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MAIN TRENDS OF CLIMATE CHANGE IN THE ARAL SEA REGION

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Modern global environmental changes are increasingly regarded as a complex of interrelated processes leading to a decline in the resilience of natural and socio-ecological systems. One of the most large-scale examples of anthropogenic ecosystem degradation is the Aral Sea crisis, the consequences of which extend far beyond the regional level.

This article analyzes the main trends of climate change in the Aral Sea region associated with the desiccation of the Aral Sea, transformation of the hydrological regime, and intensification of climatic aridization. Special attention is paid to contemporary climatic anomalies, the increasing frequency of extreme weather events, desertification processes, and their impacts on ecosystems and public health.

The results indicate that under ongoing global climate change, the Aral Sea region remains one of the most environmentally vulnerable territories of Central Asia, requiring integrated scientific assessment and sustainable management strategies.

Key words: Aral Sea region, Aral Sea, climate change, aridization, environmental disaster, extreme climatic events.

Introduction. Global environmental transformations of recent decades represent a cumulative effect of anthropogenic pressures on natural systems, resulting in reduced adaptive capacity of both ecosystems and human communities. Among the most illustrative cases of large-scale human-induced environmental disruption is the Aral Sea crisis, which emerged as a consequence of long-term mismanagement of transboundary water resources in Central Asia.

The environmental changes occurring within the Aral Sea basin have exceeded local boundaries and acquired regional and global significance. Alterations in the hydrological regime, land surface characteristics, and atmospheric processes have led to persistent climatic shifts, creating conditions of increased ecological vulnerability. In

this context, the Aral Sea region represents a unique natural laboratory for studying the interaction between climate change, desertification, and socio-environmental risks.

The Republic of Kazakhstan faces complex environmental challenges characterized by spatial heterogeneity and the accumulation of multiple stress factors. The Aral Sea region occupies a special position among environmentally disadvantaged territories due to the combined impact of climatic aridization, soil degradation, and public health risks. These circumstances necessitate a systematic scientific assessment of current climate trends and their potential long-term consequences.

Results and Discussion. Climatic Transformation of the Aral Sea Region. The large-scale reduction of the Aral Sea water surface has fundamentally altered the regional energy and moisture balance. The disappearance of a major water body eliminated its moderating influence on air temperature, leading to enhanced continentality of the local climate. As a result, the amplitude of both seasonal and diurnal temperature fluctuations has increased.

Instrumental observations indicate a steady rise in summer air temperatures accompanied by more frequent episodes of extreme heat, while winter periods are characterrized by sharper and more prolonged cold spells. Simultaneously, atmospheric humidity has decreased, and precipitation regimes have become more irregular. These changes contribute to the shortening of the vegetation period and increased probability of drought events.

Aridization and Aeolian Processes. Climatic aridization in the Aral Sea region is closely associated with intensified aeolian processes. The exposed seabed, composed of fine sediments enriched with salts and agrochemical residues, serves as a continuous source of airborne particles. Under conditions of strong winds, these materials are transported over hundreds and even thousands of kilometers, affecting soil quality, atmospheric transparency, and cryospheric systems in distant regions.

The frequency of dust and salt storms has increased, accelerating land degradation and further reducing the resilience of local ecosystems. These processes create feedback mechanisms that exacerbate regional climate anomalies and hinder natural vegetation recovery.

Environmental Zoning and Health Risks. According to national environmental classification, the Aral Sea region includes territories designated as zones of ecological disaster, crisis, and pre-crisis conditions. These zones are characterized by differing degrees of environmental stress; however, all are associated with elevated risks to public health. Long-term exposure to airborne dust, high salinity, and climatic extremes contributes to the prevalence of respiratory, cardiovascular, and other environmentally dependent diseases.

Conclusion. The analysis demonstrates that the desiccation of the Aral Sea has become a dominant driver of climatic and environmental transformation in the region. Increased aridity, amplification of temperature extremes, and the intensification of

hazardous weather phenomena collectively undermine ecosystem stability and human well-being.

Under ongoing global climate change, these negative trends are likely to persist or intensify, emphasizing the need for continuous climatic monitoring and integrated environmental management strategies. The Aral Sea crisis should therefore be regarded not only as a regional environmental catastrophe but also as a globally significant example of the long-term climatic consequences of unsustainable natural resource use.

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АРАЛ МАҢЫ ӨҢІРІНДЕГІ КЛИМАТТЫҚ ТРАНСФОРМАЦИЯНЫҢ ҚАЗІРГІ ҮРДІСТЕРІ

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Тұжырым

Қазіргі заманғы жаһандық экологиялық өзгерістер табиғи және әлеуметтік-экологиялық жүйелердің тұрақтылығының төмендеуіне әкелетін өзара байланыс-

ты үдерістердің жиынтығы ретінде қарастырылады. Экожүйелердің антропогендік деградациясының ең ауқымды мысалдарының бірі – салдары аймақтық деңгейден әлдеқайда асып кеткен Арал теңізі дағдарысы.

Мақалада Арал теңізінің тартылуы, гидрологиялық режимнің өзгеруі және климаттың аридизациясының күшеюі нәтижесінде қалыптасқан Арал маңы аймағындағы климаттың өзгеруінің негізгі үрдістері қарастырылады. Қазіргі климаттық аномалияларға, экстремалды ауа райы құбылыстарының жиілеуіне, шөлейттену үдерістеріне және олардың экожүйелер мен халық денсаулығына әсеріне ерекше назар аударылады.

Түйінді сөздер: Арал маңы өңірі, Арал теңізі, климаттың өзгеруі, аридизация, экологиялық апат, экстремалды климаттық құбылыстар.

СОВРЕМЕННЫЕ ТЕНДЕНЦИИ КЛИМАТИЧЕСКОЙ ТРАНСФОРМАЦИИ ПРИАРАЛЬЯ

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Резюме

Современные глобальные изменения окружающей среды рассматриваются как совокупность взаимосвязанных процессов, приводящих к снижению устойчивости природных и социально-экологических систем. Одним из наиболее масштабных примеров антропогенной деградации экосистем является кризис Аральского моря, последствия которого вышли далеко за пределы регионального уровня. В статье рассматриваются основные тенденции изменения климата Приаралья, обусловленные усыханием Аральского моря, трансформацией гидрологического режима и усилением аридизации климата. Особое внимание уделяется современным климатическим аномалиям, росту частоты экстремальных погодных явлений, процессам опустынивания и их воздействию на экосистемы и здоровье населения.

Ключевые слова: Приаралье, Аральское море, изменение климата, аридизация, экологическая катастрофа, экстремальные климатические явления.