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Abbasova Saadat Meydanali Ganja State University, Ganja, Azerbaijan

WAYS TO İMPROVE THE GEOECOLOGİCAL POTENTİAL OF THE NATURAL-ANTHROPOGENİC LANDSCAPES OF THE NORTH-EASTERN SLOPE OF THE LESSER CAUCASUS

Purpose. The purpose of the research is to study the geoecological potential of the natural anthropogenic landscapes of the north-eastern slope of the lesser caucasus.

Method. During the writing of the article, historical, cartographic, mathematical-statistical, comparative analysis methods were used. The northeastern slope of the Lesser Caucasus was chosen as the research object

Result. In the article, the patterns of development of the landscapes of the north-eastern slope of the Lesser Caucasus, height differentiation, settlement of the territory and the location of settlements on the height belts, ways of improving the geo-ecological potential are explained. In the region under study, extensive information was provided on natural population growth, expansion of settlement areas, increasing influence of agricultural land, and anthropogenic transformation of natural landscapes. Analysis of the distribution of urban and rural settlements by altitudinal landscape zones, the placement of the population, settlements and farms depending on the landscape-altitude-spatial differentiation of the territory, the formation of functional activity under the influence of natural geographical conditions. conditions were analyzed. Methods of an integrated approach have been studied in order to determine and assess the relationship between population settlement and the location of various economic fields with the formation of a more favorable natural-geographical environment in the flat parts of the area, depending on favorable conditions. relief, lithological, hydrological and hydrogeological conditions and the influence of these features on natural landscapes.

Scientific novelity. The analysis of the distribution of urban and rural settlements by altitude-landscape zones was carried out, the location and functional activity of the population, settlements and farm areas, depending on the altitude-spatial differentiation of the landscape on the north-eastern slope of the Lesser Caucasus, were formed under the direct influence of natural-geographical conditions, the settlement of the population and It has been studied that the location of different farm areas is related to the more favorable natural-geographical environment. An analysis of the distribution and density of the population and settlements in the area by altitude zones was carried

Keywords: Lesser Caucases, natural landscape, anthropogenic loads, optimization, high-altitude landscape zones, settlements, farms, integrated approach, population settlement.

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Аббасова Саадат Мейданалі Гянджінський державний університет, Гянджі, Азербайджан.

Мета дослідження – вивчення геоекологічного потенціалу природно-антропогенних ландшафтів північно-східного схилу Малого Кавказу.

Метод. Під час написання статті використано історичний, картографічний, математико-статистичний, порівняльний методи аналізу. Об’єктом дослідження обрано північно-східний схил Малого Кавказу

Результат. У статті висвітлено закономірності розвитку ландшафтів північно-східного схилу Малого Кавказу, висотну диференціацію, заселення території та розміщення поселень на висотних поясах, шляхи підвищення геоекологічного потенціалу. У досліджуваному регіоні надано велику кількість інформації про природний приріст населення, розширення територій розселення, посилення впливу сільськогосподарських угідь, антропогенну трансформацію природних ландшафтів. Аналіз розподілу міських і сільських поселень за висотними ландшафтними зонами, розміщення населення, поселень і господарств залежно від ландшафтно-висотно-просторової диференціації території, формування функціональної діяльності під впливом природно-географічних умов. умови були проаналізовані. Досліджено методи комплексного підходу з метою визначення та оцінки взаємозв’язку розселення населення з розміщенням різних галузей господарювання з формуванням більш сприятливого природно-географічного середовища на рівнинних частинах території залежно від сприятливих умов. рельєф, літологічні, гідрологічні та гідрогеологічні умови та вплив цих особливостей на природні ландшафти.

Наукова новизна. Проведено аналіз розподілу міських і сільських поселень за висотно-ландшафтними поясами, розміщення та функціональної активності населення, поселень і господарських територій залежно від висотно-просторової диференціації ландшафту на північно-східному схилі с. Малому Кавказі, сформувалися під безпосереднім впливом природно-географічних умов, розселення населення і Досліджено, що розташування різних районів господарства пов’язане з більш сприятливим природно-географічним середовищем. Проведено аналіз розміщення та щільності населення та поселень району за висотними поясами

Ключові слова: Малий Кавказ, природний ландшафт, антропогенне навантаження, оптимізація, висотні ландшафтні зони, поселення, ферми, комплексний підхід, розселення населення.

Relevance of the topic. A number of measures have been taken and projects have been developed in order to prevent desertification processes in the territory of the republic, including in the northeastern slope of the Lesser Caucasus. Thus, our state has also joined environmental-oriented international and regional conventions in order to further improve the current ecological situation in the country, to use natural resources effectively, and to ensure their preservation for future generations. Effective use of land, construction of artificial forest strips, minimizing the use of firewood as fuel should be the priority directions of the fight against desertification processes. During the fight against them, national action plans should be drawn up taking into account the specific characteristics of each region, and this fight should be carried out in a comprehensive manner. Environmental education should form the basis of the fight against desertification.

Scientific innovation: To determine the degree of anthropogenicization of the landscapes of the northeastern slopes of the Lesser Caucasus, the impact of agricultural areas, settlements, and natural destructive processes on landscape complexes was thoroughly analyzed. As a result of the analysis of the ecological problems caused by the anthropogenic transformation of the landscapes of the area, it was determined that as the anthropogenic transformation of the landscapes accelerates, the activity of exodynamic processes also increases. As a result, the damage caused by the various consequences of degradation to the agricultural areas and the population increases accordingly.

Discussion: It is considered legitimate to expect the continuous development of scientific and technical progress, a deeper influence of man on the landscape, and an increase in the intensity of the use of natural resources. For this reason, it is important to investigate ways of improving the geoecological potential of natural-anthropogenic landscapes, the impact of society on the surrounding natural environment. The main issue here is to establish a balanced relationship between exploitation, conservation and reclamation. The solution of anthropogenic problems depends on the development of the scientific basis of the formation of the agricultural landscape, the inclusion of landscape-geographic territory organization in the land-use practice (that is, the rational planning of the agricultural landscape). In the scientific literature, modern landscapes are divided according to the nature of change due to human influence as follows: lowland (conditional, primary), little changed (tundra, desert); disturbed or greatly changed - here human economic activity has led to useless processes (washing, erosion, swamping); culturally or rationally modified. (Garibov, 2012). Development regularities of the landscapes of the north-eastern slope of the Lesser Caucasus, height differentiation, settlement of the territory and the features of the location of settlements on the heights began to be studied relatively earlier. In the studied region, the natural growth of the population, the expansion of the area of settlements, and the increase of the economic effects related to this, are sharply manifested in the anthropogenic transformation of natural landscapes. In order to determine and evaluate the impact of the mentioned features on natural landscapes, complex approach methods were used. The directions of influence of human economic activities on the degradation of the landscapes of the area are as follows.

1. Destruction of vegetation, soil degradation as a result of development of mining industry, expansion of irrigation network, etc.;

2. Significant decrease in productivity of summer and winter pastures as a result of unsystematic grazing;

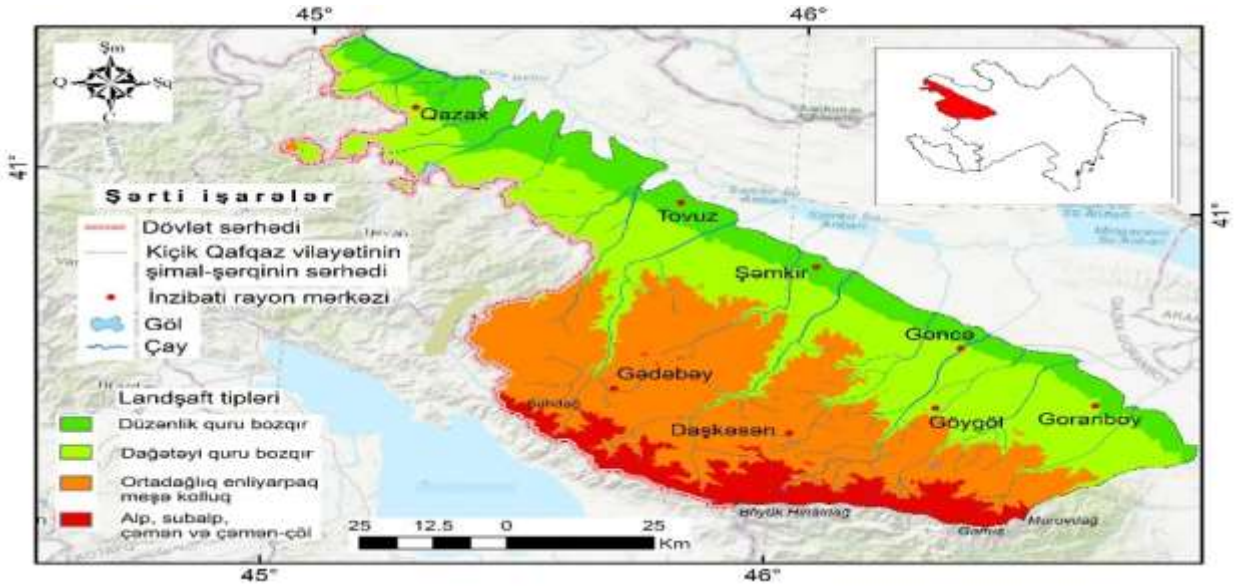
3. Deforestation;

4. As a result of non-irrigation in accordance with agrotechnical standards in the areas where irrigated agriculture is developed, re-salinization of soils and decrease in their productivity;

5. As a result of the intensification of the erosion process on the mountain slopes, the soil is washed away and left out of the crop rotation.

The agro landscapes in the region are divided into the more widespread types of paddy farming, irrigated agriculture (agro-irrigated landscapes), garden plantation and pasture-meadow types. Historically, the development of cattle breeding, horticulture, agriculture in the region has increased the agricultural potential of the area and the level of exploitation. Based on Y.A. Garibov's classification, the natural landscapes of the studied region can be divided into several categories according to anthropogenic transformation, decoding of space images (with data from Landsat 7-8 orbital stations) based on the ArcGIS program, and the degree of landscape change: (Garibov, 2013). Landscapes that are practically unchanged, retaining their natural structure and stability (Aə0,8). These landscape complexes include large urban and rural-seliteb complexes, artificial water bodies (canals, collectors, hydro-technical facilities), communications, industry, mining facilities, processing plants, roads, etc. These landscapes have almost

completely lost their natural structural-functional characteristics and have a serious ecological impact on the environment.



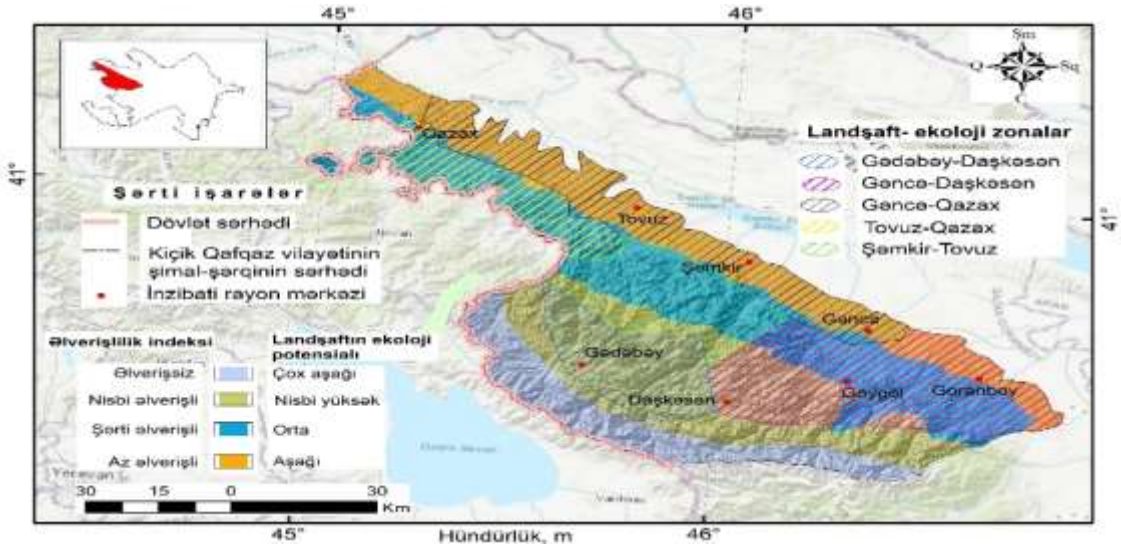
Map-scheme 1. Landscape types of the northeastern slope of the Lesser Caucasus

The area's foothill to peak landscape types include lowland dry steppe, foothill dry steppe, midmontane broadleaf forest-shrub, alpine, subalpine, grassland, and meadow-steppe. However, in recent times, the rapid growth of the population has caused the natural complexes in the plains and foothills of the area to be completely changed and replaced by agro-landscapes, and in relatively high areas, they have been transformed into secondary landscapes. Our scientific studies show that population settlement on the northeastern slope of the Lesser Caucasus is subject to the height zone of the landscape. Thus, from the foothills to the highlands, the population and the number of settlements, respectively, decrease in a regular manner. In the northeastern slope of the Lesser Caucasus, in accordance with the increase in the population and the number of settlements, agricultural areas, especially irrigation agriculture, are developing, and grazing areas are being expanded. This results in the increase of anthropogenic load in the study area. The analysis of the distribution of settlements and population in the region by landscape complexes shows that the majority of the population settled in complexes with fertile soil, which are more suitable for agriculture, with favorable relief and climate characteristics. More than 70% of the population and settlements are in plain-forest, mountain-meadow, foothill and low-mountain steppe, forest-steppe, brown, chestnut-snow-soil forest and desertified complexes of sloping plains and smooth strips, widened rivers of intermountain plains in mountain steppes it is concentrated in its terraces, valleys, etc.(Mammadov, 2011).

In order to determine the degree of anthropogenicity of the region's landscapes, the impact of agricultural areas, settlements and natural destructive processes on landscape complexes was thoroughly analyzed. Thus, as a result of the analysis of the ecological problems caused by the anthropogenic transformation of the landscapes of the area, we have determined that as the anthropogenic transformation of the landscapes accelerates, the activity of exodynamic processes also increases. As a result, the damage caused by various consequences of degradation to the farm and the population increases accordingly (Abbasova, 2022).

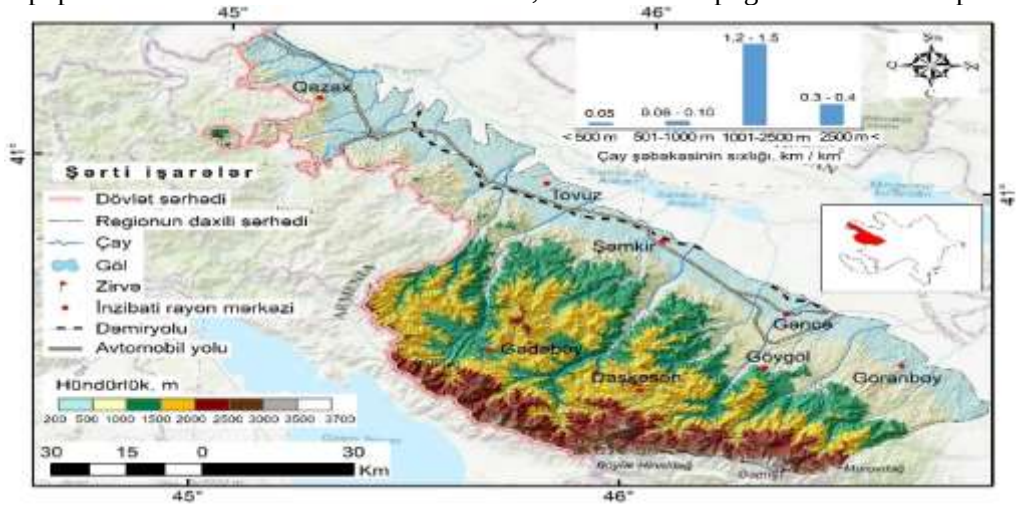
As can be seen from the map-scheme, in recent years, the rapid growth of the population and the number of settlements has increased the anthropogenicity of landscapes, and created conditions for the disruption of the ecological balance and the acceleration of degradation in landscapes that are more exposed to anthropogenic pressure. The natural landscapes of the modern agricultural and horticultural regions on the north-eastern slope of the Lesser Caucasus have been dramatically changed as a result of the long-term effects of people, and species diversity has arisen in the natural landscapes, they have been replaced by repeated or new anthropogenic units. Here, as a result of the transformation of natural landscapes, the main anthropogenic landscapes formed in their place were agrocomplexes. Most of them were created in the place of plain forests, and forest-steppe complexes. Gadabey-Dashkasan, Ganja-Dashkasan, Ganja-Gazakh, Tovuz-Gazakh and Shamkir-Tovuz areas, which are especially exposed to environmental stress, are very different from each other according to the accessibility index. Because of their great ecological potential,

they have become less favorable zones. These are settlements and areas where the majority of the population lives in the forest belt of the low and mid-mountains of the northeastern slope of the Lesser Caucasus. However, this indicator has very serious regional differences in the area we studied. While more than 30-40% of the region's population is concentrated in Gazakh, Agstafa, Tovuz, Shamkir, Khanlar, Goranboy districts, this indicator is not more than 10-15% in Dashkasan, Gadabey districts. All this is related to the regular and systematic transformation of the natural landscapes of the region during historical periods (Abbasova , 2022).



Map-scheme 2. Ecological zones where it is important to improve the geoecological potential of the northeastern slope of the Lesser Caucasus

Settlements in the forest zone of the study area have a greater influence on the change of natural complexes. In the space images, these complexes are deciphered with large scattered areas, chain along the river, and in some cases circular structures. Due to the unfavorable environmental conditions in the highlands of the region, the level of population settlement in these zones is low, and the anthropogenic effects are episodic in nature.



Map-scheme 3. River network density of the landscapes of the northeastern slope of the Lesser Caucasus

Since the foothill plains and low mountainous zones of the northeastern slope of the Lesser Caucasus are arid regions with a high population density, irrigation agriculture is developed here. Thus, in order to provide water for agricultural plants, irrigation canals were built from the rivers flowing through the area. Flood events have an important role in the development of the desertification process. Mountain rivers deposit the suspended materials they bring every year in the plains, removing large areas of land from agricultural circulation. Floods are also directly caused by natural and anthropogenic factors (Garibov, 2012). Dumping of mining industry waste into river valleys, overcrowding of summer pastures with cattle, deforestation,

construction of highways are the factors that lead to the recurrence of floods. The rapid use of land resources in the region has led to desertification, degradation, erosion and a sharp decrease in plant productivity in the existing landscapes here. The denudation process is more intensive in the middle mountainous areas due to the high inclination. The high amount of annual precipitation intensifies the processes of erosion and denudation. As a result, avalanches and landslides occur on mountain slopes. Avalanches and landslides create the ground for denudation and desertification on mountain slopes. Each change in the climate has a very strong effect on all the features of the area, including the course of the desertification process.

Intensive livestock grazing on the northeastern slopes of the Lesser Caucasus is one of the factors that strongly influence the intensity of the desertification process. As a result of overloading of pastures with livestock, their productivity decreases in semi-desert, dry steppe and mountain-meadow landscapes with non-sustainable vegetation cover (Mammadov, 2011). The analysis of the location of the population in the region along landscape zones shows that the population density decreases from east to west. As a result of the analysis of the distribution of the population of the studied region by vertical zones, we found that 11.4% of the population lives in the absolute altitudes of 0-200 meters, 43.3% in the foothills-plain areas with absolute altitudes of 200-500 meters, 47.3 % are concentrated in the absolute altitudes of 500-1000 meters, 3.4% in the altitudes of 1000-2000 meters, and 0.1% in the zones above 2000 (The population of Azerbaijan. 2022) Settlements and their functional farm areas are characterized by a relatively high density in the immediate plains, terraced alluvial plains of river valleys, intermountain depressions, and plains with smooth surfaces. Settlements along the Ganja-Gazakh sloping plain are distributed almost evenly over the entire area. Since the climate, lithological and hydrological conditions in the south-eastern part of the area have changed dramatically, the relatively small amount of water resources in the location of settlements is a socio-ecological problem, and therefore the settlements in the area are mainly located along the river banks (Abbasova, 2022).

The analysis of the distribution of urban and rural settlements on the height-landscape zones shows that the location and functional activity of the population, settlements and farms were formed under the direct influence of natural-geographic conditions, depending on the height-spatial differentiation of the landscape on the northeastern slope of the Lesser Caucasus. From this point of view, depending on favorable relief, lithological, hydrological and hydrogeological conditions in the plain parts, the settlement of the population and the location of various farms are also related to the formation of a more favorable natural-geographical environment. This is also shown by the analysis of the distribution and density of the population and settlements on the altitude zones.

Table 1.

The number of urban and rural population living in the north-eastern slope of the Lesser Caucasus, per 1000 people

Administrative districts	Number of population	Urban population	Rural population
Ganja-Dashkasan	**596,0**	**424,6**	**171,4**
Ganja	330,3	330,3	-
Naphthalan	8,6	7,3	1,3
Dashkasan	33,2	14,5	18,7
Goranboy	101,2	24,3	76,9
Goygol	64,5	25,6	38,9
Samux	58,2	22,6	35,6
Gazakh-Tovuz	**674,4**	**165,9**	**508,5**
Agstafa	85,9	21,0	64,9
Gadabay	100,8	14,6	86,2
Qazakh	95,8	20,8	75,0
Shamkir	216,2	73,4	142,8
Tovuz	175,7	36,1	139,6

Source: ARSSC data, prepared on the basis of statistical compilation. Population of Azerbaijan 2023, p. 75-77.

The analysis of the data of the table we compiled shows that in the Ganja-Dashkasan economic district of the region, according to the data of 2023, there are 216 settlements (7 cities, 19 settlements, 190 villages) and 596.0 thousand people living in them (424.6 thousand urban population) , 171.4 thousand rural population), and in the Gazakh-Tovuz economic district there are 345 settlements (6 cities, 8 settlements, 331 villages) and 674.4 thousand people living in them (165.9 thousand urban, 508.5 thousand and village population) were recorded. Currently, the urban population of the region is 590.5 thousand people, and the population living in rural settlements is 679.9 thousand people. As it can be seen, the vast majority of the population living in the region is concentrated in rural settlements. In the administrative districts included in the region, the share of the population living in rural settlements reaches 60-89% on

average. This indicator has a significant regional difference in the area. Thus, 75.6% of the population of Agstafa, 66% of the population of Shamkir, 56.3% of the population of Dashkasan, 75.9% of the population of Goranboy, 61.2% of the population of Samukh live in rural settlements. This has led to the expansion of the area of settlements and seliteb complexes, the economic impact of people on the landscape complexes, and the transformation of natural complexes. [Source: ARDSK data, prepared on the basis of statistical compilation. Population of Azerbaijan in 2023].

Result: The investigation of ways to improve the geoecological potential of the natural-anthropogenic landscapes of the north-eastern slope of the Lesser Caucasus showed that Gadabey-Dashkasan, Ganja-Dashkasan, Ganja-Gazakh, Tovuz-Gazakh and Shamkir-Tovuz areas, which are more exposed to environmental stress, are very different from each other according to the suitability index. Most of the territory has become less favorable zones due to its great ecological potential. The analysis of the location of the population living here on landscape zones shows that the population density decreases from east to west. As a result of the analysis of the distribution of the population in vertical zones, it was determined that 11.4% of the population lives in the absolute altitudes of 0-200 meters, 43.3% in the foothills-plain areas with absolute altitudes of 200-500 meters, 47.3% 500-1000 meters are concentrated in absolute altitudes, 3.4% are concentrated in 1000-2000 meters altitudes, and 0.1% are concentrated in zones above 2000 meters. In the administrative districts included in the region, the share of the population living in rural settlements reaches 60-89% on average. This indicator has a significant regional difference in the area. The expansion of the area of settlements and seliteb complexes, the economic effects of the population on the landscape complexes have led to the transformation of natural complexes.

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