

<https://doi.org/10.26565/2410-7360-2026-64-09>

UDC 502; 574 /47. 9245/ 911.3

The impact of natural and anthropogenic risks on population safety and agriculture development in the Gazakh-Tovuz economic region

Samira Ogtay Alakbarova,  <https://orcid.org/0000-0001-9138-3403>, e-mail: alakbarovasamira@hotmail.com

PhD (Geography), Associate Professor, Head of the "Population geography" laboratory of the Institute of Geography Public Legal Entity, Baku, Azerbaijan

ABSTRACT

The natural-geographical conditions of the Gazakh–Tovuz economic region determine the spatial interdependence between population safety and agricultural development. However, global climate change, land degradation, increasing environmental pressure, and the expansion of human activity have significantly increased vulnerability to natural and anthropogenic risks. At the same time, agriculture remains a key sector of the regional economy, playing an important role in employment. Uneven spatial development, declining land productivity in some areas, and increasing exposure to natural hazards hinder the efficient use of resources. This situation highlights the need for a comprehensive assessment of risk factors influencing both agriculture and settlement structure. Therefore, identifying the current problems and ensuring sustainable territorial development under changing environmental conditions is of high scientific and practical importance for the region.

Aim of the study. To study the spatial analysis of the Gazakh–Tovuz economic region and the role of natural-anthropogenic risks in the territorial organization of agriculture and the safe settlement of the population. To determine the level of disaster risk in the development of agricultural sectors. This makes it possible to assess the impact of natural and anthropogenic risks on both population safety and the sustainable development of agricultural areas in zones highly sensitive to destructive processes within the study area.

Research methodology. This study applies a quantitative approach to analyze the impact of natural and anthropogenic risks on population settlement and agricultural development. The assessment is based on an integrated index system that considers the intensity and frequency of events, the level of exposure, and the vulnerability of agricultural systems. In addition, the Analytic Hierarchy Process is used to rank different types of risks through a weighted multi-criteria evaluation. The results support the identification of vulnerable areas and the development of spatial risk maps for the region.

Results. The spatial analysis indicates that natural and anthropogenic risks in the Gazakh–Tovuz economic region are unevenly distributed and significantly influence both population settlement patterns and agricultural development. The southern and western parts of the region are identified as the most vulnerable zones, particularly where agricultural activity is more intensive and settlements are more exposed. Based on a four-level classification, approximately 0–5% of the territory is classified as very weak risk, 10–20% as weak, 20–33% as medium, and 33–50% as strong risk. Weak-risk areas have limited impact on settlements and agriculture, while medium and strong-risk zones are associated with recurring damage to infrastructure, agricultural lands, and rural settlements, leading to socio-economic disruptions. Overall, a considerable part of the region is exposed to medium and high risk levels, which adversely affects the stability of settlement systems and the sustainable development of agriculture.

ARTICLE INFO

Manuscript received
1 May 2025

Revised manuscript received
10 March 2026

Manuscript accepted
25 May 2026

Available online
30 May 2026

Keywords:

agriculture, risk assessment, population safety, economic and geographical assessment, continuous development, Gazakh-Tovuz economic region.

Introduction

Population growth, increasing anthropogenic impacts, and climate change in the Gazakh-Tovuz economic region intensify natural and

anthropogenic risks, leading to a reduction in usable land resources and negatively affecting agriculture. These processes also influence population safety and the spatial organization of economic activities. Therefore, reducing risks

In cites:

Alakbarova Samira (2026). The impact of natural and anthropogenic risks on population safety and agriculture development in the Gazakh-Tovuz economic region. *Visnyk of V. N. Karazin Kharkiv National University, Series Geology. Geography. Ecology*, (64), 121–130. <https://doi.org/10.26565/2410-7360-2026-64-09>



© Samira Ogtay Alakbarova, 2026

This work is licensed under a Creative Commons Attribution 4.0 International License

and implementing protective measures are of crucial importance. Natural and anthropogenic risks cause serious damage to settlements, infrastructure, agricultural areas, and natural resources, leading to considerable economic losses. Therefore, studying these risks and implementing mitigation measures is of great importance.

This topic is relevant because agriculture plays a crucial role in the Gazakh-Tovuz economic region, serving as a primary source of employment and income for a significant part of the population. Analyzing the impact of natural and anthropogenic risks on population safety and agricultural development is essential for identifying problems, improving the use of resources, and ensuring sustainable development. Furthermore, the analysis of the spatial distribution and intensity of natural and anthropogenic risks, as well as their potential impacts, provides an important foundation for ensuring sustainable regional development and effective spatial planning.

The purpose of the research work. The main purpose of this study is to comprehensively analyze the impact of natural and anthropogenic risks on population safety and agriculture development in the Gazakh-Tovuz economic region, while assessing future development prospects and potential risks. The research also evaluates the effects of these factors on the agricultural sector and determines the overall level of risk. Based on these assessments, the study aims to develop scientifically grounded strategies to enhance the resilience of the region's agriculture sector, reduce risks, and support sustainable socio-economic development, thereby improving the welfare of the rural population.

Material and methods

Within the framework of the study, methods including risk assessment, mapping, forecasting, geographic information systems, and Analytic Hierarchy Process (AHP) analyses were applied. Furthermore, the decisions and measures outlined in State Programs were thoroughly analyzed, and the results were presented based on extensive scientific literature. This study applies two complementary approaches. First, mathematical-statistical methods – based on probability theory are used for parameter estimation, spatial correlation, areal analysis, and landscape structure analysis. Second, mathematical analysis of statistical data – is employed for practical processing of empirical data, including descriptive statistics, spatial distribution analysis, and model fitting. Together, these approaches ensure a robust theoretical-statistical framework and systematic analysis of spatial data.

The study is based on official statistical data, regional development reports, and thematic map

covering the Gazakh-Tovuz economic region. Quantitative analysis was applied to assess the impact of natural and technogenic risks on population safety and agricultural development. A hazard-based index approach was used, integrating indicators of intensity, frequency, exposure, and vulnerability to evaluate risk levels. In addition, the Analytic Hierarchy Process (AHP) was applied to rank different risk factors using a weighted multi-criteria system. Spatial analysis and modern computer technologies were used to develop risk map and identify vulnerable zones. The assessment was carried out across different administrative districts to ensure comparative analysis and spatial differentiation of risk levels.

Scientific novelty of the study. It is based on the integrated assessment of natural and anthropogenic risks in the Gazakh-Tovuz economic region using a spatially differentiated approach that combines demographic, population safety, geographical, and agricultural indicators. The regional risk structure is systematically analyzed in relation to settlement patterns and agricultural development, which enables the identification of medium and high-risk zones affecting rural sustainability.

Analysis and Discussion. The Gazakh-Tovuz economic region, located in the western part of Azerbaijan, is distinguished by its rich natural resources, favorable climatic conditions, and strategic geographical position [14]. Agriculture holds an important place in the region's economic structure and is considered one of the main sectors of employment for the population. In particular, traditional activities such as viticulture, grain farming, livestock breeding, and horticulture play a significant role in the socio-economic development of the region. At the same time, the development of agriculture in this region is closely linked to population settlement patterns, since the spatial distribution of settlements, the rural demographic structure, and the availability of labor resources play a decisive role in shaping land use practices and the organization of agriculture. In areas with favourable natural and climatic conditions, agriculture becomes a key determinant of settlement structure and labour allocation.

The structure of land-use distribution in the region plays a decisive role in shaping its agricultural productivity and spatial development potential [13]. Variations among arable land, forest areas, water-covered territories, and other land categories determine both the region's resource availability and its environmental constraints (Fig. 1).

Over the past decade, intensive anthropogenic activities have significantly altered the natural landscapes of the region, leading to a considerable

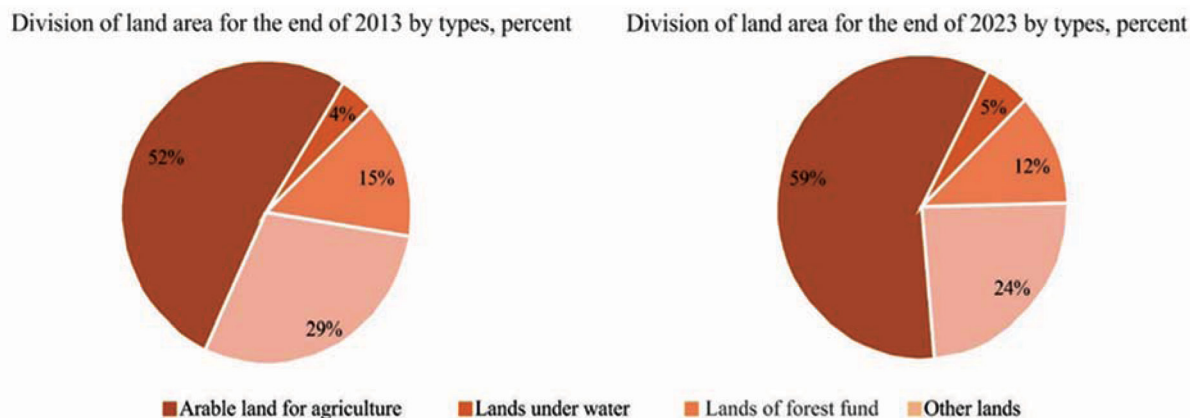


Fig. 1. Division of land area by types in the Gazakh-Tovuz economic region, %
Source: Calculated and compiled by the author using statistical data [16, 21].

reduction in forest cover. As a result of ecological imbalance, certain areas have experienced ecosystem degradation and have become ecologically stressed.

In agriculture, the greatest damage from various natural disasters is caused to soil resources. U. Aksoy [1], Z. Imrani et al [8], N. Korohoda, T. Kupach [10], and others have examined the technological features of evaluating agricultural ecosystem services, while O. Rybalova et al [18] and other foreign researchers have conducted risk assessments for public health due to soil contamination at solid waste disposal sites, carried out large-scale studies in various regions, and obtained scientifically significant innovations. L. Moldavan et al. [15] systematically analyzes the impacts of climate change on the agricultural sector at a macro level and establishes the scientific and theoretical foundations for transitioning to a sustainable development model, O. Kukhar et al. [11] provides a micro-level, analytical evaluation of how diversification strategies enhance the economic resilience of agricultural enterprises and mitigate sustainability-related risks. N. Shevchuk [20], Baranovskyi M., Hlushko D. [7] employed a combination of monographic, comparative, empirical, and abstract-logical methods to systematically evaluate the impacts of climate change on agriculture the scientific foundations for transitioning to a sustainable development model. N.A. Babakhanov [6], R.N. Mahmudov [12], S.G. Rustamov [17], S.A. Tarikhazar et al. [22, 23, 24, 25] and other local specialists have investigated the relief characteristics of the mountainous and foothill areas of Azerbaijan, examined the influence of natural conditions, climate, and the hydrological environment on the development of agricultural sectors, and assessed the formation of extreme and destructive natural events as well as technogenic hazards. The research conducted by us integrates various approaches to perform a comparative analysis, highlights the current status of agricultural development in the Gazakh-

Tovuz economic region of Azerbaijan, and relates it to global trends, including prospects and risk assessment.

Especially mudflows cause erosion of soil cover, washing away its valuable topsoil and carrying away stones, clay, sand, etc., this leads to clogging of the soil with suspended matter and its exclusion from crop rotation. Periodically observed mudflows on the rivers of the region, such as Aghstafachay, Akhinchay, Tovuzchay, Zayamchay, Asrikchay, Shamkirchay and their tributaries, cause lands in the area to become unusable [2, 3]. As a result of mudflows, more than 0.5 thousand ha of the entire land mudflows of the region were washed away and lost 30-40% of their productivity [9, 16]. 3.2% of such lands are located in areas prone to waterlogging. Of the lands taken out of turnover as a result of mudflows, 317 thousand ha were washed away as a result of mudflows in the region [16]. Based on the conducted research, we prepared a diagram illustrating the relationship between the recurrence of natural disaster events and the agricultural damage they caused in the Gazakh-Tovuz economic region during the period from 1950 to 2025 (Fig. 2.).

As a result of various natural disasters, especially mudflows, which occur annually in this district, the total yield of all types of crops is decreasing, and the fields are often flooded. The table demonstrates a clear relationship between the recurrence of natural disaster events in the Gazakh-Tovuz economic region and the magnitude of economic losses in the agricultural sector. In particular, more frequent events are associated with substantially higher damage expressed in manat, indicating an increasing economic burden on agricultural areas and underscoring the necessity of strengthening risk reduction and adaptive management strategies.

Application of the Analytic Hierarchy Process for risk evaluation. The Analytic Hierarchy Process (AHP) was applied in this study

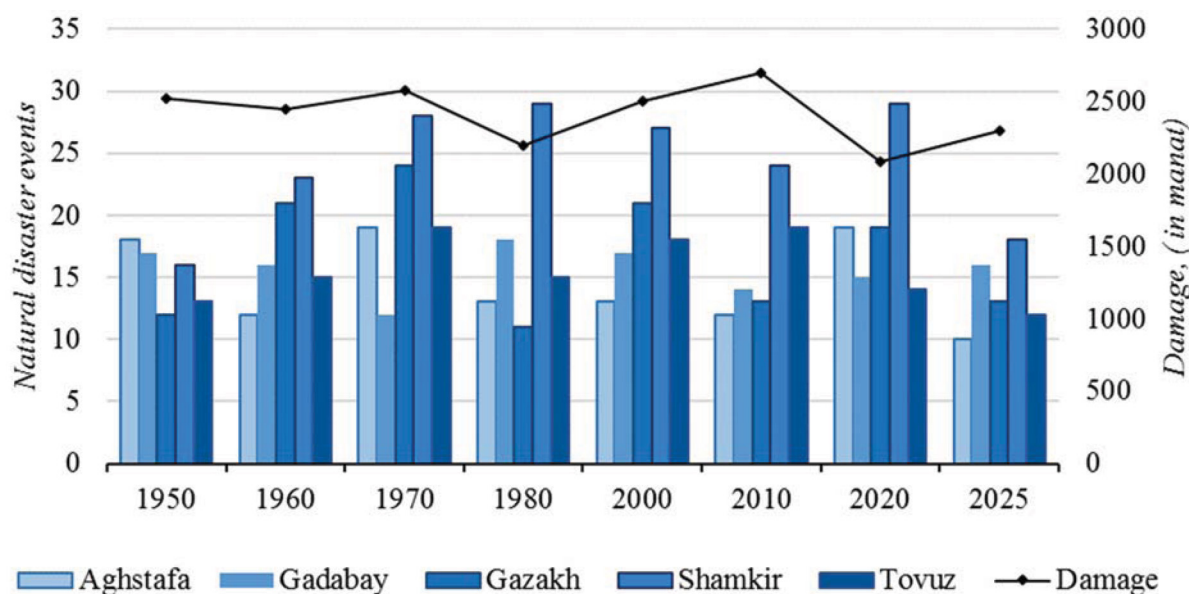


Fig. 2. Recurrence of natural disaster events in the Gazakh–Tovuz economic region and the damage they cause to agricultural areas (in manat)

Source: Calculated and compiled by the author using statistical data [16].

to assess the impact of various natural disaster events and intensive anthropogenic activities on agriculture in the Gazakh–Tovuz economic region [4;]. The method allows evaluating the impact of each event based on a multi-criteria assessment [5, 16, 19].

Three main criteria were defined to evaluate the impact of each disaster event: Severity S_i – the damage caused by the event to agriculture; Frequency F_i – the number of occurrences of similar events within a certain period; Population Affected P_i – the number of people adversely affected by the event. Weights c_S , c_F and c_P were assigned to the criteria based on expert evaluation. In this study, the weights were determined as: $c_S=0.4$, $c_F=0.3$, $c_P=0.3$. The sum of all weights equals 1: $c_S + c_F + c_P = 1$.

The AHP score for each event, including both natural disasters and anthropogenic incidents, is calculated as the weighted sum of the criteria (a):

$$AHP = c_S \times S_i + c_F \times F_i + c_P \times P_i \quad (a)$$

Thus, the AHP score for each disaster event is determined and recorded in the corresponding table. A higher AHP score indicates a greater impact on agriculture and is used to prioritize mitigation measures and plan strategic interventions. Each criterion was scored on a scale from 1 to 5 (Table 1).

The AHP results indicate that certain natural disasters and intensive anthropogenic activities exert a more pronounced negative impact on agricultural development in the region. These prioritized factors highlight the areas where risk mitigation and management measures should be strengthened to reduce potential losses and support sustainable agriculture. Building on

this framework, agricultural insurance has increasingly supported the reduction of losses caused by natural and anthropogenic risks and has strengthened the adaptive capacity of rural areas.

Over the period 2000–2025, the agricultural insurance system in Azerbaijan has evolved as an integral component of regional development policy, aimed at improving rural livelihoods and ensuring the sustainable development of agriculture. In this context, insurance contributes to the spatial stability of agricultural systems and the socio-economic sustainability of rural settlement in regions such as Gazakh–Tovuz. The regulatory framework established in 2002 laid the institutional foundation for risk management in agriculture, while subsequent regional programs, particularly the 2019–2023 State Program, further emphasized insurance expansion as a tool for stabilizing rural incomes and enhancing resilience [21]. Thus, the integration of insurance mechanisms into regional development policy plays a significant role in enhancing the resilience and territorial sustainability of agriculture.

Risk assessment. Disaster risk assessment in the agricultural sector is a multidimensional process that requires the integration of hazard characteristics, exposure levels, and system vulnerability. In this study, we applied a hazard index–based methodology to quantitatively evaluate potential risks to agricultural production across different zones. The assessment was conducted in three sequential stages: estimation of the initial hazard index, computation of the agricultural impact index, and integration of both indices to derive the total agricultural risk.

Table 1

Prioritized AHP assessment of the most damaging various natural disaster events and intensive anthropogenic activities on agriculture in the Gazakh-Tovuz economic region (2009-2025)

Date	Location, rivers	Agricultural hazard impact	AHP
04.08.2009	Tovuz, Aghstafa	A severe landslide led to significant damage to agricultural land and private property.	4.4
06.08.2009	Tovuz, Tovuzchay	A landslide destroyed houses and caused partial damage to additional residential properties, resulting in a temporary interruption of agricultural.	3.7
17.05.2010	Amirvar, Gushchu, Zaylik, Shamkirchay	A landslide inflicted substantial damage to farms and resulted in losses, livestock lost.	4.6
28.05.2011	Gadabay, Soyudlu	A landslide caused one human casualty, as well as damage to property and farmland.	3.0
30.05.2014	Agbashlar, Zayamchay	Heavy rainfall caused temporary disruption to agricultural, flooding agricultural fields.	2.5
13.06.2014	Galakand, Shamkirchay	Intense rainfall and mudflows affected residential areas and farm plots, damaging property and crops.	3.7
17.06.2016	Shakerbey, Chetindara, Zayamchay	Severe mudflows resulted in extensive damage to private property, flooding agricultural fields, losses of livestock and poultry were recorded.	3.7
12.06.2020	Yanigly, Meshadili, Alakol, Zayamchay	The landslide caused damage to homes and electrical infrastructure, and flooding agricultural fields.	3.0
18.09.2021	Yanigly, Cirdakhan, Zayamchay	Mudflows damaged approximately 100 hectares of farmland and affected residential walls.	3.7
23.06.2023	Gazakh, Cogazchay	Heavy rain caused the Cogaz river to overflow, resulting in the flooding of farm plots.	3.5
16.05.2024	Ashagi Salahli and Orta Salahli villages	Significant damage was inflicted on household farms and agricultural lands.	3.8
26.05.2024	Gazakh, Agstafachay, Cogazchay	Intense rainfall and mudflows caused damage to farmland, with water inundating the land, as a result, damage was inflicted on houses, household plots, agricultural fields, and losses of livestock recorded.	4.8
14.05.2025	Tovuz, Ahmadabad village	Heavy rainfall and hail lasting 10–15 minutes caused significant damage to crop fields and fruit trees. Road transport was disrupted due to difficult driving conditions, and temporary interruptions in electricity supply were recorded.	4.1

Source: The table developed, by S.O. Alakbarova, using data from the State Statistics Committee, the Ministry of Emergency Situations, State Programs, field research, and relevant publications.

Initial hazard index: The initial hazard index (*RI*) quantifies the likelihood and severity of natural hazards affecting agricultural areas. It is expressed as a product of hazard intensity and frequency, exposure and vulnerability (b):

$$RI = H \times E \times V \quad (b)$$

Where, (*H*) represents the intensity and occurrence frequency of natural hazards, (*E*) denotes the degree of exposure of agricultural lands and infrastructure, (*V*) indicates the susceptibility of crops and farming systems to the impacts of hazards. Historical disaster records, land-use maps, and environmental parameters were analyzed to accurately determine these variables for each agricultural zone. This approach allows for a spatially explicit assessment of potential hazard levels and the identification of high-risk areas.

Agricultural impact index: The agricultural impact index (*AI*) assesses the potential

consequences of hazards on crop production, accounting for both quantitative and qualitative aspects of agricultural systems. The index is defined as (c):

$$AI = Y \times A \times T \quad (c)$$

Where, (*Y*) represents crop yield, (*A*) denotes the cultivated area, (*T*) is the technology and management index, reflecting the effectiveness of agronomic practices, infrastructure, and adaptive capacity. By incorporating the technological and managerial dimension, the *AI* index provides a realistic estimate of agricultural losses under hazardous conditions, allowing for the differentiation between zones with similar exposure but varying resilience.

Total agricultural risk: The overall agricultural risk (*TR*) integrates the hazard index with the agricultural impact index, thereby providing a comprehensive measure of risk that

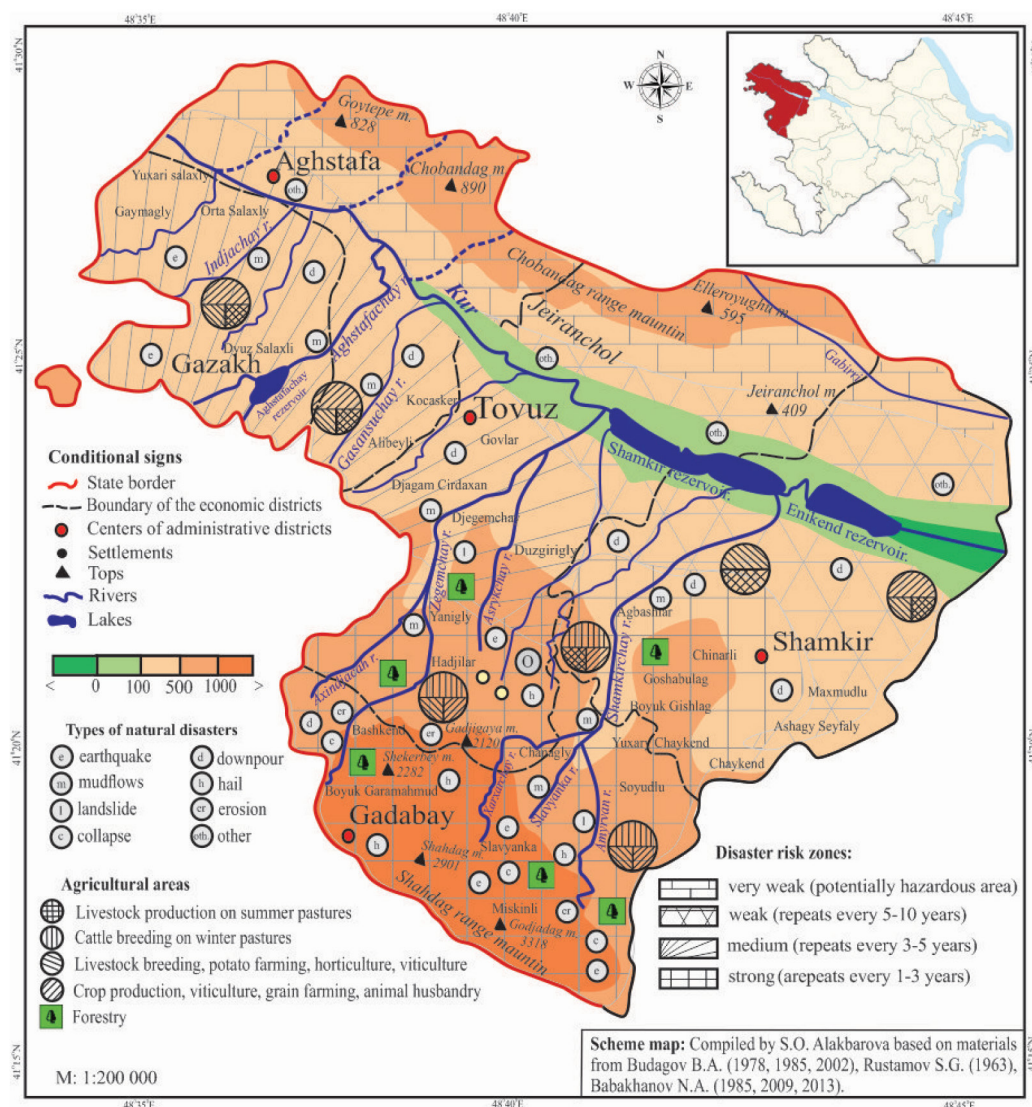


Fig. 3. Map of disaster risk assessment in the development of agricultural sectors

Source: The map developed, by S.O. Alakbarova, using data from the State Statistics Committee, the Ministry of Emergency Situations, State Programs, field research, and relevant publications

considers both environmental hazards and the capacity of agricultural systems to absorb and adapt to shocks (d):

$$TR = RI \times AI \quad (d)$$

Where, (*TR*) is the total agricultural risk indicator, (*RI*) is the initial hazard index, (*AI*) is the agricultural impact index. This combined indicator allows for the identification of zones where high hazard potential coincides with intensive agricultural activity, thus prioritizing areas for risk mitigation strategies.

The risk index was calculated for each zone, and hazard maps, illustrating the most vulnerable areas with intensive agricultural activity, were compiled using modern information technologies (Fig. 3.).

Figure 3 depicts that the southern and western parts of the economic region are at risk, especially areas where agricultural lands are more developed. Disaster risk in the development of agricultural sectors of Gazakh-Tovuz economic

region was assessed on 4 scales; 1. very weak (potentially hazardous area), 2. weak (repeats every 5-10 years), 3. medium (repeats every 3-5 years), 4. strong (repeats every 1-3 years).

The hazard index-based framework provides a scientifically rigorous, reproducible method for agricultural risk assessment. By integrating geospatial analysis, historical hazard data, and crop production characteristics, it supports the development of high-resolution risk maps. These maps are critical for evidence-based disaster preparedness, planning resilient and sustainable agricultural systems.

Building on this framework, the analysis of this map enables the evaluation of settlements and administrative territories in relation to hazard distribution and risk levels. In this context, the main demographic and geographical characteristics of the administrative districts of the Gazakh-Tovuz economic region, including

Table 2

Regional and risk characteristics of the Gazakh–Tovuz economic districts

District	Elevation of settlements (m)	Area, thousand km ²	Population, thousand persons		Population density (persons/km ²)		Risk level
			2019	2025	2019	2025	
Agstafa	215-600	1,50	84,7	86,7	56	58	very weak and medium
Gadabay	1100-2000	1,23	95,6	101,2	78	82	strong
Gazakh	215-820	0,70	94,3	96,5	135	138	medium
Shamkir	205-1500	1,66	211,6	218,3	127	132	weak and medium
Tovuz	340-2100	1,94	171,9	177,9	89	92	medium
By region	205-2100	7,03	658,1	680,6	94	97	moderate risk

Source: Calculated and compiled by the author using statistical data [16]

area, population size, population density, and the elevation range of settlements, are presented in Table 2. Based on the comparative analysis of these parameters, the risk levels for the administrative districts of the Gazakh–Tovuz economic region are assessed as follows (Table 2.).

The results indicate significant spatial differentiation among the administrative districts of the Gazakh–Tovuz economic region in terms of elevation, area, population, and population density. These variations play an important role in shaping regional development patterns and determining overall risk levels.

The continuous development of agricultural sectors is fundamental for ensuring both economic and social sustainability. Economic and geographical assessments enable the systematic evaluation of regional potentials, limitations, and spatial distributions (Fig. 4).

According to the State Programs on the Socio-Economic Development of the Regions of the Republic of Azerbaijan strengthening social insurance mechanisms plays a key role in mitigating the impacts of natural disasters on the agrarian sector [21]. The proposed model provides a scientifically grounded analysis of natural

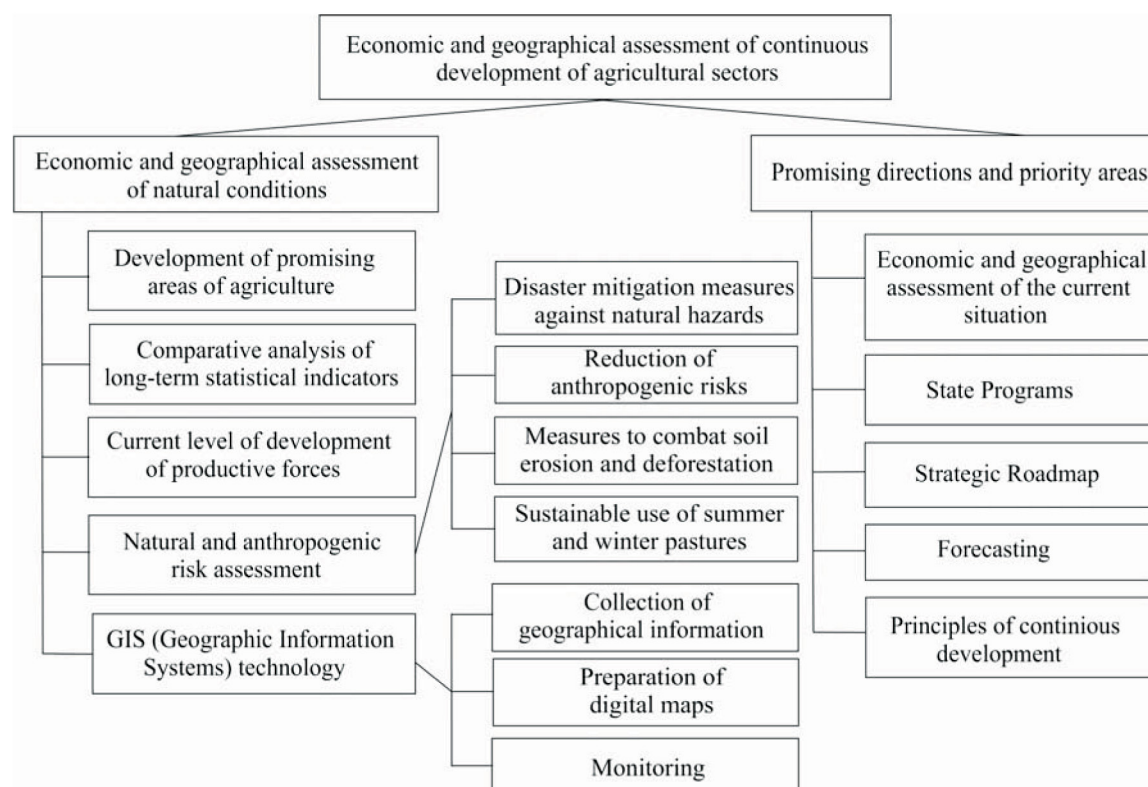


Fig. 4. Model for economic and geographical assessment of continuous development of agricultural sectors

Source: The model, developed by S.O. Alakbarova, is based on the analysis of opportunities, challenges, and measures for agriculture within the framework of State Programs aimed at sustainable territorial development [21]

risk factors for assessing the current level of agricultural development and identifying future prospects in the Gazakh–Tovuz economic region, thereby offering significant scientific and practical value for regional development planning.

Conclusion. Agriculture is one of the leading sectors in the Gazakh–Tovuz economic region; however, its development is strongly influenced by natural and anthropogenic risks, especially in areas with more intensive agricultural activity. The results demonstrate a clear spatial differentiation of risk across the region, where medium (20–33%) and strong (33–50%) risk zones cover a considerable part of the territory, exerting significant pressure on agricultural

systems and rural settlement stability, while low-risk areas are comparatively limited. In medium and high-risk zones, recurrent natural hazards lead to substantial losses in crop production, livestock farming, and agricultural infrastructure.

In this context, increasing the effectiveness of risk management and monitoring systems is essential for ensuring sustainable agricultural development in the region. Currently, 70.1% of agricultural output is attributed to crop production and 29.9% to livestock farming, while state insurance compensates 30–40% of crop-related losses and 40–60% of livestock losses caused by natural and anthropogenic hazards.

Конфлікт інтересів: автор повідомляє про відсутність конфлікту інтересів.

Декларація про використання генеративного штучного інтелекту: автор підтверджує, що під час підготовки рукопису не використовувалися інструменти штучного інтелекту.

Conflict of Interest: The author declare no conflict of interest.

Declaration of use of generative artificial intelligence: The author confirm that no AI tools were used during the preparation of the manuscript.

BIBLIOGRAPHY

REFERENCES

1. Aksoy U., Boz İ., Eynalov H., & Guliyev Y. (2018). Organic Agriculture in Azerbaijan: Current status and potentials for future development. Ankara, 104.
2. Алекперова, С.О., (2024). Динамика селевых явлений в бассейне реки Курмукчай (Азербайджан). *GeoRisk World*, 18(1), 40–49. <https://doi.org/10.25296/1997-8669-2024-18-1-40-49>
3. Alakbarova S.O. (2025) Integrating spatial risk analysis into sustainable territorial development: A complex approach in the context of the Shaki-Zagatala economic region. *Journal of the Bulgarian Geographical Society*, (53) 157–186. <https://doi.org/10.3897/jbgs.e159882>
4. Алекперова С.О., & Мамиева С.А., (2025) Пространственно-временная динамика природных опасностей и их влияние на хозяйство в азербайджанской части Малого Кавказа. *Известия Тульского Государственного Университета. Науки о Земле*. Тула, (4) 23–30.
5. Алекперова С.О., Гасымова С.Г. (2024). Оценка природно-техногенного риска на автомобильных дорогах Газах-Товузского экономического района. *Известия Тульского государственного университета. Науки о Земле*. Выпуск, Тула, (1) 25–39.
6. Бабаханов Н.А. (2009) Районирование Азербайджана по интенсивности проявления стихийных бедствий // *Труды конференции «Человек и опасность»*. Баку, 39–43.
7. Baranovskyi M., & Hlushko D. (2023). Territorial transformations in agriculture of Chernihiv region in the context of climate change: the case of corn and sunflower. *Visnyk of V. N. Karazin Kharkiv National University. Series «Geology. Geography. Ecology»*, (58), 134–142. <https://doi.org/10.26565/2410-7360-2023-58-11>
8. Imrani, Z., Zeynalova, K., & Babakhanov, A. (2025). Investment dependence of tourism industry and differences in economic growth in the Republic of Azerbaijan. *Geojournal of Tourism and Geosites*, 61(3), 1668–1675. <https://doi.org/10.30892/gtg.61325-1535>
9. Hajiyeva G.N. (2024) Ecological problems of the plant cover of the northeastern slope of Great Caucasus (within Azerbaijan). *Visnyk of V.N. Karazin Kharkiv National University. Series Geology. Geography. Ecology*, (60) 335–341. <https://doi.org/10.26565/2410-7360-2024-60-24>
10. Корогода Н., & Тетяна К. (2024). Технологічні особливості проведення оцінки культурних екосистемних послуг / *Вісник Харківського національного університету імені В. Н. Каразіна, серія «Геологія. Географія. Екологія»*, (60), 342–353 <https://doi.org/10.26565/2410-7360-2024-60-25>
1. Aksoy U., Boz İ., Eynalov H., & Guliyev Y. (2018). Organic Agriculture in Azerbaijan: Current status and potentials for future development. Ankara, 104.
2. Alakbarova, S. O. (2024). Dynamics of mudflow phenomena in the Kurmukhchay River basin (Azerbaijan). *GeoRisk World*, 18(1), 40–49. <https://doi.org/10.25296/1997-8669-2024-18-1-40-49>
3. Alakbarova S.O. (2025) Integrating spatial risk analysis into sustainable territorial development: A complex approach in the context of the Shaki-Zagatala economic region. *Journal of the Bulgarian Geographical Society*, (53), 2025, 157–186. <https://doi.org/10.3897/jbgs.e159882>
4. Alakbarova S.O., Mamiyeva S.A. (2025) Spatial and temporal dynamics of natural hazards and their impact on the economy in the azerbaijani part of the Small Caucasus. *Bulletin of Tula State University. Earth Sciences*. Tula, (4) 23–30.
5. Alakbarova S.O., & Gasymova S.G. (2024). Assessment of natural technogenic risk on highways of Gazakh-Tovuz economic region. *News of Tula State University. Earth Sciences*. Tula, 2024, (1) 25–39.
6. Babakhanov N.A. (2009). Zoning of Azerbaijan by intensity of manifestation of natural disasters. *Proceedings of the conference "Man and Danger"*. Baku, 39–43.
7. Baranovskyi M., & Hlushko D. (2023). Territorial transformations in agriculture of Chernihiv region in the context of climate change: the case of corn and sunflower. *Visnyk of V. N. Karazin Kharkiv National University, series Geology. Geography. Ecology*, (58), 134–142. <https://doi.org/10.26565/2410-7360-2023-58-11> [in Ukrainian]
8. Imrani, Z., Zeynalova, K., & Babakhanov, A., (2025). Investment dependence of tourism industry and differences in economic growth in the Republic of Azerbaijan. *Geojournal of Tourism and Geosites*, 61(3), 1668–1675. <https://doi.org/10.30892/gtg.61325-1535>
9. Hajiyeva G.N., (2024) Ecological problems of the plant cover of the northeastern slope of Great Caucasus (within Azerbaijan). *Visnyk of V.N. Karazin Kharkiv National University. Series Geology. Geography. Ecology*, (60) 335–341. <https://doi.org/10.26565/2410-7360-2024-60-24>
10. Korohoda N., & Kupach T. (2024). Technological features of cultural ecosystem services assessment. *Visnyk of V. N. Karazin Kharkiv National University. Series Geology. Geography. Ecology*, (60), 342–353. <https://doi.org/10.26565/2410-7360-2024-60-25> [in Ukrainian]

11. Kukhar, O., Kryukova, I., & Rudenko, S., (2024). Realization of the potential of diversification of agricultural business to reduce the risks of sustainable development. *Ukrainian Journal of Applied Economics and Technology*, 1:24–28. <https://doi.org/10.36887/2415-8453-2024-1-3>
12. Mahmudov R.N. (2017). Müasir iqlim dəyişiklikləri və təhlükəli hadisələr. Bakı, 231
13. Мамиева С.А., Гамидова З.А., & Алекперова С.О. (2015) Селевая опасность на Малом Кавказе и оценка влияния селей на экономическую систему (на примере северо-восточного склона Малого Кавказа). *Журнал "География и природные ресурсы"*. Баку, 2: 35–40.
14. Мамиева, С. А., & Алекперова, С. О. (2025). Активизация селевых явлений в современных условиях и пути борьбы с ними на примере Малого Кавказа (в пределах Азербайджана). *Вектор ГеоНаук*, 8(1), 4–15.
15. Moldavan, L., Pimenowa, O., Wasilewski, M., & Wasilewska, N., (2023). Sustainable Development of Agriculture of Ukraine in the Context of Climate Change. *Sustainability*, 15(13), 10517. <https://doi.org/10.3390/su151310517>
16. Azərbaycanın regionları – statistik məcmuə, (2000-2024). Bakı, 778
17. Rüstəmov S.Q., (1960). Azərbaycan çayları və onların hidroloji xüsusiyyətləri., Bakı, 196
18. Рибалова О., Артем'ев С., Бригада О., Ільїнський О., & Мацак А., (2024). Оцінка ризику для здоров'я населення від забруднення ґрунтів на території полігонів твердих побутових відходів, *Вісник Харківського національного університету імені В. Н. Каразіна, серія «Геологія. Географія. Екологія»*, (60), 399–413. <https://doi.org/10.26565/2410-7360-2024-60-30>
19. Saaty T.L., & Vargas L.G. (2001). The Seven Pillars of the Analytic Hierarchy Process. In: *Models, Methods, Concepts & Applications of the Analytic Hierarchy Process*. International Series in Operations Research & Management Science. Springer US, Boston, MA, 27–46. https://doi.org/10.1007/978-1-4615-1665-1_2
20. Shevchuk, N. (2024). The current status and prospects of growing plant-based food products in the present conditions of the Ukrainian agricultural sector. *Ukrainian Black Sea Region Agrarian Science*, 28(1), 79–88. <https://doi.org/10.56407/bs.agrarian/1.2024.79>
21. 2019–2023-cü illərdə Azərbaycan Respublikası regionlarının sosial-iqtisadi inkişafı üzrə Dövlət Proqramı [(2019), Bakı, 352
22. Tarikhazer, S.A., (2022) Assessment of ecological strength and risk of geosystems of the north-eastern slope of the Great Caucasus (within Azerbaijan) // *Visnyk of V.N. Karazin Kharkiv National University. Series Geology. Geography. Ecology*, (56), 264–276. <https://doi.org/10.26565/2410-7360-2022-56-20>
23. Тарихазер, С. А., Гамидова, З. А., & Алекперова, С. О., (2013). Оценка геодинамической активности селевых явлений в горных геоконкомпексах (на примере азербайджанской части Большого Кавказа). В материалах международной научно-практической конференции молодых ученых, посвященной 95-летию НАН Украины, Киев, Украина, 396–403.
24. Tarikhazer S.A., Kuchinskaya I.Ya., Karimova E.J., & Alakbarova S.O., (2021) Issues of geomorphological-landscape risk (on the example of the Kishchay river). *Bulletin of the National Academy of Sciences of the Republic of Kazakhstan. Series of Geology of Technical Sciences*. 6(450), 133–140. <https://doi.org/10.32014/2021.2518-170X.129>
25. Tarikhazer S.A., Karimova E.J., & Kuchinskaya I.Ya., (2022). Quantitative assessment of debris flow risk in the Greater Caucasus of Azerbaijan (on the example of the northeastern slope). *Journal of Geology, Geography and Geoecology*. 31(4), 722–736. <https://doi.org/10.15421/112268>
11. Kukhar, O., Kryukova, I., & Rudenko, S. (2024). Realization of the potential of diversification of agricultural business to reduce the risks of sustainable development. *Ukrainian Journal of Applied Economics and Technology*, 1:24–28. <https://doi.org/10.36887/2415-8453-2024-1-3>
12. Makhmudov R.N. (2017). Modern climate changes and dangerous phenomena. Baku, 231 p. [in Azerbaijan]
13. Mamiyeva S.A., Hamidova Z.A., & Alakbarova S.O., (2015). Mudflow hazard in the Lesser Caucasus and assessment of the impact of mudflows on the economic system (using the northeastern slope of the Lesser Caucasus as an example). *Journal Geography and Natural Resources*, 2, 35–40.
14. Mamiyeva S.A., & Alakbarova S.O., (2025). Activation of mudflow phenomena in modern conditions and ways to combat them using the example of the Lesser Caucasus (within Azerbaijan). *Vector GeoSciences*, 8(1), 4–15.
15. Moldavan, L., Pimenowa, O., Wasilewski, M., & Wasilewska, N., (2023). Sustainable Development of Agriculture of Ukraine in the Context of Climate Change. *Sustainability*, 15(13), 10517. <https://doi.org/10.3390/su151310517>
16. Regions of Azerbaijan – statistical collection, (2000-2024). Baku, 778 [in Azerbaijan]
17. Rustamov S.G., (1960). Rivers of the Azerbaijan and their hydrological features., Baku, 196 [in Azerbaijan]
18. Rybalova, O., Serhii, A., Olena, B., Oleksii, I., & Anton, M. (2024). Assessment of the risk to public health from soil contamination on the territory of solid waste landfills. *Visnyk of V. N. Karazin Kharkiv National University. Series Geology. Geography. Ecology*, (60), 399–413. <https://doi.org/10.26565/2410-7360-2024-60-30> [in Ukrainian]
19. Saaty T.L., & Vargas L.G., (2001) The Seven Pillars of the Analytic Hierarchy Process. In: *Models, Methods, Concepts & Applications of the Analytic Hierarchy Process*. International Series in Operations Research & Management Science. Springer US, Boston, MA, 27–46. https://doi.org/10.1007/978-1-4615-1665-1_2
20. Shevchuk, N., (2024). The current status and prospects of growing plant-based food products in the present conditions of the Ukrainian agricultural sector. *Ukrainian Black Sea Region Agrarian Science*, 28(1), 79–88. <https://doi.org/10.56407/bs.agrarian/1.2024.79>
21. State Program for the socio-economic development of the regions of the Republic of Azerbaijan in 2019–2023 (2019), Baku, 352 [in Azerbaijan]
22. Tarikhazer, S.A., (2022) Assessment of ecological strength and risk of geosystems of the north-eastern slope of the Great Caucasus (within Azerbaijan). *Visnyk of V.N. Karazin Kharkiv National University. Series Geology. Geography. Ecology*, (56), 264–276. <https://doi.org/10.26565/2410-7360-2022-56-20>
23. Tarikhazer, S. A., Gamidova, Z. A., & Alekperova, S. O., (2013). Assessment of geodynamic activity of mudflow phenomena in mountain geocomplexes (on the example of the Azerbaijani part of the Greater Caucasus). In *Proceedings of the international scientific-practical conference of young scientists dedicated to the 95th anniversary of the National Academy of Sciences of Ukraine*, Kyiv, Ukraine, 396–403.
24. Tarikhazer S.A., Kuchinskaya I.Ya., Karimova E.J., & Alakbarova S.O., (2021) Issues of geomorphological-landscape risk (on the example of the Kishchay river). *Bulletin of the National Academy of Sciences of the Republic of Kazakhstan. Series of Geology of Technical Sciences*. 6(450), 133–140. <https://doi.org/10.32014/2021.2518-170X.129>
25. Tarikhazer S.A., Karimova E.J., & Kuchinskaya I.Ya., (2022). Quantitative assessment of debris flow risk in the Greater Caucasus of Azerbaijan (on the example of the northeastern slope). *Journal of Geology, Geography and Geoecology*. 31(4), 722–736. <https://doi.org/10.15421/112268>

Вплив природних і техногенних ризиків на безпеку населення та розвиток сільського господарства в Газах–Товузькому економічному регіоні

Саміра Алекперова,  <https://orcid.org/0000-0001-9138-3403>, e-mail: alakbarovasamira@hotmail.com

*д. філософії (географія) доцент, зав. лабораторії «Географія населення»
Інституту географії публічної юридичної особи, Баку, Азербайджан*

АНОТАЦІЯ

Це дослідження розглядає вплив природних і техногенних ризиків на безпеку населення та розвиток сільського господарства в Газах–Товузькому економічному регіоні. Особлива увага приділяється інтенсифікації природних катастроф в умовах зміни клімату. У роботі досліджується масштаб завданих такими явищами збитків сільським поселенням, орним землям, садам і присадибним ділянкам, а також їхній вплив на просторову організацію сільського господарства. Аналіз базується на статистичних даних, що дозволяє детально вивчити просторові та галузеві відмінності у вразливості регіону. Застосовано кількісну методологічну основу, де статистичні дані обробляються за допомогою математичних і аналітичних методів для забезпечення точності та надійності. Оцінювання ризиків здійснюється через інтегровану систему показників, що відображають інтенсивність, частоту, експозицію та вразливість. Ці показники систематично об'єднуються для отримання комплексної оцінки ризикових умов у регіоні. Крім того, для ранжування природних і техногенних ризиків застосовується метод аналізу ієрархій із використанням багатокритеріальної зваженої оцінки. Просторовий аналіз, підтриманий сучасними обчислювальними методами, використовується для виявлення та картографування зон підвищеного ризику в адміністративних районах, що забезпечує чітке відображення регіональних відмінностей. На основі просторового аналізу та сучасних комп'ютерних методів були розроблені карта ризиків для визначення територій із підвищеною вразливістю. Хоча поняття небезпечних явищ природного та антропогенного походження широко використовується як у науковій літературі, так і в практичній діяльності, досі не існує методу, який забезпечував би повне усунення або запобігання їхнім наслідкам. У цьому зв'язку вивчення та управління цими ризиками має особливе значення для сталого розвитку регіонів. Результати показують, що зміна клімату посилила частоту та вплив природних катастроф, значно підвищивши тиск як на сільськогосподарські системи, так і на системи розселення населення. Південні та західні частини Газах–Товузького економічного регіону визначені як найбільш вразливі території, де висока концентрація сільського господарства поєднується з підвищеним рівнем ризику. Дослідження підтверджує, що інтеграція оцінки ризиків із просторовим та статистичним аналізом є необхідною для вдосконалення регіонального планування та забезпечення сталого розвитку сільського господарства і систем розселення.

ІНФОРМАЦІЯ ПРО СТАТТЮ :

Рукопис надійшов
1 травня 2026

Отримано після рецензування
10 березня 2026

Затверджено до друку
25 травня 2026

Опубліковано онлайн
30 травня 2026

Ключові слова :

сільське господарство, оцінка ризиків, безпека населення, економіко-географічна оцінка, сталий розвиток, Газах–Товузький економічний регіон.