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ASSESSMENT AND MONITORING OF THE ECOLOGICAL STATE OF AREAS WITH HIGH TECHNOGENIC RISK.

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Abstract:
This article discusses the issue of assessing and monitoring the ecological state of areas with high technogenic risk. Also, as a result of the research, the concept of technogenic hazardous zones, their types, and the origin of risks in connection with the territorial features and geographical location of the region were analyzed. In addition, the issues of developing criteria for assessing and monitoring risk levels and creating a database on this basis, as well as modeling and mapping using modern methods were discussed. In particular, the work proposes comprehensive approaches to increasing the effectiveness of risk management in technogenic hazardous zones, ensuring ecological stability, and creating a safe living environment for the population.

Keywords: Technogenic hazardous zones, geographic information systems (GIS), state land cadastre, risk assessment, emergency situations, territorial planning, environmental safety, database, risk management

INTRODUCTION

In recent years, the Kashkadarya and Surkhandarya regions of southwestern Uzbekistan have witnessed rapid population growth, the development of various sectors of the national economy, including industry, oil and gas production, construction and transport infrastructure. This has increased the strong technogenic load on the natural environment and necessitated regular monitoring of the ecological situation in high-risk areas. Ecological monitoring is the process of systematic observation, analysis and prediction of changes in the components of the natural environment [1]. It serves to identify, prevent and develop measures to reduce the risks of negative environmental consequences arising from the influence of technogenic factors. Identification of technogenic hazardous zones and their maintenance by the state cadastre system, protection of the population and the environment are of great importance. As a result of global climate change and human activity, natural disasters, industrial development, energy production, chemical industry risks and extreme situations are becoming increasingly common. Technogenic hazardous zones, in turn, can cause environmental, economic and social damage. Therefore, identification of technogenic hazardous zones and inclusion of information on them in the cadastre system remains an urgent issue. This will not only ensure the safety of the population, but also help reduce economic and environmental damage. The inclusion of such information in the state cadastre system increases the efficiency of territorial management and serves as the basis for developing strategies to preserve natural resources and economic activity and combat various risks. The main goal of conducting research is to study the problems of identifying, assessing technogenic hazardous zones and including them in the state cadastre system. The main task is to study the methodological foundations of identifying technogenic hazardous zones, analyze existing approaches to assessment, identify technical, legal, and financial problems in including technogenic hazardous zones in the cadastral system, and develop effective systems for managing hazardous areas. . *[1]. Tashkentov I. (2021). Technogenic hazards and their management. Tashkent: Fan Publishing House. 2/52*

ANALYSIS OF THE USED LITERATURE. A.N. Nedugov, Yu.A. Aleksandrova, Yu.A. Buyvolova, A.S. Shestakova, A.A. Varlamova, S.N. Volkova, S.A. Galchenko, P.F. Loyko, R.T. Nagaeva and 1.
others were engaged in the assessment and monitoring of the ecological state of areas with high technogenic risk and achieved certain results.

RESEARCH METHODOLOGY Based on cartographic and geoinformation technologies, work was carried out to identify technogenic hazard zones, compile ecological maps, monitor and assess their territorial distribution. Spatial data (geological, hydrogeological, industrial, ecological and climatic data) obtained on the basis of remote sensing materials are integrated into a single information system using geoinformation technologies. As a result, state cadastral maps of zones with high ecological and technogenic hazard are created, reflecting the level of pollution, types of hazards and their territorial boundaries (Figure 1)

Figure 1

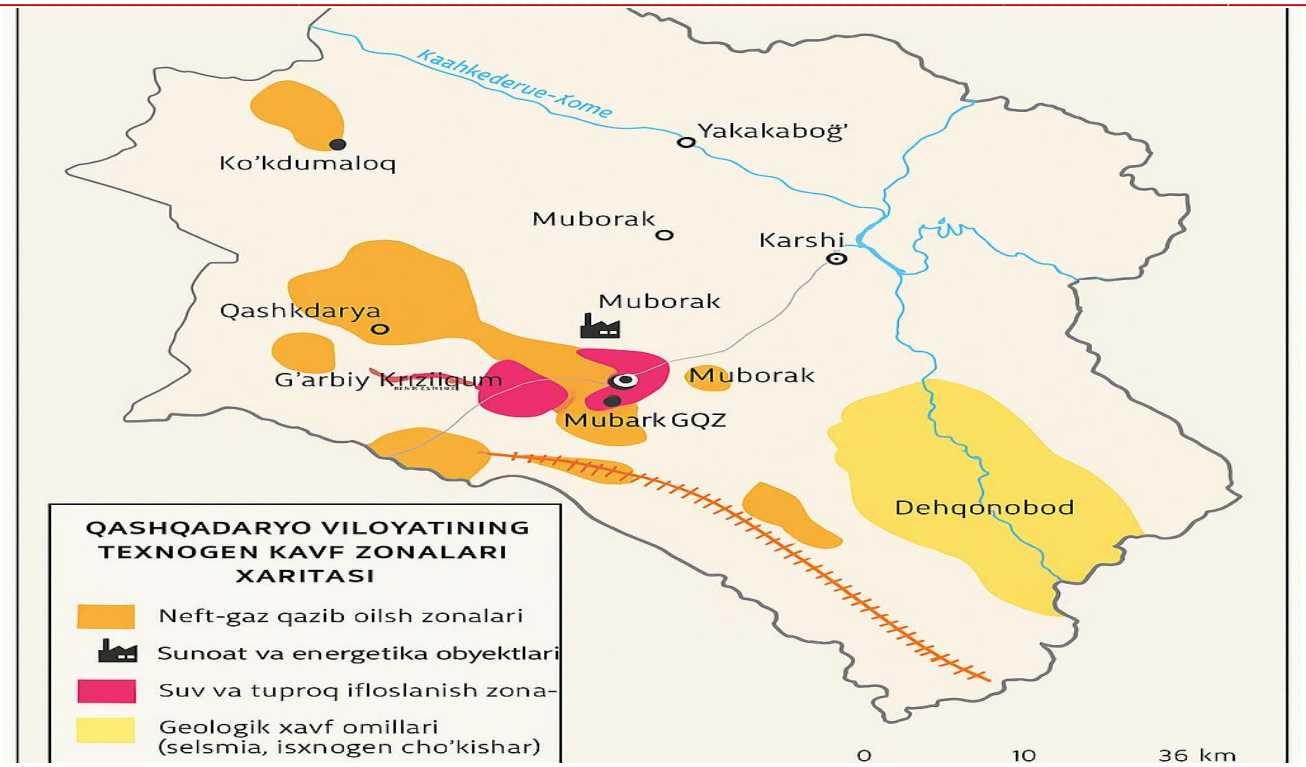

Figure 1: Map of zones with high technogenic risk in the Kashkadarya region.

As a result of the study, a scientific basis was created for identifying areas with a high level of risk in the process of assessing the territorial impact of technogenic processes (for example, oil and gas production, industrial waste, transport emissions), monitoring the dynamics of the ecological state, forecasting and automating these processes, and making management decisions. Areas with a high level of technogenic risk are areas where the natural balance has been disrupted as a result of human activity, and where environmental risk factors have accumulated at a high level under the influence of industrial, energy, transport or mining processes.

STATISTICAL ANALYSIS OF AREAS WITH HIGH TECHNOGENIC RISK: One of the most important scientific and methodological directions is the identification of areas with high technogenic risk, assessment of their condition and monitoring of their dynamics based on statistical analyses. With the help of these analyses, the level of technogenic load, the volume of pollution, the amount of waste and their territorial distribution are determined based on quantitative indicators. An analysis of the Kashkadarya and Surkhandarya regions shows that densely populated industrial zones (Mubarak, Shurtan, Kokdumalaq, Western Kyzylkum, Dehqonabad) have the highest levels of environmental pollution in the republic. According to statistics, in recent years, the volume of harmful gases emitted into the atmosphere in these regions has averaged 3.5-4.2 thousand tons per year, of which 60-65% is carbon monoxide (CO), 20% is nitrogen oxide (NOx), and the rest is dust, sulfur dioxide (SO2) and other pollutants.

The main sources of industrial waste are the Shurtan gas and chemical complex, the Mubarak gas and oil complex, and the Dehqanabad potash plant. According to statistical observations, an average of 1.1–1.3 million tons of gas are processed per year in the Mubarak district alone, resulting in 450–500 tons of harmful substances being released into the atmosphere each year. In addition, wastewater and drilling mud generated during oil and gas production negatively affect the quality of soil and groundwater.

When analyzing the technogenic load of regions, the main statistical factors are indicators such as population density, number of industrial facilities, amount of waste and energy consumption. For example, in the northwestern part of the Kashkadarya region (Kokdumaloq-Western Kyzyl-Kum zone), the number of industrial facilities per 1 km² is 2.3 times higher than the average for the republic. Therefore, these areas are classified as having a high level of risk.

When the results of the statistical analysis are integrated with GIS data, a regional differential map of technogenic risk is formed. Based on this map, the following groups are distinguished:

High-risk zones - gas and chemical industry centers (Mubarak, Shurtan, Kokdumaloq);

Medium-risk zones - areas with dense transport and energy infrastructure (Karshi, Yakkabog, Dehqanabad);

Low-risk zones are foothill and agricultural districts (Koson, Nishon, Mirishkor).

The results of statistical modeling show that the technogenic load index (TYI) in the Kashkadarya region has increased by 1.6 times over the past decade, indicating the need to strengthen the environmental monitoring system in this region. In particular, seasonal changes in atmospheric pollution (high in summer, low in winter) are clearly noticeable. Based on this, the need to reduce waste, recycle waste and establish a GIS-based management system is emphasized in the regional environmental policy.

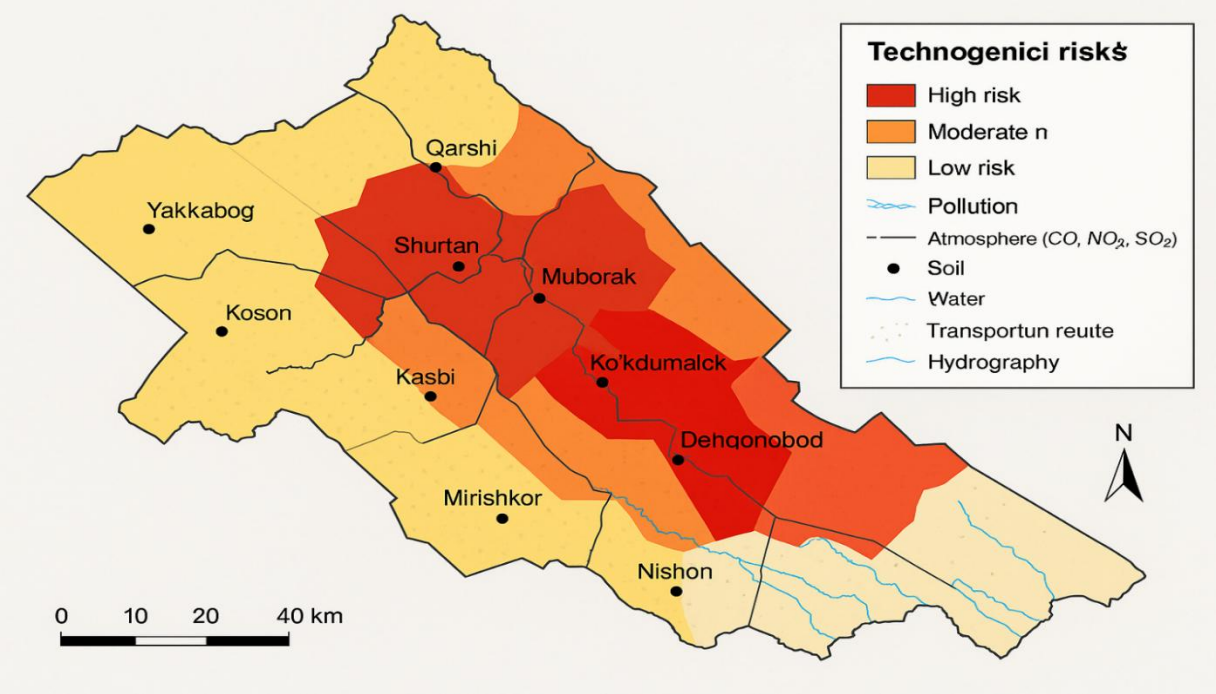

Figure 2: Regional differential map of Kashkadarya region with high technogenic risk.

Thus, the results of statistical analysis allow us to quantitatively assess the scale, intensity, and dynamics of technogenic hazard zones. This serves as an important scientific basis for reducing environmental risks, strengthening safety measures in territorial planning, and developing a sustainable development strategy.

Results of statistical analysis of areas with high technogenic risk in Kashkadarya region

№	Region (district/city)	Main source of risk	Harmful substances emitted into the atmosphere (tons/year)	Industrial waste (thousand tons/year)	Pollution level (indicator score)	Technogenic risk level
1	Mubarak district	Oil and gas production, thermal power plant	8 200	12,5	0,82	High
3	Dehqanabad district	Limestone and cement production	6 150	8,1	0,69	Medium-high
4	Karshi city	Transport, energy, household waste	4 300	6,7	0,61	Middle
5	Yakkabag district	Agricultural chemical treatments	2 950	4,5	0,54	Middle
6	Kason district	Industrial enterprises, traffic	2 700	3,9	0,47	Low–medium
7	Kasbi district	Cotton ginning, agricultural waste	2 300	2,8	0,41	Low
8	Mirishkor district	Pollution of water resources	1 850	2,3	0,38	Low

		(Aral Sea effect)				

Estimating land surface change based on space monitoring data

Space data is one of the main sources for monitoring man-made processes. Today, the following changes are being detected in the Kashkadarya region through remote sensing technologies:

Land subsidence - due to gas extraction around Mubarak and Shurtan, an average of 2.5–5.8 cm/year is recorded in 2010–2024 (according to InSAR analysis) (Table 2).

Vegetation index (NDVI) decrease - a 12–17% decrease is observed around Yakkabog and Karshi due to industrial emissions.

Soil moisture and reflectivity changes - an increase of 0.04–0.07 units in Dehqanabad and Mirishkor districts, which indicates an increase in salinization processes.

Water resource depletion — The area of the Amu Darya network and artificial reservoirs decreased by 8–10% in 2015–2024.

Land level change indicators based on remote sensing (RS) data (2010–2024)

№	Region	Parameter studied	Amount of change	Source (RS data type)	Type of technogenic impact
1	Mubarak district	Land subsidence	5.8 cm/year	Sentinel-1 (InSAR)	Gas extraction
2	Shurtan complex	Surface deformation	4.3 cm/year	TerraSAR-X	Chemical industry
3	Dehkanabad district	NDVI decrease	–0.12 (12%)	Landsat-8 (NDVI)	Atmospheric dust
4	Qarshi city	Green area decrease	–15%	Sentinel-2 (RGB, NIR)	Transport and waste
5	Yakkabog district	Salinity index (SI)	0.05	MODIS (SWIR)	Agro-technogenic load
6	Mirishkor district	Soil reflectivity increase	0.07	Landsat-9 (SWIR)	Water shortage
7	Nishon district	Water surface shrinkage	–9%	PlanetScope (RGB)	Water resource degradation

Their analysis shows that the deformation of the land surface and the decrease in the vegetation index in the areas close to the gas and chemical industries in the Kashkadarya region are a direct result of the technogenic load. Integration of space monitoring data with GIS allows for the accurate updating of technogenic risk maps.

Their analysis shows that the deformation of the ground surface and the decrease in the vegetation index in the areas close to the gas and chemical industries in the Kashkadarya region are a direct result of the technogenic load. Integration of space monitoring data with GIS allows us to update the technogenic risk maps with greater accuracy.

According to the results of the study, the Guzar, Mubarak and Dehqanabad districts of the Kashkadarya region and the Boysun and Angor districts of the Surkhandarya region are among the areas with a high level of technogenic risk.

Industrial sectors in the Kashkadarya and Surkhandarya regions, including oil and gas fields and their infrastructure, emit carbon oxides, nitrogen oxides, and hydrogen sulfide into the atmosphere, while building materials factories pollute the air with dust and heavy metal particles, and the transport network increases the environmental load as a result of fuel combustion products. According to the results of the study and Remote Sensing data, the NDVI index of vegetation cover in the industrial zones of the Kashkadarya region decreased by 0.15 units in 2010–2024, which indicates a deterioration in the ecological situation.

CONCLUSION. Monitoring in areas associated with technogenic activity should be carried out not only on the basis of statistical data, but on the basis of a comprehensive geoinformation approach. Because only in this way can an accurate assessment of the territorial scale of anthropogenic changes, differentiation of the level of environmental risk and development of sustainable development policies be made. Ecological monitoring of areas with high technogenic risk is

the most effective means not only of controlling the state of pollution, but also of maintaining the ecological stability of the natural environment. A monitoring system based on GIS and remote sensing technologies allows automating and increasing the accuracy of this process.

In the future, the introduction of such systems in the system of the Ministry of Ecology, Environmental Protection and Climate Change of the Republic of Uzbekistan is one of the most important issues.

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