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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

ORGANIZATION OF THE USE OF THE ECOLOGICAL POTENTIAL OF THE GEOCOMPLEXES ON THE NORTHEASTERN SLOPE OF THE GREATER CAUCASUS BASED ON LANDSCAPE PLANNING (ON THE EXAMPLE OF BETWEEN GUDYALCHAY AND SAMURCHAY)

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GENERAL CHARACTERISTIC OF THE WORK

Relevance of the topic and degree of elaboration. The sustainable development of the economy in the Republic of Azerbaijan, ensuring food security, improving the well-being of the population, optimizing the ecological situation in nature, and the sustainable management of natural resources, including land, have always been at the center of the state's attention.

During the years of independence, significant efforts have been made to regulate property issues in line with new economic and political relations, and agrarian and land reforms have been implemented. Since 2004, the State Programs carried out have ensured the dynamic development of the economy in the regions and the systematic implementation of state-significant ecological projects.

However, with the annual increase in population, the reduction of arable land per capita, and the backdrop of global climate change, one of the pressing issues facing society is the proper regulation of human-nature-society relations and the continuous improvement of state management mechanisms for natural resources, including land resources.

One of the important issues facing the society in the face of the annual increase in the number of people, the reduction of arable land per person, and global climate changes is the proper regulation of human-nature-society relationships, the continuous improvement of the state management mechanism of natural resources, including land resources.

For this reason, the assessment of the ecological potential of ecogeocomplexes and the improvement of mechanisms for the utilization of landscapes are among the most pressing issues of our time in our republic. Among Azerbaijani scientists H.A.Aliyev (1982, 2001), M.I.Jafarov (1997), B.A.Budagov (1985, 1988), G.Sh.Mammadov (2002), R.M.Mammadov (2016), R.M.Guliyev (2008, 2021), Z.N.Eminov (2018), N.A.Pashayev (2010), M.J.Ismayilov (2011, 2019), and others have conducted fundamental scientific research in the direction of landscape planning with the aim

of nature conservation, soil protection, and increasing fertility, and improve the efficiency of using natural areas.

Foreign scholars such as V.Y. Zapletin (1970), S.N. Volkov (1997, 1998), M.I. Lopirev (2015), V.V. Kosinskiy (2016), V.D. Postolov (2017), D. Bruns (2003), K. Dietz (2000), A. Rauch (2000), and A. Fisahn (2004) have developed the scientific foundations for maintaining ecological balance in landscapes.

However, traditional classical scientific research does not fully address the tasks set in regulating new land relations and protecting nature. The complete execution of these tasks can only be achieved through the implementation of scientifically grounded research on landscape planning, incorporating practical recommendations and proposals of significant relevance.

Object and subject of the research. The object of the study is the area between the Gudyalchay and Samurchay rivers on the northeastern slope of the Greater Caucasus geocomplexes in the Republic of Azerbaijan, characterized by high-altitude belts and diverse directional, and complex-structured anthropogenic landscapes. The area of the research object is 517.7 thousand hectares.

The subject of the research is the differentiation and evaluation of the ecological, socio-economic potentials, and natural-geographical conditions of the geocomplexes between Gudyalchay and Samurchay rivers on the northeastern slope of the Greater Caucasus, the examination of modern socio-economic relations, the investigation of the regularities of ecological-landscape organization of the area under the conditions of elevation belts, and the exploration of the development of theoretical-methodical and methodological bases of territory organization based on landscape planning.

Purpose and objectives of the research. The purpose of the research is to evaluate the ecological potential of the natural and natural-anthropogenic geocomplexes on the northeastern slope of the Greater Caucasus between Gudyalchay and Samurchay, assess the current state of their use, and develop scientifically based, experimentally important digital maps, suggestions, and

recommendations for organizing the use of this potential based on landscape planning.

In accordance with the purpose of the research, the following tasks were identified:

- Investigating of the practice of organizing landscape areas and development on the theoretical-methodical and methodological bases of landscape planning in the conditions of elevation belts in Azerbaijan.

- Differentiation, assessment of the use of natural resources of geocomplexes and their landscape-ecological potential, structural-spatial conditions and preparation of various thematic digital maps;

- Assessment of the sensitivity and stability of geocomplexes and determination of the main conflicts caused by socio-economic conditions, as well as the coefficient of ecological stability in natural-anthropogenic landscapes with various structural and functional characteristics;

- Scientific justification of an integrated system of measures for landscape planning of geocomplexes.

Research methods. The materials obtained during field expeditions conducted in 2020-2022 were extensively utilized in the implementation of the dissertation work. Large-scale (1:100,000) landscape maps were prepared using semi-stationary and route mapping methods in designated observation areas. During the preparation of digital maps, topographic maps with scales of 1:100,000 and 1:25,000, as well as satellite images, were utilized. Additionally, in the scientific research, geoinformation, mathematical-statistical comparison, cartometric analysis, systematic approach, and forecasting methods were applied, along with the use of computer technologies. The prepared maps were created using ArcGIS 10.8 software.

During the implementation of the dissertation work, cadastral data from the State Service for Property Issues under the Ministry of Economy, statistical and other data from the Ministry of Ecology and Natural Resources, the Ministry of Agriculture, the State Statistical Committee, as well as experiences from developed and post-Soviet

countries, and the results of research by scientists and experts from foreign countries and our republic were utilized.

The main provisions of the defense.

1. Assessment of the use of natural resources of geocomplexes and their ecological-landscape potential;

2. Application of landscape planning and eco-economic issues;

3. Integrated system of measures in landscape planning and ecological stability.

The scientific novelty of the research.

- The theoretical and methodological foundations of organizing the landscape planning of the areas characterized by elevation zones in the geocomplexes of the northeastern slope of the Greater Caucasus, between the Gudyalchay and Samurchay rivers, have been developed;

- Indicators characterizing the ecological-landscape and spatial conditions of the study area have been determined, and the issues of landscape area management have been identified.

- For the first time, large-scale thematic digital maps reflecting the main indicators of ecological diversity and stability of anthropogenic landscapes in the study area have been created;

- The areas of the Guba and Gusar districts in the study area have been classified as ecologically moderately stable, while the area of the Khachmaz district has been classified as ecologically unstable and stable landscapes. The natural landscapes of the research object are characterized by high levels of anthropogenic changes, with anthropogenic alterations expressed through diverse forms of land use[1];

- In the application of landscape planning based on ecological potential, the landscapes have been grouped according to sensitivity and significance degree into low, medium, and high categories based on existing criteria: 54% of the area (1640.1 km²) consists of low-

[1]Guliyev M.R. "Assessment of Land Use and Ecological Sustainability in the Northeastern Slope Geocomplexes of the Greater Caucasus (Case Study of the Samurchay-Gudyalchay Interfluve)" // Geography and Natural Resources, - Baku: "Optimist" - 2022. - No. 1(16), - pp. 82-87 (in Aze.).

sensitivity geocomplexes, 27.2% (825.7 km²) are medium-sensitivity, and 18.8% (570.9 km²) are high-sensitivity geocomplexes.

- Conflicts arising from mutual relations between human and nature in geocomplexes were categorized based on their characteristics and manifestation forms. Natural-anthropogenic conflicts on the landscape types in the area were evaluated in terms of their origin, ecological consequences, continuity and intensity, and socio-economic outcomes. A comprehensive digital conflict map was prepared. It has been revealed that 17.9% of natural-anthropogenic conflicts in the geocomplexes between the Samurchay and Gudyalchay rivers are of low intensity, 12.4% are of medium intensity, and 69.7% are of high-intensity landscapes;

- For the first time, based on existing methodological recommendations, a cartographic model of the ecological framework of the researched area was developed. Taking into account the unique characteristics of the area, the functional elements of the ecological framework, and the four main levels of land management – national, regional, local, and individual farming – were determined to establish the differential structure.

Theoretical and practical significance of the research. In the dissertation work, the studies of foreign scientists, as well as scientists from Azerbaijan, on the theoretical-methodical and methodological bases of landscape planning were summarized, the analysis of the modern state of landscape planning in Azerbaijan was carried out, and the basis of the theory of landscape planning for the conditions of Azerbaijan was improved.

The practical importance of the system of indicators characterizing ecological diversity and sustainability lies in its ability to determine a unified state policy in the field of ecological security, prepare and implement ecological projects and state programs, and play a fundamental role in giving the status of an emergency ecological situation zone to the relevant areas. The optimization of the structures of agro-landscapes and the area ratios of agricultural locations based on ecological landscape planning is of great practical importance for the organization of ecologically and economically sustainable anthropogenic landscapes.

Approbation and application. The results of the scientific research have been presented in 3 international and 2 domestic conferences: The international conference "Actual Problems of Modern Natural and Economic Sciences" dedicated to the 99th anniversary of the birth of the national leader Heydar Aliyev and "National Revival Day" at Ganja State University (Ganja, May 6-7, 2022); The international conference on "Contemporary Issues in Geography: Integration of Science and Education" at the Institute of Geography named after academician H.A.Aliyev, the Ministry of Science and Education of the Republic of Azerbaijan (Baku, November 29-30, 2022); The international scientific-practical conference on "Natural Resource Potential and Rehabilitation of Degraded Landscapes" at the Chechen State University named after A.A.Kadyrov under the Ministry of Science and Higher Education of the Russian Federation (Grozny, March 17-18, 2023); The Republic Conference on the topic "National Leader Heydar Aliyev and Ganja" at the Ganja Branch of the Azerbaijan National Academy of Sciences (Ganja, May 4-5, 2023); The Republic Conference on the topic "The Role of Heydar Aliyev in the Development of Science and Education in Azerbaijan" at the Institute of Geography named after academician H.A.Aliyev, the Ministry of Science and Education of the Republic of Azerbaijan (Baku, June 7, 2023). The book "Cadastre of Real Estate" which reflects some of the results of the research, is used as a textbook for students studying in the bachelor's degree program in "Land Management and Real Estate Cadastre" in higher educational institutions of the Republic.

According to the results of the dissertation, 11 articles have been published in various journals of our country and foreign countries.

The name of the institution where the dissertation was carried out. The dissertation work was performed at the Department of “Political and Economic Geography of Azerbaijan” of the Institute of Geography named after academician H.A.Aliyev of the Ministry of Science and Education of the Republic of Azerbaijan.

The volume and structure of the dissertation. The dissertation consists of an introduction, four chapters, conclusions

and recommendations, a bibliography with 139 references, and appendices. The work is presented on 180 pages and includes a total of 33 figures and 27 tables. Of these, 15 figures and 4 tables are provided in the appendices. Excluding tables, figures, and the bibliography, the dissertation comprises a total of 203,969 characters (introduction: 10,864 characters; Chapter I: 74,254 characters; Chapter II: 63,174 characters; Chapter III: 28,570 characters; Chapter IV: 22,384 characters; conclusions and recommendations: 4,723 characters).

THE MAIN CONTENT OF THE RESEARCH

The first chapter of the dissertation is titled "**Theoretical-Methodical and Methodological Foundations of Landscape Planning**". In this chapter, the experience of organizing landscape areas in Azerbaijan is analyzed historically and geographically, the experience of organizing areas with landscape planning in the years of independence in our country is studied, and the theoretical-methodical and methodological foundations of landscape area management are provided.

The change in the socio-political formations in the historical development of states, in turn, leads to the emergence of a new system of land ownership relations and the formation of new types of economic management in the economy. As a result, there is a redistribution of property, including land. All of these require the reorganization and management of territorial landscapes.

Analysis based on the development stages of land planning in Azerbaijan has determined that approaches to territorial planning at various historical periods can be categorized into organizational-economic, socio-economic, technical-economic, and ecological perspectives[2].

[2] Guliyev M.R. Formation and Development Stages of Land Planning in Azerbaijan: Historical Overview, Analyses, Recommendations" // Materials of the Republic Conference on "The Role of Heydar Aliyev in the Development of Science and Education in Azerbaijan" - Baku: 2023. - pp. 161-167.

The beginning of the 60s of the last century is considered the date of origin of the theory of planning the ecological framework of the territory. Starting from this period, conceptual ideas emerged in North America and Europe for optimizing the mutual interactions of natural and anthropogenic landscapes through the system of areas subjected to various functional loads[3].

The practical stage of planning the ecological framework of territories in the Republic of Azerbaijan began in the early 1960s. Starting from that period, a network of specially protected natural areas was formed across the country in accordance with the concept of nature conservation.

The relationship between humans and nature during the use of natural resources is currently tense, whether globally, nationally, or within the framework of the research object of the dissertation, and in some areas, it is even in a critical condition.

Currently, in the Republic of Azerbaijan, including the northeastern slope of the Greater Caucasus geocomplexes, the problems of managing landscape areas can be divided into the following 3 groups: problems related to ecological organizational support, problems related to economic support, and problems related to legal support[4].

Ecological and organizational problems in the management of landscape areas include the improper use of lands according to their designation, arbitrary construction activities on lands, the lack of implementation of measures for large-scale land recultivation, conservation, and strengthening, as well as situations related to deficiencies of rural-farmer economies.

The economic problems in the management of landscape areas can be attributed to issues such as the limited application of

[3] Mammadov R.M. "Landscape Planning: Nature and Application." / R.M.Mammadov - Baku: Science and Knowledge, - 2016. - 292 p.

[4] Guliyev M.R. The Current State of Soils in Azerbaijan and Ways to Improve their Efficiency." // Mountain Geosystems in Azerbaijan: Problems and Perspectives, Proceedings of the Azerbaijan Geographical Society, Volume XIX, - Baku: "Europe" Publishing, 2017. - pp. 219-225.

economic stimulation measures, the lack of flexible economic mechanisms that serve the formation of the optimal land use system.

The legal assurance issues in the management of landscape areas can include situations such as the lack of restrictions on the size (area) of agricultural land, the failure to determine the threshold for land division, and the limited scope of cases in which land ownership rights are registered.

Currently, the areas designated for the production of certain agricultural products have been divided into small plots, with some being sold as "agricultural land" in sizes of 500 m², 700 m², and in some cases, even smaller areas. Naturally, these lands, originally intended for the production of agricultural products, have later been used for the construction of individual residential houses and non-agricultural purpose objects.

The second chapter is devoted to the research on the "**Ecological Resource Potentials of the Northeastern Slope of the Greater Caucasus and Their Evaluation**" problems.

The research area administratively covers the territories of Guba, Gusar and Khachmaz districts and is a part of the Guba-Khachmaz economic region. The area between Gudyalchay-Samurchay of the geocomplexes of the northeastern slope of the Greater Caucasus is 517.7 thousand ha, which makes up 74.3% of the area of the Guba-Khachmaz economic region. More than half of the lands of the study area - 290.9 thousand ha (56.2%) are suitable for agriculture. The remaining 43.8% of the territory (226.4 thousand ha) are non-agricultural areas[5].

211.9 thousand hectares (40.9%) of the research area lands are state-owned, 157.0 thousand hectares (30.4%) are privately owned, and 148.8 thousand hectares (28.7%) belong to municipalities. In the research area, the population density is 88 people per 1 km^2. Here,

[5] Guliyev, M.R. "Assessment of Land Use and Ecological Sustainability in the Northeastern Slope Geocomplexes of the Greater Caucasus (Case Study of the Samurchay-Gudyalchay Interfluve)" // Geography and Natural Resources, - Baku: – 2022. – No. 1(16), – pp. 82-87 (in Aze.).

each person corresponds to 0.64 hectares of land suitable for agriculture and 0.17 hectares of cultivated land[6].

The division was carried out on hypsometric steps, which are the main morphometric element of the relief of the study area. Accordingly, the boundaries and areas of the elevation zones were determined and digital maps were prepared. 125,000 hectares (24.1% of the total area) of the research area are located in the zone from sea level to 200 meters, 67,600 hectares (13.0%) in the zone from 201 to 500 meters, 79,900 hectares (15.4%) in the zone from 501 to 1000 meters, 80,400 hectares (15.5%) in the zone from 1001 to 1500 meters, 60,000 hectares (12%) in the zone from 1501 to 2000 meters, and 104,400 hectares (20.0%) in landscapes above 2000 meters above sea level[7].

The landscape features of elevation belts formed by the laws of nature have shaped the natural and historical characteristics of agricultural locations, determining the directions of agricultural development. The landscape features of the geocomplex area, along with soil and climate conditions, allow for cultivation mainly in elevations ranging from sea level to 1000 meters.

Our study investigated the spatial conditions of the agricultural facilities formed after land reclamation in the Guba, Gusar, and Khachmaz regions. The eco-geographical and economic evaluation of these conditions was conducted. In the research area, the indicators are as follows: the total number of land parcels for allotment lands is 135,915, the total area is 122,826 hectares, and the average area of one parcel is 0.90 hectares. Out of the researched allotment land parcels, 95,545 (70.3%) consist of parcels with areas up to 1 hectare. This constitutes 40,548.32 hectares (33.17%) of the total area of allotment lands in the regions.

[6] Agriculture of Azerbaijan. Statistical Compilation / State Statistics Committee of the Republic of Azerbaijan – Baku: – 2022. – 774 p.

[7] Guliyev M.R. Soil Reserves and Human Resources of the Territory of the North-Eastern Slope of the Greater Caucasus // Young Researcher Scientific-Practical Journal, Volume VIII, - Baku: "Elm", - 2022. - p. 125-133.

More than half (66.93%) of the allotment lands consist of areas with widths up to 50 meters. There are also areas among the allotment lands with lengths even up to 50 meters.

The impact of small-scale contouring of cultivated areas on the ecological condition of the land and the economic aspects of farming were determined through calculations using the example of the former Niyazabad village in the Khachmaz district. For the 2019 agricultural year, it was calculated based on the data on the cultivated areas under grain and grain legumes that the amount of annual loss and damage due to small contours was 1,307,927 manats in the study area. Due to the changes in the composition and ratio of farms the condition of the Niyazabad sovkhoz area, which was previously classified as ecologically sustainable permanent land with a score of 0.42, has been evaluated after the reforms as ecologically unstable land with a score of 0.28[8].

In order to increase the efficiency of land use in the geocomplexes of the North-Eastern slope of the Greater Caucasus, indicators characterizing the ecological diversity and sustainability of land uses formed in the area were determined, and the spatial and landscape conditions of the area were analyzed (Table).

Taking into account the practical significance and calculation specifics of the indicators characterizing the ecological diversity and stability of landscape areas, the boundaries of the study area were aligned with the administrative borders of Guba, Gusar, and Khachmaz districts during the determination of these indicators and the preparation of corresponding maps (Figure 1, Figure 2).

[8] Guliyev M.R. "Ecological-Landscape Condition and Prospects of Rational Land Use (on the example of the territory of geocomplexes of the northeastern slope of the Greater Caucasus in the Republic of Azerbaijan)" // Land Management, Cadastre, and Land Monitoring, - Moscow: - 2022. - Vol.17, - No.10 (213), - p. 662-670 (in Rus.).

Table

Ecological diversity, stability, and spatial indicators of territorial units

№	Indicators	Guba	Gusar	Khachmaz	The area between Gudalchay-Samurchay	Guba-Khachmaz e.r.	Azerbaijan Republic
1	Total area, thousand ha	261,0	150,0	106,3	517,3	696,5	8655,5
2	Area of lands suitable for agriculture, thousand ha	144,8	84,7	61,4	290,9	386,3	4780,1
3	Cultivated area, thousand ha	19,2	31,1	27,7	78,0	112,5	1882
4	Number of people per 1 km^2	67	66	171	88	81	117
5	Area of lands suitable for agriculture per 1 person, ha	0,83	0,85	0,34	0,64	0,69	0,47
6	Cultivated area per 1 person, ha	0,11	0,31	0,15	0,17	0,20	0,20
7	Area of allotment lands, ha	40197	44352	37687	122237	152178	x
8	Number of allotment lands, units	52006	48445	35445	135896	200166	x
9	Average area of allotment lands, ha	0,77	0,92	1,06	0,90	0,76	x
10	Area of natural regeneration areas, thousand ha	119,2	52,4	14,8	186,4	x	x
11	Total length of ecotones, thousand m.	24931,1	17326,8	16730,5	58988,5	x	x
12	Length of ecotones per 1 ha of planting, m/ha	1295	557	604	703	x	x
13	Ecological stability coefficient of the area	0,61	0,51	0,43	0,54	0,53	0,47
14	Degree of anthropogenic loading, score	2,79	3,01	3,13	2,92	2,90	2,91
15	Ecological diversity index of the area	175,8	177,6	182,7	178,2	x	x
16	Forests, thousand ha	52,7	22,0	20,6	95,3	122,9	1040,2
17	Area covered by forest, %	20,2	14,7	19,4	18,4	17,6	12,0

"x" - The calculation of these indicators for these areas is not envisaged in the research plan.

The system of indicators characterizing the ecological diversity and sustainability of landscape areas includes parameters such as the ecological stability index of the area, the degree of anthropogenic load (index), the length of ecotones calculated per hectare of cultivation, the ecological diversity index of the area, etc., which have been identified and evaluated[9].

The ecological stability index of the area was calculated by the following formula:

$$Э_{ek.s} = \frac{\sum э_i \cdot S_i}{\sum S_i} \quad (1)$$

In the formula:

$Э_{ek.s.}$ - Ecological stability index of the area;

$э_i$ - Ecological stability index of farm place of type i;

S_i - Area of farm place of type i, ha.

The calculations have determined that the **ecological stability index** for the entire country is equal to 0.47. The ecological stability index for the research area is 0.54, indicating that the studied geocomplexes can be considered as an average ecologically stable area. Based on the ecological stability indices, separate digital ecological stability maps have been prepared for each administrative region within the research area, as well as for the studied geocomplexes as a whole (Figure 1).

The degree of anthropogenic load (index) indicates the degree of impact of human activities on the surrounding environment. Taking into account the degrees of anthropogenic load, a digital map of the area was prepared.

The anthropogenic load index of the area was determined by the following formula:

$$э = \frac{\sum SB}{\sum s} \quad (2)$$

In the formula:

Э - Degree of anthropogenic load (index);

[9] Volkov S.N. Land Management in the Context of Land Reform (Economics, Ecology, Law). – Moscow: "Bylina", 1998. – p. 214.

S - Area of the groups according to the degree of anthropogenic loading and evaluation score, ha;

B - Degree of anthropogenic load of the soil group, score.

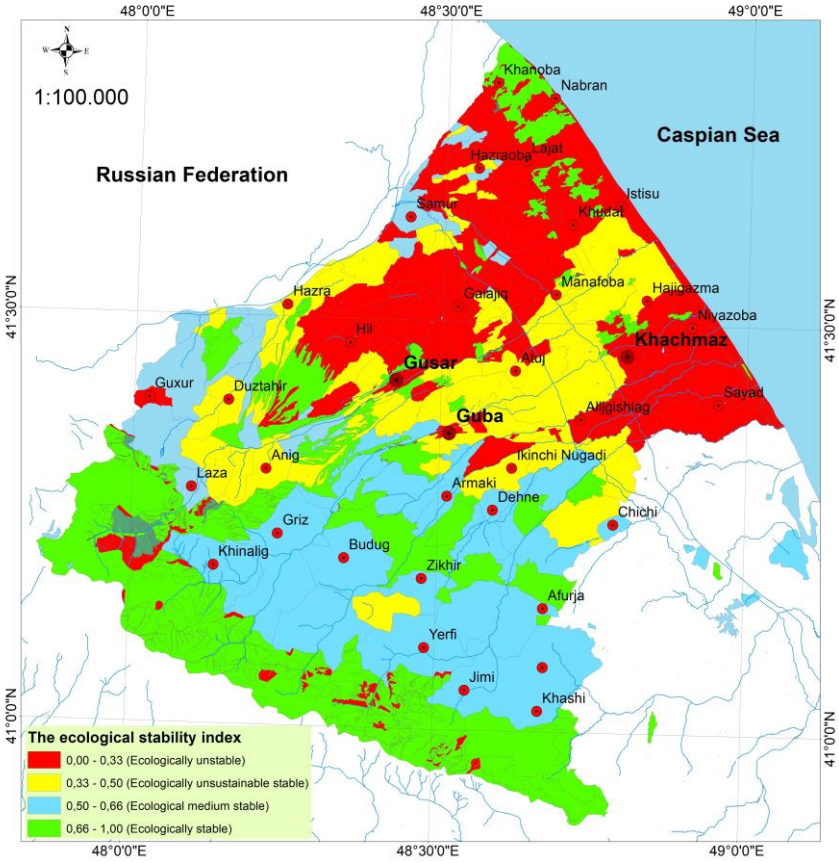

Figure 1. Ecological stability map of the Guba, Gusar, and Khachmaz districts

The anthropogenic load index for the Republic of Azerbaijan is 2.91, for the Guba-Khachmaz economic region it is 2.90, for Guba district it is 2.79, for Gusar district it is 3.01, for Khachmaz district it is 3.13, and for the entire research area, it is 2.92 (Figure 2).

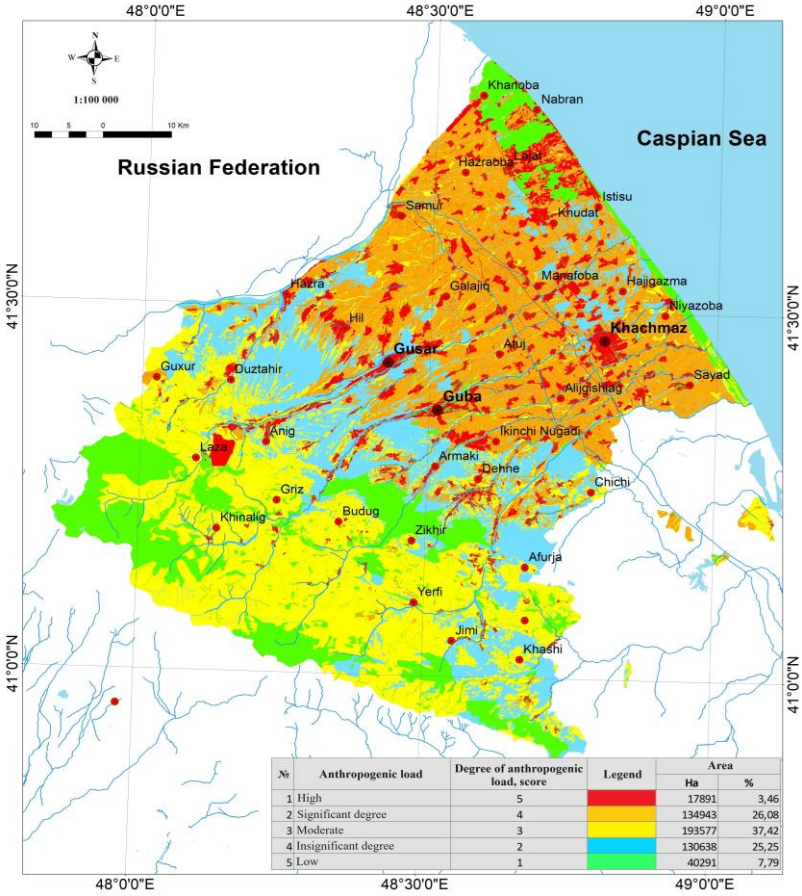

Figure 2. Anthropogenic load map of the Guba, Gusar, and Khachmaz districts

In order to improve the ecological conditions of the areas, it is essential to prioritize the selection of locations for industrial and transportation facilities, residential areas, etc., based on lower ecological stability indices rather than areas with ecological sustainability, such as natural forests, natural fertile pastures, etc.

The length of ecotones per hectare of crops. The length of ecotones means the length of the borders of different neighboring, adjacent farming areas (farmland) existing in the researched area where ecological diversity is being studied. Using a specific

program, the length of ecotones was determined for the entire territories of Guba, Gusar, and Khachmaz districts, as well as for the former farming areas in these regions.

In order to determine the ***index of ecological diversity*** of the area, the difference between the total area and the area of natural renewable areas (ecologically sustainable farming areas) was calculated, along with the total length of ecotones in the area.

The ecological diversity index of the area was calculated using the following formula:

$$I_{e.m} = \frac{\sum l_i}{S - S_i} \quad (3)$$

In the formula:

I - Ecological diversity index of the area;

l - Length of ecotones (neighboring boundaries of different farming areas), m;

S - Total area, ha;

S_i - Area of natural renewable areas (ecologically sustainable farming areas), ha.

The research allows for the conclusion that the natural landscapes of the research object are characterized by high-level anthropogenic changes. Anthropogenic changes are associated with various forms of utilizing nature.

The study of the demographic situation is crucial for managing the impacts on nature. Research on the distribution of human resources by altitude zones shows that these settlements are regulated by the norms of altitude belts. Thus, 93.7% of the total population (427,194 people) reside in areas ranging from sea level to 1000 meters[10]. During allocating land for new settlements within the boundaries of existing settlements, compact arrays should be allocated as far as possible, and scattering of land should not be allowed. Settlement activities should be halted in areas with high natural risk factors. During the planning of settlement projects,

[10] Guliyev M.R. Soil Reserves and Human Resources of the Territory of the North-Eastern Slope of the Greater Caucasus // Young Researcher Scientific-Practical Journal, Volume VIII, - Baku: "Elm", - 2022. - p. 125-133.

environmental protection requirements must be adhered to, and financial and labor resources related to settlement activities should be saved.

The third chapter is titled "**Application of Landscape Planning on the Area and Ways to Solve Eco-Economic Problems**," where the inventory of landscape use is conducted, the sensitivity and significance of landscape complexes to anthropogenic influences are assessed, and the main conflicts arising from the use of nature and socio-economic conditions in the territory are identified. Additionally, proposals for their resolution are provided[11].

By studying the landscape complexes of the research area, 10 landscape types and 34 landscape species were identified in the area.

In order to optimize the ecological-landscape and spatial conditions of the geocomplexes of the northeast slope of the Greater Caucasus, ***the sensitivity of landscapes to anthropogenic influences and the significance potential*** were evaluated and corresponding large-scale digital maps were drawn up.

In the area, predominantly plain landscapes were identified as belonging to the low sensitivity category, while mountainous landscapes fall into the medium and high sensitivity categories. 27.2% of the area was classified as high sensitivity, 18.8% as medium sensitivity, and 54% as low sensitivity landscapes. In order to prevent degradation processes in highly sensitive subalpine and alpine meadows, the observance of grazing norms and the strengthening of protection of mountain-forest ecosystems distinguished by their moderate sensitivity are considered important and significant factors.

[11] Ismayilov M.J., Guliyev M.R. Landscape-ecological conflicts caused by nature use and socio-economic conditions and their solution ways. Natural resource potential and ecological rehabilitation of degraded landscapes / Collection of materials of the International Scientific and Practical Conference (Grozny, March 17-18, 2023). – Grozny: Publishing House of the Federal State Educational Institution of Higher Education "Chechen State University named after A.A.Kadyrov", – 2023. – pp. 178-184.

The high mountainous nival and subnival landscapes within the research area, as well as the territories, which are under special protection, Shahdag National Park and Samur-Yalama National Park, are assigned to a highly significant category due to their compliance with relevant natural conditions. Alpine and sub-alpine meadows, sparse forest and forest-shrubs are included in the landscape group of medium significance, as they are partially affected by anthropogenic influences. In terms of significance, the lowest category includes residential areas and surrounding territories where anthropogenic activity is significantly felt, and modified landscapes predominate, including agricultural fields used in farming. In the research work, natural-anthropogenic conflicts have been classified and mapped (Figure 3).

Conflicts with a higher degree of intensity are mainly observed in alpine and subalpine meadows, forest-steppe, steppe and meadow-steppe landscapes of low and medium highlands, and dry steppe and xerophyte-steppe landscapes of denudation-accumulating plains. In terms of anthropogenic influences, especially during the summer months, unregulated grazing of cattle and sheep, in mountain meadows leads to the degradation of grasslands and soil cover, while also causing a decrease in the productivity of pasture areas.

The relatively low intensity of anthropogenic factors was observed in the high mountainous nival and subnival landscapes, as well as in the beech-hornbeam and oak-hornbeam forests that are under protection in medium and partially high mountainous areas.

Arid forests and forest thickets of low and medium highlands, and forest and forest-steppe landscapes of accumulative plains belong to the landscapes with moderate intensity of conflicts. Since ecosystems in this group are partly under protection, the intensity of conflicts is considered to be at a moderate level. The main sources of conflict in this category may include human settlements, agricultural activities, especially in cultivation and livestock areas, as well as tourism-recreation areas.

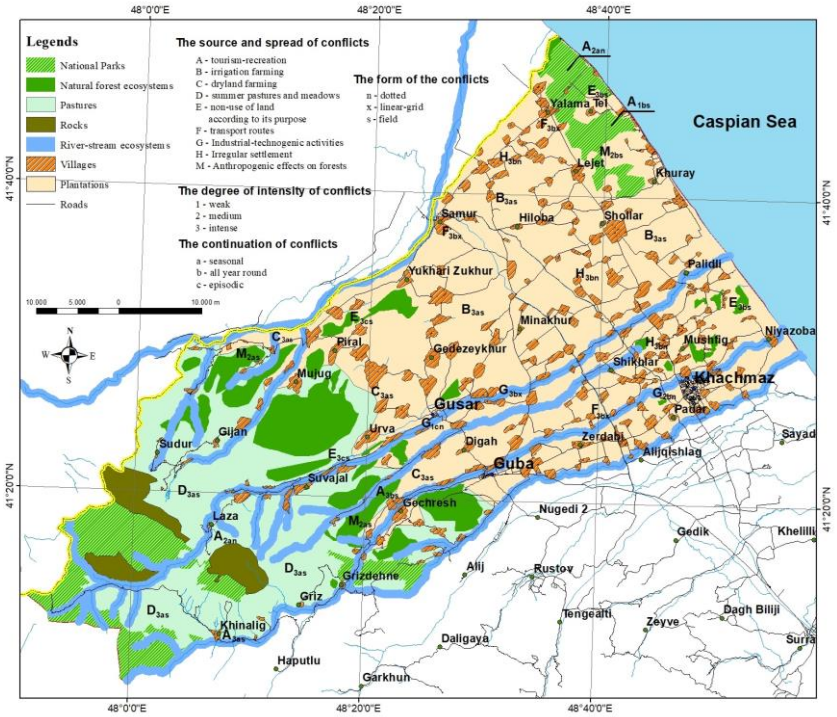

Figure 3. Natural-anthropogenic conflicts map of the geocomplexes between Samurchay-Gudyalchay

According to our calculations, 17.9% of natural-anthropogenic conflicts in the research area between Samurchay-Gudyalchay belong to low-intensity, 12.4% to medium-intensity, and 69.7% to high-intensity landscapes.

The types of landscapes where high-intensity conflicts are observed the most are dry steppe and xerophyte-steppe landscapes of denudation-accumulation plains (44.7%).

The fourth chapter is devoted to the topic **"Ways to Improve the Integrated Measures System and Ecological Balance in Landscape Planning".** In this chapter, the territorial structure goals of the research area were identified, an integrated eco-economic measures system was determined, and a modern ecological framework was formed with proposals for its improvement.

The results of the inventory and assessment stages conducted in the landscape complexes of the research area allowed us to determine the three main goals of land use, and carry out zoning in the area. The specially protected natural areas of the territory (Shahdag National Park and Samur-Yalama National Park) and their surrounding sanitary-protection zones are assigned for protection purposes. For the fulfillment of development goals, the designated zones in the research area include beech, oak, and hornbeam forests in the low and middle mountains, as well as arid forests and shrubs, and oak-beech forests and shrubs spread on the slopes of widened river valleys. The third type of purpose of planning carried out in the area is aimed at improving geocomplexes and agricultural systems. Mainly, the areas where residential areas, lands intensively used for agricultural purposes, and alpine meadows in the upper mountainous areas are spread, are classified under the category of planning improvement.

In the establishment of the ecological framework model for the research area, national parks - Shahdag National Park and Samur-Yalama National Park - were identified as the core elements. Natural forest ecosystems within the State Forest Fund lands have also been determined as elements of the ecological framework. Another important element of the ecological framework is ecological corridors. Ecological corridors play a crucial role in facilitating the migration of fauna and flora species and connecting natural components with each other. The valleys of flowing rivers in the region, such as the Samurchay, Gudyalchay, Gusarchay, and Agchay, were considered more favorable for fulfilling the corridor function in the ecological network[12].

In the dissertation work, the preparation of the ecological framework model for the Samurchay-Gudyalchay geocomplexes aimed to ensure the maximum efficiency of nature's differential management and ecological stability (Figure 4).

[12] Guliyev M.R., Ismayilov M.J. Grouping of geosystems according to the degree of ecological tension and organization of ecological management in landscape planning Geography and tourism. – 2023. – V.72. – pp. 53-60.

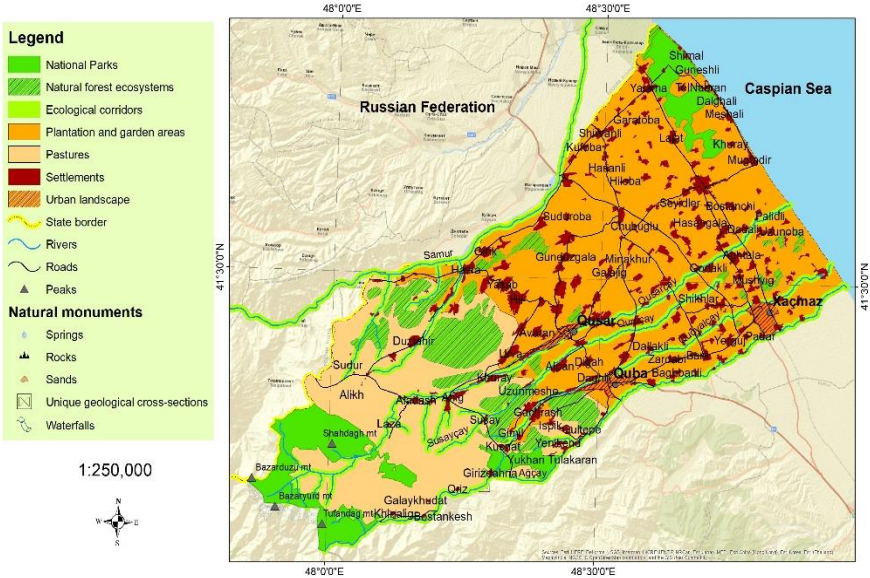

Figure 4. Ecological framework model of the geocomplexes between Samurchay-Gudyalchay

The geological values such as rocks with geological significance, unique geological cross-sections, waterfalls, springs, sandy areas, etc., in the research area were recognized as important elements of the ecological framework.

Thus, the socio-economic development of the region depends on ecological balance and the sustainable functioning of all components of nature. The concept of the ecological framework of the area is a form of environmental management for solving the problems of optimal organization of anthropogenic landscapes and rational management of natural ecosystems.

CONCLUSION

1. In the modern geosystems of the studied area, three main directions of ecological-geographical tension were identified: depletion of the natural reserve potential of geosystems due to the long-term activities of industry, the agricultural sector, and other

economic areas; new trends in the structural-functional aspects of natural complexes and components; and the occurrence of problems in social-demographic, economic, and technological approaches due to the imbalance in ecosystems [3].

2. During land reform, the plots of land allocated to citizens and intended for the production of agricultural products are characterized by their small size. The formation of an optimal agro-landscape system requires the consolidation of 52,006 share plots with an average area of 0.77 ha in the Guba district, 48,445 share plots with an average area of 0.92 ha in the Gusar district, and 35,445 share plots with an average area of 1.06 ha in the Khachmaz district [2].

3. For the first time, as the main indicators of the ecological diversity and stability of anthropogenic landscapes in the study area, indicators such as the ecological stability index of the area, the degree of anthropogenic load (index) of the area, the length of ecotones per hectare of crops, the ecological diversity index of the area were determined and large-scale digital maps containing these indicators were compiled [4, 9].

4. For the first time, based on the existing methodological recommendations, a cartographic model of the ecological framework of the researched area has been developed. Taking into account the unique characteristics of the area, the functional elements of the ecological framework, and the four main levels of land management - national, regional, local, and individual farm management, have been determined with a differential structure [11].

5. During the application of landscape planning based on ecological potential in the research area, landscapes have been categorized into low, medium, and high sensitivity and significance levels according to existing criteria. It has been determined that 54% (1640.1 km^2) of the area is classified as low sensitivity, 27.2% (825.7 km^2) as medium sensitivity, and 18.8% (570.9 km^2) as high sensitivity geocomplexes. Specially protected areas were assigned to landscapes of high significance, and geocomplexes of accumulative and accumulative-denudation plains were assigned to

landscapes of low significance. It was identified that geocomplexes of medium significance include mountain-meadow, mountain-forest, and forest-shrub landscapes [8].

6. For the first time, conflicts arising from the interactions between human and nature in the geocomplexes have been categorized based on their characteristics and manifestation forms. Natural and anthropogenic conflicts in the landscape types in the area were evaluated in terms of their origin, ecological consequences, duration, and intensity, and socio-economic consequences, and a large-scale digital conflict map was compiled. It was found that in the geocomplexes between Samurchay and Gudyalchay rivers, 17.9% of natural anthropogenic conflicts are of low intensity, 12.4% are of moderate intensity, and 69.7% are of high-intensity landscapes. The highest intensity conflicts are most observed in denudation-accumulative plains in xerophytic-steppe and arid steppe landscape types. In the area, three main directions have been determined for the spatial structure of the balanced development of natural-agricultural systems: preservation, development, and improvement. The goals have been zonally distributed across the territory, and relevant digital maps have been prepared [10].

RECOMMENDATIONS

1. The conceptual foundations of landscape planning in the area were determined: the optimal balance between the components of anthropogenic landscapes should ensure the life activity of people and the normal development of agrocenoses; complexity in utilizing the natural reserve potential of geocomplexes and the conservation of the natural environment elements composing them must be ensured; landscape internal ecological diversity should be considered in the sustainable development of landscapes; and the intensity and direction of using landscape reserves should be determined based on agroecological zoning relying on complex evaluation of eco-economic and natural-geographical indicators [5, 9].

2. Suggested is the differentiation of subsidies given to agricultural producers based on the calculation of 1 ha, and during its determination, farmers with areas close to the optimal size should be incentivized. Additionally, it is proposed to differentiate the land tax for agricultural producers not only based on soil fertility and location but also based on their sizes [7].

3. As a result of the study of the ecological-landscape and spatial conditions of the research area, the content and essence of the problems in the management of land resources in the territory of the geocomplexes of the northeastern slope of the Greater Caucasus in Azerbaijan, as well as the consequences caused by these problems, were determined. The study has provided recommendations and suggestions for addressing these issues and optimizing the ecological-landscape and spatial conditions in the geocomplex [1, 6].

Scientific works published on the subject of the dissertation:

1. Guliyev, M.R. The Current State of Soils in Azerbaijan and Ways to Improve their Efficiency." // Mountain Geosystems in Azerbaijan: Problems and Perspectives, Proceedings of the Azerbaijan Geographical Society, Volume XIX. Baku: – 2017. – pp. 219-225 (in Aze.).

2. Guliyev, M.R. "Assessment of Land Use and Ecological Sustainability in the Northeastern Slope Geocomplexes of the Greater Caucasus (Case Study of the Samurchay-Gudyalchay Interfluve)" // Geography and Natural Resources. Baku: – 2022. – No. 1(16), – pp. 82-87 (in Aze.).

3. Guliyev, M.R. Soil Reserves and Human Resources of the Territory of the North-Eastern Slope of the Greater Caucasus // Young Researcher Scientific-Practical Journal, Volume VIII. Baku: – 2022. – p. 125-133 (in Aze.).

4. Guliyev, M.R. The Impact of Composition and Ratios of farming places on the Ecological State of the Environment (on the example of Geocomplexes between Gudyalchay and Samurchay in

the Northeastern Slope of the Greater Caucasus) // Nakhchivan State University. "Scientific Works". Series of Natural and Medical Sciences. Nakhchivan: – 2022. – No. 7(120), – pp. 123-130 (in Aze.).

5. Guliyev, M.R. Formation and Development Stages of Land Planning in Azerbaijan: Historical Overview, Analyses, and Recommendations" // Materials of the Republic Conference on "The Role of Heydar Aliyev in the Development of Science and Education in Azerbaijan". Baku: May 10, 2023, – 2023. – pp. 161-167 (in Aze.).

6. Guliyev, M.R. Characteristics of Distribution of Soil Resources and their Use in Conditions of elevation zones (on the example of Geocomplexes between Gudyalchay and Samurchay in the Northeastern Slope of the Greater Caucasus) // Proceedings of the International Scientific Conference "Contemporary Issues in Geography: Integration of Science and Education,", Vol. 1. Baku: November 29-30, 2022, – 2022, – pp. 261-268 (in Aze.).

7. Guliyev, M.R. Haydar Aliyev Land Policy in Azerbaijan: Results, New Challenges // Materials of the Republic Conference on the Topic "National Leader Haydar Aliyev and Ganja." Ganja: May 4-5, 2023. – 2023. – pp. 157-171 (in Aze.).

8. Guliyev, M.R. Analysis of Differentiation of Landscapes of the North-Eastern Slope of the Greater Caucasus and Assessment of Their Sensitivity to Anthropogenic Influences (on the Example of the Samur-Gudyalchay Interfluve) // Zemlya Belarusi. Minsk: – 2022. – No. 4, – pp. 51-58 (in Rus.).

9. Guliyev, M.R. "Ecological-Landscape Condition and Prospects of Rational Land Use (On the example of the territory of geocomplexes of the northeastern slope of the Greater Caucasus in the Republic of Azerbaijan)" // Land Management, Cadastre, and Land Monitoring. Moscow: – 2022. – Vol.17, – No.10 (213), – p. 662-670 (in Rus.).

10. Guliyev, M.R. Landscape-ecological conflicts caused by nature use and socio-economic conditions and their solution ways. Natural resource potential and ecological rehabilitation of degraded landscapes / Collection of materials of the International Scientific

and Practical Conference. – Grozny: March 17-18, 2023, Publishing House of the Federal State Educational Institution of Higher Education "Chechen State University named after A.A. Kadyrov", – 2023. – pp. 178-183 (Co-author: Ismayilov, M.J.).

11. Guliyev, M.R. Grouping of geosystems according to the degree of ecological tension and organization of ecological management in landscape planning // Geography and tourism. – 2023. – V.72. – pp. 53-60 (Co-author: Ismayilov, M.J.).

The defense of the dissertation work will be held on the 21 February 2025, at 14 PM at the meeting of the Disposable Dissertation Council BFD 3.15 of Supreme Attestation Commission under the President of the Republic of Azerbaijan operating at the Institute of Geography of the Ministry of Science and Education.

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The dissertation is accessible at the library of the Institute of Geography named after acad. H.A. Aliyev, the Ministry of Science and Education of the Republic of Azerbaijan.

The electronic version of the abstract is available on the official website of the Institute of Geography named after academician H. Aliyev, the Ministry of Science and Education of the Republic of Azerbaijan (www.igaz.az.).

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