

Ecological problems of the plant cover of the northeastern slope of Great Caucasus (within Azerbaijan)

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ABSTRACT

Highlight the purpose. Plant cover of our republic, especially forest ecosystems, has lost its original state as a result of the influence of natural and anthropogenic factors. The study of the impact of these factors on biodiversity has been the focus of many experts. The settlement of the studied area since ancient times and the good development of agriculture have caused the degradation and erosion of the forest cover that covers large areas, as well as the vegetation that replaces each other in the altitude zones here. For this reason, the issues of protection and protection of vegetation are distinguished by their relevance. The main goal of our research is to protect the vegetation of forests that have changed their initial state.

Objectives. Mountain geosystems of the northeastern slope of the Greater Caucasus are bordered by the Russian Federation to the north, northwest, and west, the Samur-Devachi plain to the east, and the watershed line of the Greater Caucasus Range and Atachay to the south and southeast.

Methods. Field studies were organized to solve the issues raised during the research period. Short-term visual observations of the existing geoeological conditions were carried out, from topographic maps and other maps (landscape, vegetation, etc.) of various scales, as well as from 1:25000 scale aerial and space images in the fund of the Institute of Ecology of MAKKA, "Google" and "Bing" space images with a resolution of 1 meter in the funds, taken in the visible zone of the spectrum, obtained from various satellites in 2020-2023 and based on the application of SASPlanet, ArcGIS processing programs were used. With the help of these materials, the vegetation degradation and erosion processes of the research area were studied.

Results. The northeast part of the Great Caucasus differs from the other mountainous regions for its appropriation features. For a long time appropriation of the investigated zone by the various farming areas caused a serious change in the natural geosystems. Thus, the zones where a hypsometric height of 200-500 m are mainly replaced by agro-complexes, the parts within 500-1800 m turned into a life and rest objects together with the arable and pastures, an irregular use from the summer pastures in cattle-breeding in the zones higher than 1800 m was completed by exposing of the plant cover to transformation. During assimilation, activation of ecological problems like decreased plant productivity, intensification of the erosion process, acceleration of degradation, and so on activates a problem of rational use. Defining importance, sensitiveness of plant cover, and rational use ways as protection, refusal of usage, extensive use of protection, development, extensive use, improvement, and development were determined.

Keywords: *geosystem, soils, protection, development, improvement, extensive use, environmental, ecosystem, plant cover.*

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Problem statement. The mountain region of the northeastern slope of the Greater Caucasus is border by the Samur-Davachi lowland from the north and northeast, the Russian Federation from the north and north-west, and the southwestern slope of the Greater Caucasus from the south. The total area of the investigated area is 49 thousand km². The northeastern slope of the Greater Caucasus includes mountain geosystems from 200 m to 4466 m above sea level. The area of the mountainous part of the northeastern slope with a total area of 9719.9 km² is 4852.3 km² (Fig. 1). The northeast part of the Great Caucasus differs from the other mountainous regions for its appropriation features. Some elements of the natural-geographical environment in the zone are convenient for the appropriation, but some elements of the climate and relief create definite problems here. Thus, the climate here is colder, the relief is splinter more than in the southern part of the Great Caucasus. Despite this, the performed historical and ethnographical researches show that the ap-

propriation of the zone coincides with the long historical period. Some scientists studying the investigated zone's history made notes in their works.

The northeastern slope of the Great Caucasus, which consists of a mountainous region, is Azerbaijan's most important agricultural area. Here there are favorable natural conditions for the development of fruit growing, grain growing, horticulture, vegetable growing, and animal husbandry. Favorable climatic features and morphometric indicators of the area's relief allow to harvest twice a year and develop good agriculture. For this reason, special importance is given to the further improvement of the agriculture of the studied area in the "State Program of Socio-Economic Development of Regions (2014-2018 years)". A number of infrastructure projects are planned to be implemented here.

For a long time, appropriation of the investigated zone by the various farming areas caused a serious change in the natural geosystems. Thus, the zones where a hypsometric height of 200-500 m are



Fig. 1. Investigation area

mainly replaced by agro-complexes, the parts within 500-1800 m turned into a life and rest objects together with the arable and pastures, an irregular use from the summer pastures in cattle-breeding in the zones higher than 1800 m was completed by exposing of the soil and plant cover to transformation. The complexity of the geological, and geomorphological structure of the northeastern slope in the Great Caucasus, and the strong change in the climate created a condition for the formation of various plant zones.

Analysis of recent research and publications.

The geobotanical research on the vegetation in the region started at the beginning of the XX century. L.I. Prilipko gave the following classification scheme of the vegetation in the research zone: 1) foothill dry steppe vegetation (till 200-500 m); 2) mountain xerophyte vegetation (500-1200 m); forest vegetation (700-1800 m); 4) subalpine meadow vegetation (1800-2200 m); 5) alp-meadow vegetation (more than 2200-3200 m) [13, 15]. The mentioned vegetation caused intensive assimilation of different farm areas, settlements, sowing areas as pasture-hayfield, their transformation, and replacement of cultural plants by weed, poisonous and harmful plants [3]. Continuous negative anthropogenic effects will lead to the loss of the initial appearance of vegetation, and tenseness of ecological problems in ecosystems of the mountain geosystems on the northeastern slope of the Great Caucasus [9, 10, 17, 18]. The rational use of biotopes is an important and urgent task to prevent the future ecological situation from tension. We should evaluate the vegetation of the research zone. Their importance and sensitiveness should be investigated and the ways to use them should be determined [5, 6, 8].

Research method. Innovations of GIC technologies, historical-territorial, statistic-mathematic, comparison, cartography, zoning, systematic analy-

sis, and other methods and collected primary field research methods have been used in the realization of the research work. While defining the importance of vegetation in the zone we were based on R.M. Mammadov's and other research [11, 14, 16].

Research result. R.M. Mammadov was one of the first scientists who studied the importance and sensitivity of vegetation in our republic. He studied the vegetation of Aggol and Yalama National Parks and determined their conservation principles. Based on the scientist's research, buffer zones were created in the mentioned national parks, and appropriate regions were allocated for the development of ecotourism. Using his research, we have determined ways to protect and optimize the vegetation of our study area, especially forest ecosystems. Its importance criteria (spreading height, diversity of species, degree of vegetation, relict, endemism, treatment importance, use in a farm) were used (Table 1).

Assessing the importance of the vegetation of the mountain geosystems of the north-eastern slope of the Great Caucasus, we determined that 20,9% of biotopes of the total zone are highly important, 67,2%-average 5,7%-less important. The highly important vegetation of the research zone is formed by subalpine plants, forests, and xerophyte-thin woodlands [1, 2, 4]. The potential of these biotopes is distinguished by the use degree in farm, rare, relict, and endemism [7, 11, 12]. But the averagely important vegetation is close to the initial situation of the existing condition (alp meadow, mountain meadow, shrubberies, and steppe plants). It is possible to restore the disturbed biotopes [19, 20, 21]. The modern appearances of the less important differ from their first state. These plants mainly spread in the semi-desert zone. They lost their initial appearance and their use is less in the farm areas.

After determining the importance of the vegetation in the research area, we studied its sensitivity.

Table 1

Scale for assessing the socio-economic significance of vegetation

Spreading height of the plant groups	Till 1500 m 1500-2000 m 2500-3000 m	3 scores 2 scores 1 score
Diversity of plants	Multi-species Partial less Homogeneous	3 scores 2 scores 1 score
Area of vegetation	More than 75% 50-70% 20-49%	3 scores 2 scores 1 score
Existence of relict, endemic plants in the zone	3 and more 1, 2	3 scores 2 scores
Registration of treatment plants	Exist	3 scores
Use of plants on the farm	As summer pastures, gathering for fruit-growing and in preparation of medications, and is used in winter pastures, perennial plantations, fire-wood stock, used as planting areas. Mainly fruit gardens and orchard plants. Partially summer pasture, sowing area, and hayfields	3 scores

Note: highly important plants-more than 15 scores; averagely important plants- 12-15 scores; less important plants – 11 scores.

In this case, the criteria for the sensitivity of biotopes - exogenous processes (landslides), farms, settlements, highways, the impact of tourism, the sensitivity of plants to burning, and the intensity of breakage were analyzed separately for each plant species (Table 2, 3). The sensitivity of plants means how their properties can change as a result of anthropogenic effects. The sensitivity of biocenoses to burning, deforestation, grazing, winter and pasture livestock, entry of aerosols, etc. are taken into account to assess it. A species composition, structure, and features of the plant groups are drawn to the fore in the assessment of vegetation sensitivity to burning. Taking into account the mentioned factors we determined the vegetation sensitivity of the research zone [22, 23].

As a result of our investigations the sensitive plants form more than 31,9% of the vegetation of mountain geosystems on the northeastern slope of the Great Caucasus. These plant species surround subalpine, mountain-meadow, and forest zones. The summer pastures of the subalpine and mountain-meadow zones are use as hayfields, and they lose their initial state and the erosion process is activated

while grazing rules are not followed. The area with very sensitive plants is the forests. The process of forest regeneration itself takes a long time and it is unequivocally important to prevent them from breaking. The averagely important sensitive plants of the one consist of alp and xerophyte sparse forestry plants (21,9%). The alp plants are broken for summer pasture, and the xerophyte sparse woodlands are broken for sowing areas. It is important to obey the grazing norm in alp vegetation to prevent these plants' degradation. But it is important to prevent the xerophyte sparse vegetation from assimilation in various farm areas. 40,3% of the total zone is planted with less sensitivity. These plants are intensively assimilate in sowing, winter pastures, settlements, and other farm areas. Though they are less sensitive, they are replace by shrubby steppes and semi-desert plants. It is necessary to prevent their intensive assimilation to the prevention of these changes.

After determining the importance and sensitivity of the vegetation in the investigation area, we determined their effective use (Table 4, Fig. 2).

As is seen from the table, we separated plants

Table 2

The scale of biotope sensitivity assessment

Influence of exogen relief-forming processes on vegetation (km)	Impact of vegetation on farm areas	Presence of plant sensitivity to burning and intensive breaking of plants	Impact of settlements, highway, and tourism on biotopes existence
More than 10 km – 5 scores 5-10 km-2 scores To 5 km – 1 score	2 scores	1 score	1 score

Note: very sensitive – 6 scores; averagely sensitive – 5 scores; less sensitive – less than 4 scores.

Assessment of biotopes sensitivity in the research zone

Vegetation	Area of the landslides km ²	Influence of exogenic relief forming processes on vegetation	Impact far areas on vegetation	Presence of the plants sensitive to burning and intensively breaking the plants	Influence of settlements, highways, and tourism on biotopes' existence	Sensitivity
Alp	15,7	Snow slides and landslides perish of young plant stalks	Partially grazing of small horned cattle	Isn't observed	Isn't observed	5 scores
Subalpine	46,3	Repeat of landslides	Intensively grazing of the zones, trampling, and perish of young shoots	Isn't observed	Construction of camps and partial settlement for tourism	6 scores
Mountain meadow	9,6	The intensity of landslide and stream	Perish of summer pasture (grazing of the zone)	Fire registration	The density of the settlements	6 scores
Forest	10,8	Landslide and streams	Winter pastures. Sowing areas	Frequent registration of fire deforestation for firewood reserves	The density of the settlements, building of the tourist objects	6 scores
Shrubbery	2,8	Weak effect	Sowing areas	-	The density of the settlements, building of the tourism objects, highways	5 scores.
Xerophyte sparse woodland	3,4	Landslide	Winter pastures, sowing areas	Frequent registration of fires, ignition of dry bushes, deforestation of firewood reserves	The density of the settlements, building of the tourism objects, highways	5 scores
Steppe	1,5	Weak impact	Widespread of the sowing areas, replacement of plants by the cultural plants	Frequent fire	The density of the settlements, building of the tourist objects, highways	4 scores
Semidesert and desert	0,8	Weak impact	Widespread the sowing areas	-	The excessive density of the settlements, construction of the tourism objects, highways	4 scores

of the geosystems on the northeastern slope of the Great Caucasus into protection-refuse to use, protection-extensive use, and improvement–development categories. Rational use ways of the vegetation of the zone have been defined on the basis mentioned categories.

Conclusion. The change of the vegetation of the northeastern slope of the Greater Caucasus during the long historical period as a result of the activities of various farms created the problem of its

preservation and protection. In order to solve these problems and restore the protection of the forest cover, we have investigated the sensitivity and importance of the vegetation cover. At this time, based on the research of a number of local and foreign scientists, we have come to the following conclusions. The research zone's subalpine meadow, mountain meadows, and forest should be protect and refuse use. These zones form 32% of the vegetation. Here any anthropogenic activity is unacceptable. These

Table 4

Sensitiveness of vegetation of the mountain geosystems on the north-eastern slope in the Great Caucasus (using the integration table for area aims of the value category)

Name of the plant group (number on the plant map)	The assessment rate of plants		Aims type
	Importance	Sensitiveness	
Alp meadow and carpets	Average	Average	Development, extensive use
Subalpine meadows	High	High	Protection, refuse to use
Mountain meadows and meadow steppes	Average	High	Protection, refuse to use
Forests	High	High	Protection, refuse to use
Xerophyte sparse woodland	High	Average	Protection, extensive use
Shrubberies	Average	Low	Development, extensive use
Steppes	Average	Low	Development, extensive use
Semidesert, and desert plants	Low	Low	Improvement, development

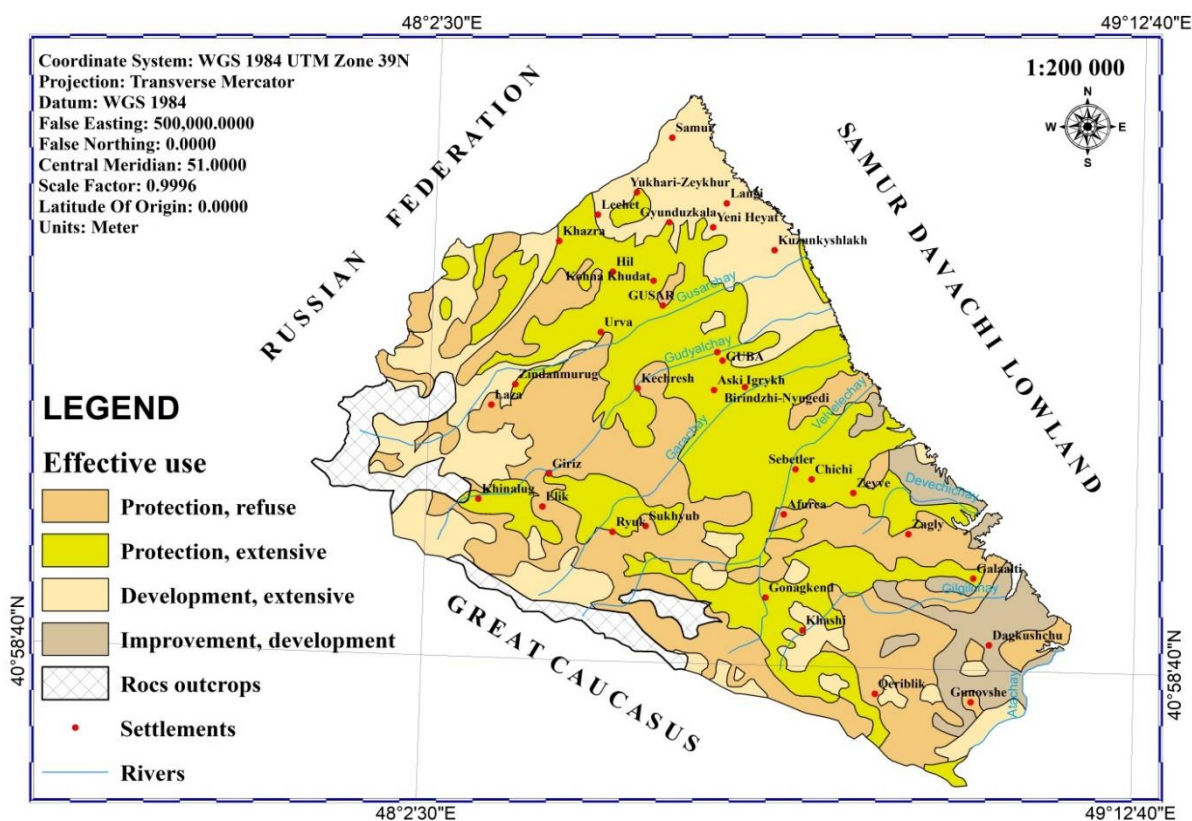


Fig. 2. Rational use map for plant cover of the mountain geosystems on the northeastern slope of the Great Caucasus

plant groups with higher importance and higher sensitivity can perish during human farm activity. The establishment of preserves and national parks and the improvement of the condition of the existing ones are expedient. Enlargement of the national park borders of Shahdagh and Altıaghaj, areas with a high concentration of rare endangered species of flora and fauna listed in the Red Book of the Republic of Azerbaijan should be included in the parking area.

Biotopes in the subalpine and mountain meadows are mainly use as summer and winter pastures. During grazing they lose their appearance, therefore,

special attention must be paid to sowing seeds, the realization of appropriate agrotechnical rules, following the grazing norm, and alternate grazing.

Protection - extensive use surround the zones with the xerophyte sparse woodlands. These plants are distinguish with higher importance and average sensitiveness. The mentioned plant species form 9.1 % of the total areas, they can lose their initial state quickly while assimilating. It is important to follow the appropriate rules during biotopes use.

39.8 % of biotopes should be development-extensive use. The alp meadow and carpets, shrubberies, and steppes are included in these plants. The

summer and winter pastures must be widened and follow the defined norm (1-4 cattle) to prevent activation with average importance and sensitiveness.

Improvement, and development – involve 13.4% of the total zone. In these zones, the areas of

winter pastures should be widen and improve, pastures should be establish because of guarding the natural pastures, and agrotechnical rules should be followed.

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Екологічні проблеми рослинного покриву північно-сходу Великого Кавказу (у межах Азербайджану)

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Рослинний покрив республіки, особливо лісові екосистеми, внаслідок впливу природних і антропогенних факторів втратили свій первинний стан. Вивчення впливу цих факторів на біорізноманіття було в центрі уваги багатьох експертів. Заселення досліджуваної території з давніх часів і сильний розвиток сільського господарства спричинили деградацію та ерозію лісового покриву, який охоплює значні площі, а також рослинності, яка змінює тут одна одну у висотних поясах. З цієї причини питання охорони та захисту рослинності вирізняються своєю актуальністю. Основною метою наших досліджень є охорона рослинності лісів, які змінили свій початковий стан. Гірські геосистеми північно-східного схилу Великого Кавказу межують на півночі, північному заході і заході з Російською Федерацією, на сході з Самур-Девачійською рівниною, на півдні і південному сході – вододілом Великого Кавказького хребта і Атачая. Для вирішення питань, поставлених у досліджуваний період, були організовані польові дослідження. Проводилися короточасні візуальні спостереження за існуючими геоекологічними умовами за топографічними та іншими картами (ландшафтними, рослинними та ін.) різного масштабу, а також за аерознімками масштабу 1:25000, що знаходяться у фонді інституту Екології, МАКА, «Google» і «Bing» космічні знімки з роздільністю 1 метр у фондах, зроблені у видимій зоні спектру, отримані з різних супутників у 2020-2023 роках і на основі застосування SASPlanet, ArcGIS, використовувалися програми обробки. За допомогою цих матеріалів досліджено процеси деградації рослинного покриву та ерозійні процеси досліджуваної території. Північно-східна частина Великого Кавказу відрізняється від інших гірських районів своїми особливостями привласнення. Протягом тривалого часу освоєння досліджуваної зони різними сільськогосподарськими угіддями викликало серйозні зміни природних геосистем. Так, зони гіпсометричної висоти 200-500 м переважно заміщені агрокомплексами, ділянки в межах 500-1800 м перетворені на об'єкти побуту та відпочинку разом з орними землями та пасовищами, нерегулярне використання літніх пасовищ у с. скотарство в зонах вище 1800 м завершилося трансформацією рослинного покриву. Під час асиміляції активізація екологічних проблем, таких як зниження продуктивності рослин, посилення процесу ерозії, прискорення деградації тощо, активізує проблему раціонального використання. Визначено визначальне значення, чутливість рослинного покриву та способи раціонального використання як захист, відмова від використання, екстенсивний захист, розвиток, екстенсивне використання, поліпшення та розвиток.

Ключові слова: геосистема, ґрунти, охорона, розвиток, поліпшення, екстенсивне використання.

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