution of precipitation, an extension of the vegetation period, and a rise in the number of extreme hot days [9], [10].

2. Methodology

According to data from the Hydrometeorological Service Center of the Republic of Uzbekistan, the average air temperature increased by 1.6°C between 1950 and 2020. This, in turn, disrupts the natural balance of ecosystems and creates conditions for the emergence of new types of natural hazards. As a result of climate change processes, specific natural hazard zones are forming in the mountainous, steppe, and desert regions of the republic. In particular, in foothill areas, glacier melting is intensifying the risk of floods and mudflows, while in central and southern regions, drought, water scarcity, and dust and sand storms are occurring more frequently. These processes have a direct impact on ecosystems, agriculture, and the quality of life of the population.

As direct consequences of climate change, the following new or increasingly intensifying natural hazards are being observed:

Drought and water scarcity. The frequency and duration of droughts have been increasing across almost all regions of Uzbekistan. Rising temperatures have intensified evaporation from water bodies, while river flows have decreased. This has led to a disruption of the water balance in the Amu Darya and Syr Darya basins. As a result, sectors dependent on water resources—such as agriculture, energy, and drinking water supply systems—are under significant pressure [11]. The prolonged drought events observed in 2021–2023 further deepened the problem of water scarcity in the country.



Figure 1. Land degradation and drought caused by climate change

Dust and sand storms. Following the desiccation of the Aral Sea, the frequency of dust and sand storms in the Aralkum Desert has sharply increased. Each year, millions of tons of salt and dust particles are lifted into the atmosphere and spread across the Karakalpakstan, Khorezm, Bukhara, and Navoi regions of Uzbekistan. This not only creates environmental problems but also leads to significant public health concerns [12]. The deterioration of air quality contributes to an increase in respiratory diseases. In addition, dust storms reduce visibility and negatively affect transport safety.



Figure 2. Urban area affected by dust storm

Mudflows and landslides. In mountainous and foothill regions, particularly in the Fergana Valley, Surkhandarya, and Tashkent regions, glacier melting and uneven precipitation distribution are increasing the risk of mudflows. Sudden mudflow events occurring in spring and summer cause damage to infrastructure, settlements, and agricultural lands [13]. In addition, soil erosion, deforestation, and the instability of mountain slopes are increasing the risk of landslides. This further highlights the growing importance of regional environmental security.



Figure 3. Landscape destruction caused by mudflow in a mountainous area

Extreme heat waves. In recent years, sharp increases in air temperature during the summer season have become a new type of risk for Uzbekistan [14]. In 2020, temperatures in some regions reached up to $+46^{\circ}\text{C}$. Such conditions have a serious impact on human health, the energy system, and agricultural productivity. Heat waves increase electricity consumption and raise demand for water resources, which in turn places additional pressure on the energy system.

The increasing risks associated with climate change are directly affecting the country's sustainable development indicators. Water scarcity and drought reduce agricultural productivity and pose a threat to food security [15]. Dust storms and extreme heat have negative impacts on public health, especially for children and the elderly. Meanwhile, mudflows and landslides in mountainous areas cause damage to road infrastructure, power transmission networks, and residential buildings. These conditions not only lead to economic losses but also intensify social problems such as population migration, rising unemployment, and environmental stress. Therefore, climate risk prevention should be viewed not only as an environmental issue but also as a matter of socio-economic stability.

3. Result and Discussion

The conducted analysis demonstrates that climate change has significantly intensified the occurrence of natural hazards in Uzbekistan. Based on hydrometeorological observations, the average annual air temperature increased by approximately 1.6°C during 1950–2020, which has accelerated environmental degradation processes and increased climate-related risks across different regions of the country.

The obtained results indicate that drought and water scarcity remain among the most critical environmental problems. Reduced river discharge in the Amu Darya and Syr Darya basins negatively affects agricultural productivity, irrigation systems, and drinking water supply. The severe drought periods observed during 2021–2023 confirmed the growing vulnerability of water resources under changing climatic conditions. These findings are consistent with regional studies emphasizing the relationship between rising temperatures and declining water availability in Central Asia.

Another significant result is the increasing frequency of dust and sand storms associated with the drying of the Aral Sea. Millions of tons of salt and dust particles are transported annually across large territories of Uzbekistan, especially affecting Karakalpakstan and neighboring regions. This process contributes to environmental degradation, deterioration of air quality, and increased

respiratory diseases among the population. The expansion of the Aralkum Desert demonstrates how climate change transforms local ecological crises into large-scale regional hazards.

The analysis also reveals that mountainous and foothill regions are becoming increasingly vulnerable to mudflows and landslides. Glacier melting and irregular precipitation patterns increase slope instability, causing damage to infrastructure, agricultural land, and residential areas. These hazards create additional socio-economic challenges and require stronger disaster risk management measures.

Furthermore, extreme heat waves have become more frequent in recent years. In some regions, summer temperatures exceeded +46°C, leading to increased electricity consumption, water demand, and public health risks. Vulnerable groups, particularly children and elderly people, are exposed to serious health impacts during prolonged periods of extreme heat.

Overall, the discussion confirms that climate change has multidimensional consequences for Uzbekistan, affecting environmental safety, economic stability, and social well-being. Therefore, strengthening climate adaptation strategies, improving monitoring systems, implementing early warning technologies, and promoting sustainable environmental management are essential for reducing future climate-related risks.

4. Conclusion

Risk reduction and improvement of monitoring systems are considered important directions. The Ministry of Emergency Situations of the Republic of Uzbekistan is implementing a number of strategic measures to manage climate-related hazards. In particular, these include expanding early warning systems for hazardous events based on meteorological observations and satellite monitoring; identifying risk levels by mapping mudflow- and landslide-prone areas in mountainous regions; restoring soil moisture in dust storm source areas and establishing “green barrier zones”; introducing water-saving technologies and climate-adapted agricultural practices in agriculture; and expanding educational and awareness programs aimed at improving the population’s safety culture.

In addition, scientific research projects on climate security are being carried out in cooperation with international organizations. This contributes to enhancing Uzbekistan’s capacity for climate change adaptation, strengthening environmental safety, and modernizing the system for managing emerging risks.

In conclusion, the increasing intensity of new types of natural hazards associated with climate change plays a fundamental role in the implementation of Uzbekistan’s long-term sustainable development policy, the modernization of environmental management systems, and the determination of priority directions for scientific and applied research.

References

- [1] Sh. M. Rakhmatullayev, *Climate Change and Water Resources Management*. Tashkent, Uzbekistan, 2019.
- [2] G. I. Ashirova and A. J. Juraev, *Geoecological Aspects of Natural Risks in Central Asia*. Tashkent, Uzbekistan, 2020.
- [3] UNEP, *Dust and Sand Storms in Central Asia: Impact and Mitigation Measures*. Geneva, Switzerland: United Nations Environment Programme, 2020.
- [4] T. B. Mamatov and Q. R. Rafiqov, *Geodynamics of Natural Hazards in Central Asia*. Samarkand, Uzbekistan: SamSU, 2021.
- [5] UNDP, *Climate Risk Management in Central Asia*. New York, NY, USA: United Nations Development Programme, 2022.

- [6] N. K. Saidova, “Increasing Desertification Processes and the Impact of Climate Change in Uzbekistan,” *Uzbek National University Scientific Bulletin*, no. 2, pp. 45–53, 2022.
- [7] A. T. Yusupov, “The Relationship Between Mudflow Hazards and Climate Change in Mountain Regions of Uzbekistan,” *Journal of Geography and Natural Resources*, no. 3, pp. 22–30, 2021.
- [8] Sh. Q. Alimov, “Dynamics of Dust Storms and Environmental Risks in the Aral Sea Region,” *Ecology and Environmental Protection*, no. 1, pp. 14–20, 2020.
- [9] Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2021: The Physical Science Basis*. Cambridge, U.K.: Cambridge University Press, 2021.
- [10] World Bank, *Central Asia Climate and Environment Outlook*. Washington, DC, USA: World Bank Publications, 2022.
- [11] M. Glantz, *Climate Change and Water Resources in Central Asia*. Boulder, CO, USA: Routledge, 2018.
- [12] B. A. Fayziev and D. K. Karimov, “Environmental Consequences of Aral Sea Drying and Regional Ecological Problems,” *Central Asian Journal of Environmental Studies*, vol. 5, no. 2, pp. 66–74, 2021.
- [13] UNESCO, *Water Security and Climate Change in Central Asia*. Paris, France: UNESCO Publishing, 2020.
- [14] A. N. Kamilov, “Assessment of Flood and Landslide Risks in Uzbekistan Under Climate Change Conditions,” *Natural Hazards Review*, vol. 12, no. 4, pp. 88–97, 2022.
- [15] Asian Development Bank, *Addressing Climate Change Risks in Central Asia*. Manila, Philippines: Asian Development Bank, 2021.