REPUBLIC OF AZERBAIJAN

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ABSTRACT

of the dissertation for the Degree of Doctor of Science

DEVELOPMENT, STRUCTURAL-FUNCTIONAL CHARACTERISTICS AND MANAGEMENT OF INTERMOUNTAIN PLAIN GEOSYSTEMS

Speciality:	5408.01 – Physical geography and biogeography, soil geography, geophysics, and geochemistry of landscapes
Field of science:	Geography
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Baku – 2025

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İmzanı təsdiq edirəm
"01" 05 (S.A.A.) 2025

GENERAL CHARACTERISTICS OF THE WORK

Relevance of the topic and degree of development. Changes in ecosystems against the background of intensifying anthropogenic effects in recent years have led to the disruption of landscape-ecological conditions, biological diversity, and the existing balance in the natural environment. In order to eliminate this type of negative situations and properly regulate the activities of the landscape aimed at meeting the needs of society and nature for various elements, the need for a correct assessment of the structural genetic and functional characteristics of landscapes, the natural resource and ecological potential, the possibilities of the ecosystem to serve people, and the risks and threats that will affect the life activities of the population has increased. Currently, the infrastructure, social and economic projects implemented by the decrees and orders of the President of the Republic of Azerbaijan increase the relevance of the mentioned studies. In September 2015, the UN member states adopted a roadmap for sustainable development until 2030. The main core of the 17 tasks set here are the improvement of the environment, the transition to a green economy, and the problems of protecting the natural resources of our planet. In this respect, the Kura valley, which plays an important role in the economic development of Azerbaijan, is no exception.

Being one of the largest morphostructures of the Kura valley depression, it is an area where natural-anthropogenic landscapes with various structural-genetic and functional characteristics are developed. Due to its favorable climate, relief, biological diversity and rich mineral resources, the Kura basin, which has been subjected to intensive anthropogenic influences, is particularly distinguished in the direction of the development of agriculture, animal husbandry and industry in the Republic.

The depression of the Kura-Araz plateau has been thoroughly and deeply studied by research scientists of various scientific fields. At the beginning of the 20th century, scientists conducting research here noted that the area has a simple geological-geomorphological structure. The research conducted in the following years showed that

there are areas in the terrain that differ in the degree of morphogenesis. The geological geomorphological structure, paleogeography of the research area were studied by N.V. Dumitrashko (1961), K.M. Soltanov, B.A.Budagov (1958), B.A.Budagov (1973), F.Sh. Ahmadbeyli (1966), Milanovski (1966), M.A. Museyibov, A.V.Mammadov (1967), A.V.Mammadov, M.A.Museyibov, N.Sh.Shirinov (1966), N.Sh.Shirinov (1975), X.K.Tanriverdiyev (2002), H.A.Khalilov, X.K.Tanriverdiyev (2011) and others, the differentiating features of the landscape were studied by M.A.Museyibov, M.A. Suleymanov (1975), H.K. Hasanov (1979), O.A. Karimov (1975), Y.A.Garibov (1982, 2013), M.C. Ismayilov (2002, 2008), E.K.Alizade, M.C.Ismayilov, S.Y.Guliyeva (2015) and others.

However, there is a need for a complex study of territorial landscapes with the help of new approaches and methods in accordance with the requirements of the modern era.

In the last 60 years, the rapid development of productive forces in the republic, the expansion of agriculture and industrial-man-made areas, has sharply increased the anthropogenic loading of natural landscapes, the balance between natural components has been disturbed, and landscapes have been subjected to various levels of degradation. The expansion of such situations hinders the sustainable development of natural landscapes and has a negative impact on the utilization of their natural resource potential in accordance with ecological norms. In order to eliminate the mentioned negative effects, first of all, the structural-genetic and functional characteristics of the natural landscapes of the area, the development trends of anthropogenic transformations were studied, and on the basis of this, the natural resources and ecological potential of the landscapes, the degree of ecological loading were evaluated, an optimization model was drawn up and the main elements of the ecological framework were determined and mapped.

The mentioned structural units were analyzed separately, and their role in the formation of modern landscapes of the valley depression was determined.

One of the important directions of the research work is the

assessment of the natural resource potential of the area. In the last 50-60 years, as a result of the intensive use of the natural complexes of the valley depression, arid forests and bushes, tugay forest ecosystems along Kura river, various grassy dry steppes have been degraded in large areas, desertification centers have expanded and field erosion has intensified, and as a result, the potential of geosystems has been sharply impaired.

Research object and subject. The main structural unit of the geological structure of the territory of Azerbaijan are the landscapes of the Kura valley depression with various structural and functional characteristics. Natural-anthropogenic dynamics, transformation, balanced development of the semi-desert, steppe, arid forest and hydromorphic landscapes of the Kura valley depression and preservation of their natural gene pool.

Research goals and objectives. Based on the study of structural-genetic and functional features of landscape formation in the studied area and their relationship with morphostructures, it is the study of rules of anthropogenic transformation and dynamics of landscapes and effective management of their use. To achieve this goal, the following tasks have been defined.

1. The modern state of landscape research in intermountain depressions and the relationship between their formation and lithomorphogenesis;

2. Studying the differentiation, classification and structural functional characteristics of landscapes in intermountain depressions;

3. The modern state of the use of landscapes, their natural-anthropogenic dynamics regularities, directions of transformation and classification of landscapes according to anthropogenic transformation;

4. Methodological bases of determining the natural resource and ecological potential of landscapes and grouping of landscapes in this direction;

5. Geoecological problems of territorial landscapes, effective management of natural resources, geoecological zoning, development of principles of landscape-ecological risks and

framework organization.

Research methods. Comparison, observation, systematic approach, modeling, algorithm analysis, mathematical-statistical, historical-geographical, paleogeographical, etc. methods were used. For this purpose, between 1995 and 2019, field research was carried out in the Ajinohur lowland and in the Ganikh-Ayrichay valley and in the Kura-Araz plain, in the Jeyranchol lowland. During field expeditions, observations related to the genetic types of the relief and the genetic connection between different levels of morphostructures and landscapes, the intensity of physical geographical processes that can express the structural and functional characteristics of ecosystems in the separated sample sites, the accumulation of biomass, the impact of human activity on the ecodynamic state of landscapes, and others were made and for the first time, large-scale (1:100,000) landscape mapping was carried out. The dimensions of the sample plots were defined as 25×25 m in forest landscapes, 15×15 m in steppe landscapes, and 10×10 m in semi-deserts. In addition, from the fund materials of the Institute of Geography named after academician H.A.Aliyev, large-scale (1:25000, 1:100 000) topographic and numerous thematic (landscape, geomorphological, soil, vegetation, hydrogeological conditions, climate, etc.) maps used as a source. In addition, Shuttle Radar Topographic Mission (SRTM) topographic radar survey data, GCS-WGS-1984 and WGS-84 projection for mapping using ArcGis 10.2 (ESRI, INC), 10.3, Landscape 7 and 8 ETM+, SPOT 1- 4, Orb View-3, satellite images of Azercosmos, drone shots with the author's participation were important sources in the performance of the work.

The main provisions defended:

1. Structural-genetic and lithomorphometric features of landscape formation
2. Differentiation and structural-functional characteristics of modern natural landscapes of the intermountain depression
3. Theoretical problems of landscape dynamics and transformation, anthropogenic transformation of surface flow, hydrogeological conditions

4. Transformation of landscapes and problems of its classification

5. Assessment and grouping of natural resource potential of landscapes

6. Geoecological problems of Kura depression landscapes and zoning in the area

7. Principles of landscape-ecological framework organization and application of ecological management

Scientific novelty of the research.

- for the first time, the relationships between the main morphostructures of the studied area and the formation of natural landscapes were systematically analyzed on the basis of lithomorphogenesis and morphometrics, and accordingly, natural landscapes were divided into two groups, morphogenetic and submorphogenetic, according to their structural and genetic characteristics:

- structural units of the relief - sloping plains at the foot of the mountains, bringing cones, buried uplifts, contact depressions, lake depressions, mud volcanoes, river valleys, coastal ridges, etc. were analyzed separately, and their role in the formation of modern landscapes of the valley depression was determined.

- the unique regularities and structure-functionality of the formation and differentiation of natural landscapes of inter-alpine depressions were analyzed and a large-scale (1:100,000) landscape map was drawn up.

- for the first time, the anthropogenic transformation of landscapes in the Kura valley basin was studied based on the algorithm, and a large-scale map of the same name was drawn up, and the transformation index for anthropogenic complexes was calculated.

- for the first time, environmental risks were determined based on large- and medium-scale maps, taking into account the factors that cause natural and anthropogenic hazards in Azerbaijan - landslides, floods, floods, earthquakes, Caspian level fluctuations, man-made and demographic loading and others.

- for the first time, the map of landscapes that can be formed

under the conditions of natural-climatic humidification was compared with the landscape maps prepared by the aerospace and field research method, and the transformation index of landscapes was calculated.

Theoretical and practical significance of research. Dissertation work is important in further enrichment of the theoretical basis of the study of structural genetic and functional characteristics of landscapes, classification and transformation problems of modern natural and anthropogenic landscapes, which are the main directions of landscape science, and in the application of new geographical methods. The conducted studies can be widely used in the implementation of the programs adopted by the Azerbaijani government regarding the socio-economic development of the regions in the valley depressions with unique natural conditions.

It is interesting to use the prepared ecological risk map in the organization of infrastructure projects, construction works, tourism-recreational systems, in the reduction and management of natural-anthropogenic hazards during landscape planning at various levels.

From the studies related to the study of the structural-genetic and functional characteristics of the landscapes in the Kura valley depression, from the systematic approaches related to the evaluation of the natural resources and ecological potential of the landscapes, and from the cartographic materials, the natural complexes with a very sensitive structure can play the role of a favorable source in increasing the efficient use of land in agriculture and in creating ecologically sustainable agroecosystems.

Algorithmic research on the transformation of landscapes, cartographic materials, as well as research on the transformation of hydrogeological conditions and surface flow will allow for the preparation of long-term and short-term forecasts in the organization of territorial planning, the correct assessment of trends in the development dynamics of anthropogenic landscapes, and the fight against processes such as salinization, swamping and desertification.

We think that the ecological frame map and the structure-management model of the ecological frame will play an important

role in strengthening nature protection measures and creating stable natural-anthropogenic systems, organizing ecosystem services, implementing important measures in biodiversity protection and improving ecological management in Azerbaijan.

Approval and application. The main provisions of the dissertation were presented at the "VII Congress of the Azerbaijan Geographical Society" (Baku, 1998), At the international scientific conference "Disturbance and restoration of natural ecosystems" (Donetsk, 2005), "Anthropogenic dynamics of the natural environment" International scientific-practical conference (Perm, 2006), "Desertification in Azerbaijan" dedicated to B.A. Budagov's 75th anniversary (Baku, 2003), in scientific conferences dedicated to the 80th anniversary of B.A.Budagov on "Extreme natural-destructive events and the ecogeographical problems caused by them" (Baku, 2008), "Modern problems of geography" (Baku, 2008), dedicated to the 85th anniversary of the national leader H.A. Aliyev, at the "Caspian Sea and the Ecosystems of the Surrounding Regions: Risks and Threats" conference dedicated to R.M. Mammadov's 60th anniversary (Baku, 2010), "Globalization and Geography" at the International scientific-practical conference dedicated to the 85th anniversary of M.A. Museibov (Baku, 2012), in republican and international conferences dedicated to the 90th anniversary of the national leader H.A. Aliyev on the topics "Evaluation and efficient use of the natural reserve potential of geosystems in the conditions of global changes" (Baku, 2013), at the II Turkey-Azerbaijan Geography Days (Izmir, 2016), at the "Geographical Problems of Azerbaijan Regions" Republican Scientific Conference (Baku, 2016), "Natural disasters and safety of life activity" International scientific and technical conference (Baku, 2017), At the conference "Mountain geosystems of Azerbaijan: problems and perspectives" dedicated to the 60th anniversary of E.K. Alizadeh (Baku, 2017), at the conference "Land management in the market economy: achievements and modern challenges" dedicated to the 95th anniversary of the national leader of the Azerbaijani people H. Aliyev (Baku, 2018), at the Eurasian GIS international conference (Baku, 2018), In the 5th International

Symposium on Turkic World Studies (Almaty, 2018), "Public geography in Azerbaijan and Russia: development priority in the 20th century" at the international scientific conference (Baku, 2018), at the international conference "The Form of the Caucasus Mountains" (Ankara, 2019),at the "Conference of Modern Problems of Geography" dedicated to the 70th anniversary of the city of Sumgayit (Sumgayit, 2019) and at the seminars of the Institute of Geography.

The name of the institution where the dissertation work was performed. The dissertation work was carried out in the "Landscape studies and landscape planning" department 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, structure and main content of the dissertation. The dissertation consists of an introduction, 6 chapters, a conclusion and a list of references, the total volume of which is 284 pages. The work consists of 32 figures, 16 tables and 279 bibliography. Introduction – 7 pages, Chapter I – 19 pages, Chapter II – 59 pages, Chapter III – 43 pages, Chapter IV – 54, Chapter V – 29 pages, Chapter VI – 38 pages, conclusion 3 pages, bibliography – 29 pages. The volume of the dissertation is 426742 characters.

THE MAIN CONTENT OF THE RESEARCH

In the introduction, the relevance of the topic is justified, the goals and objectives of the research are defined, its provisions and scientific novelty, and its practical significance are given.

The first chapter of the research work is called "**Scientific-theoretical, methodological bases and tasks of landscape studies in the valley depressions**". Interest and scientific approaches to the research conducted here have been different due to the unique features of the formation of intermountain depressions. Due to these aspects, the valley depressions have been chosen as the area of high population and localization of economic development since ancient times.

Intermountain depressions in various aspects - geological, geomorphological, landscape, geobotanical, ecogeographic, etc. has been studied. N.V.Fadeeva and G.S.Samoylova (1965) described the similarities and differences of the steppe landscapes formed in the intermountain depressions in the Altai and Baikal areas, T.V. Korolyuk (1971) again described the process of soil salinization in the dry desert landscapes of the intermountain depressions around Baikal under the conditions of the harsh continental climate of the highlands of southern Siberia, as an example of the Tvolchinsky depression, D.S. Oruceva (1988) studied the tectonic structure of intermountain depressions, the relationship between the main stages of development and the localization of oil and gas deposits, and O.I. Bonnikova (2001) studied the natural reserve potential and ecological status of intermountain depressions in the Altai Mountains. N.F.Ivanov, V.E.Vikulov and E.T.Dambiyev (2004) studied the reasons for the development of the desertification process in the valley depressions of the middle Selengin highlands of the Baikal area and separated two sources that caused the said process, natural and anthropogenic.

Within the territory of Azerbaijan, numerous scientific-research works have been devoted to the study of the geological structure, geomorphology, landscapes, hydrogeological conditions, and climate characteristics of the Kura valley depression. The reason for this is that the studied area has been inhabited by people since ancient times, and this process is still relevant.

Although sufficient attention was paid to the study of the landscapes of individual parts of the Kura valley depression, the overall landscape of the area was not studied in a systematic way. The structural-genetic characteristics, functionality, and comparative analysis of landscapes with different levels of orotectonic and geomorphological units that make up the Kura depression have not been conducted.

Due to its geological structure, the Kurdagarasi sedimentation consists mainly of accumulative plains and partly of young anticlinal ridges and ridges located in the area of tectonic subsidence.

The dominant semi-desert and arid-desert landscapes of the

Kura valley depression differ from other semi-desert and arid desert landscapes of the subtropical belt due to their unique tectolithomorphology and geomorphological structure, hydrological conditions, natural drainage and structural-denudation characteristics of the surrounding mountains and foothills. The main factor influencing the formation of general structural and functional characteristics of the landscapes here is the position of the Kura valley depression in the general morphostructural structure of the Caucasian mountain system, and its being surrounded by high mountains on three sides, and opening to the Caspian Sea in a wide area from the east. This feature played an important role in the formation of landscapes with a unique structural-genetic structure of the Kura valley depression. As a result, the barrier effect of both zonal and orographic structures played an important role in the formation of complex landscape systems of interalpine depressions.

In the section "**The role of lithomorphometric features of the territory in the formation of landscapes**" of the second chapter, which is called the structural-genetic and functional features of the formation of landscapes, the main attention in the formation of the structural-genetic and functional features of geosystems in landscape science schools was given by most researchers to the relief and lithological basis[1]. The mentioned component of the landscape is quite resistant to external influences such as climate and is the main provider of its sustainable development.

The morphometric elements of the relief are the direction and inclination of the slope, the vertical and horizontal division of the relief, the absolute height, and the formation of quantitatively and qualitatively different landscapes, the main factor in the formation of intra-landscape differentiation.

In the Kura-Araz plain, where groundwater is located close to the surface, the very small relative height differences of the relief form introzonal complexes of salt marsh and shoraket, swamp-meadow, thicket-meadow with different parameters within the

[1] A.V. Khoroshev. Multiscale organization of the geographical landscape. Moscow, Partnership of Scientific Publications KMK. 2016. 416 p.

dominant semi-desert landscape.

From the analysis of the compiled map and table, it was found that 13348.7 km^2 or 34.2% of the studied area is below the ocean level. The dominant landscape in the first hypsometric level is semi-deserts of dry subtropical accumulative plains. These semi-deserts make up 22.4% of the total area of the Kura basin. It is the area where intrazonal or hydromorphic landscapes of thicket-meadow, swamp-meadow, tugai-forest and salt marshes are most widespread. The reason for this is that the relatively depressed areas occupy a large area against the background of smooth plains. Here, 4.6% of the total area is covered byswamp-lake, meadow,tugay forest, etc., and 7.2% is salt marshes and swamps. The second hypsometric level covers an area of 9065.2 km^2 at 0-100 m altitude, which is equal to 19.2% of the total area. The main dominant landscapes at this level are semi-desert (16.2%) and dry-steppe (3.3%) natural complexes. Between the heights of 100 m and 400 m, the structure of the landscape acquires new qualities due to the complexity of the relief and the change of climatic conditions. Plains and mountain semi-deserts, dry and xerophytic shrub steppes are dominant, intrazonal badland complexes and outcrops where salinized resistant rocks are found. At altitudes higher than 400 m, the main dominant landscapes in the studied area are xerophytic shrub steppes, typical (humid) steppes, arid forest and shrubs, semi-arid forest complexes become dominant landscapes.

In the Kura-Araz plain, the following morphostructures are distinguished according to the mode of modern and new tectonic movement, tectonic structure, nature and distribution of exogenous processes: 1. Accumulative alluvial-lake-chala plains along Kura river, 2. Shirvan accumulative alluvial-proluvial plain, 3. Mughan accumulative alluvial plain, 4. Shirvan denudasion-accumulative alluvial-marine plain (Southeastern Shirvan) and 5. Salyan accumulative alluvial-marine plain.

1. Accumulative alluvial-lake-chala plain along Kura river covers a very large area of descent of the Kur-Araz lowland, and currently the process of sediment accumulation is underway in the areas, and it differs sharply from other morphostructures of the Kur-

Araz lowland due to its ecological characteristics. Meander loops and the flowless lakes formed from their development have an important role in the formation and differentiation of the landscape-ecological conditions of the accumulative plain along Kura river. According to the tectonic faults, the Kura River at the mouth of the Gargar River is directed to the northeast, leaving many empty and dry valleys on the left bank of the river (N.Shirinov, 1973). Then, due to the influence of the Zardab's buried rise, it moves to the southeast, and at this time, marshy-lake and marshy-meadow landscapes are formed on the right bank of the river (Fig. 1).

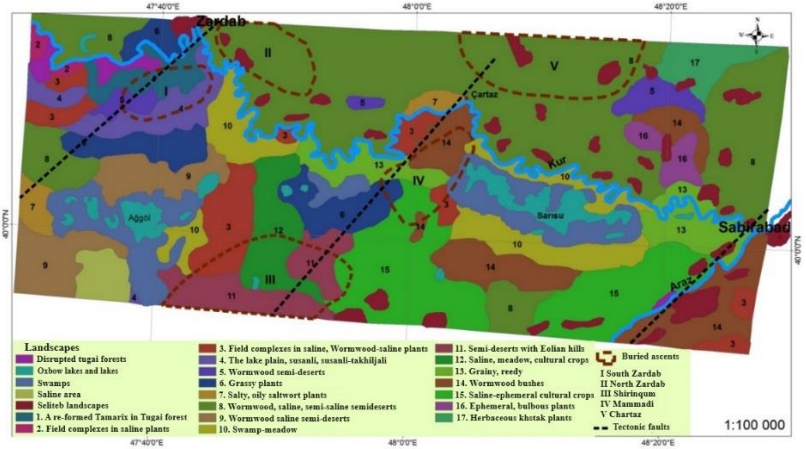

Figure 1. The influence of buried uplifts on the formation of ecogeographical district landscapes along Kura river

2. The Shirvan alluvial-proluval plain was genetically formed due to the alluvial and proluvial sediments of the Shirvan rivers. Turyanchay, Goychay, Girdimanchay, Agsuchay and other rivers, when they exit from the frontal highlands to the Shirvan plain, have created flow cones, which differ in the relief and landscape differentiation of the plain.

3. The Southeastern Shirvan alluvial-marine plain corresponds tectonically to the Gargali syncline surrounded by the Mishovdag-Kalmas-Bandovan and Gurovdag-Babazanen-Neftchala anticline area. The terrain is complicated by a series of anticlinal ridges and

elevations. In the northwestern part of Southeast Shirvan, between the cones of the Big Mishovdag and Kalmac mud volcanoes, the Mishovdag ridge is located. The Kurovdag has an asymmetric structure, extending in the submeridional direction to the west of the Southeastern Shirvan plain.

4. The Salyan accumulative alluvial marine plain is one of the youngest areas of the Kura-Araz plain and consists of a number of deltas. The surface of the plain is composed of sandy-clay sediments of the Upper Caspian age. The general background of the Salyan plain is disturbed by the dams along the bed of the Akusha River and a number of deltas.

5. Mughan accumulative alluvial plain is located between Araz and Kura rivers. Bed elevations along the Akusha River in the Salyan plain prevent surface runoff from the Mughan plain, resulting in swampy and saline depressions and the Agchala and Mahmudchala lakes in the center of the plain. The southwestern part of the Mughan Plain is older than the northeastern part. This part was formed as a result of the accumulative activity of the Araz River. Genetically, this part is also alluvial-delta (Fig. 2).

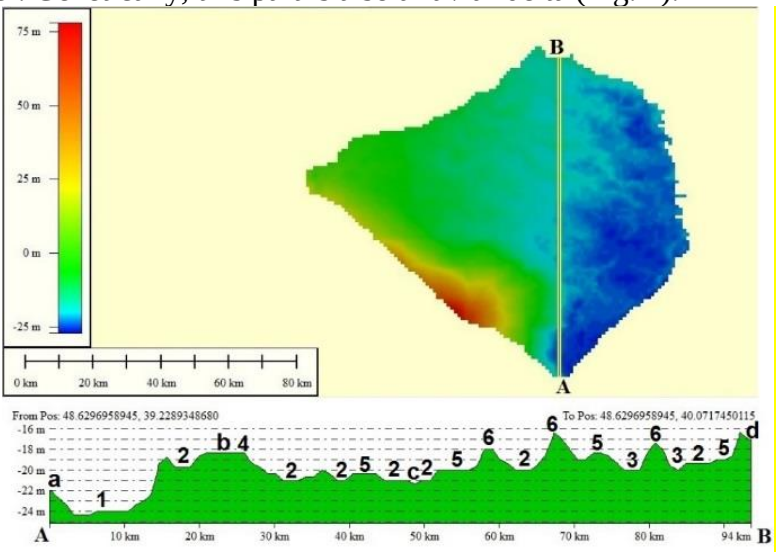

Figure 2. Digital landscape profile along lines A and B in the Mughan plain

a. Bilasuvar buried rise; b. Barakand's buried rise;

***Main landscape zones*:** 1. Mahmudchala and Agchala shallow-meadow zone of swamp-lake plain; 2. Re-salted areas of relative depressions; 3. Hydromorphic shallow-salinity zones of relative depressions; 4. Ephemeral-wormy sub-deserts of the surface of the buried uplift; 5. Wormwood semi-deserts of unfragmented smooth relatively undulating plain; 6. Weakly saline and saline ephemeral-wormwood sub-deserts of local uprising.

Surface flattening cones are widespread in the Ganja-Gazakh, Karabakh and plains along Araz river of the Kura intermountain depression. These include the flow cones of Agstafachay, Hasansu, Tovuzchay, Zayamchay, Shamkirchay and other rivers. Although they are not clearly visible in the relief, they have an important role in determining the morphological structure of landscapes.

The largest conveyance cone in the Kura basin is the ancient conveyance cone of the Araz River. The western and northwestern part of the Mil plain and the Mughan plain actually consists of the catchment cone of this river. Poorly fragmented semi-desert landscapes are characteristic of the ancient bringing cone of Araz. There are currently large stone quarries on the surface of the bringing cone[2]. The depth of the pits created by them sometimes reaches 40-50 m.

A number of ridges existing in the Kura valley depression, including Quyrugenchi and Dashuz-Amirvan, Bozdag, Akhar-Bakhar, Khojashen Langebiz ridges, have small drainage basins with a width of 2-8 km and depressions between them. These drainage basins have developed freely in the mouth of dry river valleys, gorges, and depressions opening into plains. This border of the plains from 60 to 200 m, and in the Lengibiz ridge area, it is situated between 10-200 m absolute height, exposed to the intensive influence of slope processes.

The impact of relative subsidence contact depressions on the structural-genetic characteristics of landscapes has been

[2] M.J. Ismailov. Identification of structural and functional features of modern landscapes of contact zones for the purpose of territorial planning. Moscow, Moscow State University Publishing House. 2011. pp. 138-142.

systematically studied for the first time. The contact depressions of the Kura valley depression caused the emergence of groundwater in the relatively depressed areas of the surface of the swamp, swamp-meadow hydromorphic landscapes, and in some areas, salt flats.

The relative subsidence areas of the Karasu basin are associated with the emergence of swamps, swamp-cement hydromorphic landscapes, and in some areas, the formation of shorans and salt flats, primarily due to the emergence of groundwater to the surface in the subsidence areas.

The Karasu depression in the Shirvan plain is located between the drainage basins of the rivers and the relatively high plain along of the Kura riverbed. The Karasu depression includes riverbeds of the Kura and partly other negative relief forms, mainly formed from alluvial and alluvial-lake sediments.

According to N. Sh. Shirinov (1975), this depression, which runs parallel to the Kura River from the north, was the bed of the ancient Kura River after the transgression of the Upper Khvalin. The relative depth of the Qarasu depression is 1.2-6.5 m. At a distance of about 100 km from west to east, the depression is 12-13 m in the direction of the general inclination. In the east, the Karasu depression decreases its area due to the influence of the Shor-Shor and Arshaly buried uplifts. The formation of the Karasu depression led to the development of intrazonal hydromorphic swamp landscapes.

Mahmudchala, Agchala, Aggol, and Karasu depressions are essential ecosystems for preserving the biodiversity of the Kura-Araks lowland, possessing rich vegetation. Here, moisture-loving sedges and swamp plants have developed. Swamp plants have developed in the deeper parts of the depressions, in the area of Shirvan National Park, which is the southeast extension of the Karasu depression, in the streams, in the depression in the western part of the Karabujag railway station, in Mahmudchala and in the year-round moist parts of the Aghgol depression in Agchala. Due to the effect of warming caused by global climate changes observed since the second half of the 20th century, serious aridification tendencies are observed in the structure of a number of hydromorphic landscapes. The water of the Goychay and other rivers flowing from the southern slopes of the Greater Caucasus

played a crucial role in the formation of the structural and genetic features of the hydromorphic landscapes of the Karasu depression in the Shirvan plain. Excess waters collected here were important in nourishing the lake of the same name in the Hajigabul region by flowing eastward. Due to meliorative measures implemented in the 1970s (1964-1965) and the construction of the Bash Shirvan collector, the swamp landscapes of the Karasu depression were completely dried up and as a result of the melioration measures implemented, the landscape-ecological conditions in a large area (400 km2) were fundamentally transformed.

As a result, the strongly saline semi-desert landscapes of the Hacielchi depression are formed. Genetically, the landscapes of the Hacielchi depression are anomalous geochemical landscapes.

Structural-functional characteristics of aqua-hydromorphic landscapes of oxbow lake depressions.

The accumulative plains covering both banks along the Kura River are of alluvial-lake-oxbow origin. Oxbow-lake depressions have become an important factor in the formation of landscapes in a wide area from Mingachevir to Neftchala region on both banks of the Kur.

The landscape study of the pits in the alluvial plain of the Kura coast shows that the relief and the ground water located near the surface are the leading factors in the formation of the landscape here. Due to the influence of the mentioned factors, the alluvial meadow, marsh-meadow and swampy land in the alluvial plains of the Kura coast have developed a marshy-meadow and swampy landscape. Marshy-meadow landscapes are also found in the place of the ancient bed of the Araz river, located between the northwest coast of Ghizilaghaj Bay and Agchala.

The structural-functional characteristics of river valleys have not been extensively studied through specific scientific research in Azerbaijan, but the formation and geomorphology of river valleys have been a focal point for researchers. B.A. Budaqov (1985, 1988), N.S. Shirinov (2011), and H.A. Khalilov (2018) have conducted comprehensive research on the morphogenesis and development of river valleys in Azerbaijan.

Systematic study of the physical-geographical processes occurring in river valleys from geological, geomorphological, and landscape perspectives allows for proper tracking of landscape genesis, paleogeographic conditions, and obtaining prognostic results[3]. The processes occurring in river valleys serve as essential indicators of the development dynamics of surrounding landscape areas.

In recent times, the activity of sand-gravel quarries in the majority of riverbeds flowing through the Kura valley has led to anthropogenic bottom erosion and degradation of riverside landscapes due to the natural geomorphological imbalance in the riverbeds.

Researchers such as B.A. Budaqov (1969), A.A. Mikayilov, R.H. Dashdiyev (1984), and M.J. Ismayilov (2019) have determined the impact of uplifted massifs on landscape differentiation and structural-functional characteristics in the Ganikh-Ayrichay valley, Kura-Araks plain, Samur-Davachi plain, and Ganja-Gazakh plains through landscape geomorphological research. 7 of the buried uplifts were recorded in the Mil plain, 14 in the Karabakh plain, 8 in the Mugan plain, 3 in the Salyan plain, 9 in the Southeast Shirvan plain, 6 in the Ganikh-Ayrichay valley, and 13 in the Shirvan plain. Our landscape studies in the Kura valley depression have shown that the buried uplifts are a direct manifestation of modern tectonic movements and play an important role in the formation of the structural-genetic features of the landscape and its internal differentiation.

M.J. Ismayilov (1990) has emphasized the role of uplifted massifs in the development of the structure-dynamic aspects of the forest-steppe landscape in the Shollar plain and studied their impact on the vegetation cover.

Although the Ganikh-Ayrichay valley has a synclinal inclination in terms of tectonics, the inclination of individual tectonic local blocks towards uplifted massifs has led to the formation of several uplifted massifs. B.A. Budaqov (1969), V. Nabiyev (1978), A.A. Mikayilov, R.H. Dashdiyev, and M.J. Ismayilov have mentioned uplifted massifs such as Kerimli-Sinjan, Gudurlu, Gaba-Zeyzit, Sheki, Barabakh, and

[3] G.A. Khalilov. Geomorphological essays. Selected works. Baku. Publishing house "Avropa", 2018. 452 p.

others based on geological-geophysical and landscape-geomorphological research. The interaction between river valleys and uplifted massifs has created complex landscape-ecological conditions on the background of the sloping plain. This has ultimately created conditions for the emergence of landscape types with various structures and functions in the dominant plain-steppe landscape.

The impact of mud volcanoes strengthens the internal differentiation of landscapes, leading to the formation of new lithological layers, relief forms, and biogeochemical conditions. In the studied area, mud volcanoes are predominantly concentrated in the Kur-Araz plain, particularly in the Kura River valley within the Kur-Araz region. The Langebiz range and the plains close to it, and the mud volcanoes in the South-Eastern Shirvan and Salyan plains belong to this province. Major mud volcanoes such as Kalmas, Mushovdag, Girovdag, Durovdag, Hamamdag, Aghzibir, Kursengi are located within this region. Here, their total number exceeding 34.

As a result of the geochemical analysis of samples taken from a number of mud volcanoes and various components of the surrounding landscape (soil, vegetation), it was determined that due to the migration of highly mineralized and toxic chemical compounds in the breccia and salsa flows to the surrounding areas, elements with new qualities were formed in the structure of the landscape. This migration has led to the formation of new elements with unique qualities in the landscape structure, mainly manifesting in ravines, mudflow lakes, oil-contaminated areas, sparse vegetation covers, etc.

The spectral analysis of breccia materials of some mud volcanoes (Kanizdagh, Pilpila-Garadagh, Davaboynu, Malikchobanli, Dashgil, Bahar, Ayrantoken, etc.) has shown that their composition contains significantly higher levels of microelements such as As, Mo, Cd, and V compared to the average crust of the lithosphere. This poses a threat to the ecology of the surrounding plant and animal world.

Recent tectonic movements and the resulting mud volcanoes have played a crucial role in the mutual interaction of exogenous processes, contributing significantly to the formation of contemporary relief. These relief-forming processes have occurred in a continuous and mutual relationship over time and space.

The formation of landscapes in the Kura Depression is influenced by the Dzirul (Suram) mountains, which extend up to 1500 m. These mountains play a barrier role against western air circulation, increasing aridity. As a result, semi-arid and dry steppe landscapes have developed in the Kura Depression.

B.A. Budaqov and A.A. Mikayilov (1985) note that if the altitude of the Great and Lesser Caucasus mountains surrounding the Kura Depression were 1000-1200 m, the dry subtropical climate would prevail, and dry steppe and semi-arid landscapes would develop.

In fact, under the mentioned altitude conditions, the amount of moisture would increase in the Kura basin as a result of the winds coming from the north, and typical steppe and forest-steppe landscapes would be formed. This opinion is confirmed by paleogeographic data (A.V.Mammadov, 2001). The current landscapes of the Kura depression have formed under unique geophysical conditions.

The formation of landscapes in Azerbaijan's mountainous and plain areas is closely related to the unique role of various types of atmospheric processes in shaping the geophysical characteristics of these landscapes.

The thermal properties of air masses of the plain landscapes of Azerbaijan are mainly caused by the distribution of heat by horizontal air currents. Cyclones entering the territory of the republic from the west throughout the year, especially during the warm season, and their aerodynamic conditions (southern cyclones according to A.M. Shikhlinski, 6) cause maximum precipitation in the warm season (in June) and minimum precipitation in the winter months (January-December) in the semi-desert and dry steppes of the western regions of the territory.

The overall solar radiation, radiation, and heat balance distribution play a significant role in the functional characteristics of geosystems in the studied areas of both flat and mountainous terrains.

Table 1

The relationship between the change in the ratio of heat and humidity and the horizontal and vertical differentiation of landscapes

Dampness (Md) According to A.J. Ayyubov R, kkal/sm^2 year According to A.M.Shyxlinski	<0,10-0,15 dry	0,15-0,25 arid	0,25-0,35 semi-arid	0,35-0,45 semi-humid	0,45-0,60< humid	Absolute height, m
15-30	-	-	-	-	Subnival and nival zone of highlands	3200<
30-35				The meadows of the highlands of Nakhchivan	Alpine meadows of the highlands	2500-3200
35-40			The xerophytic landscape of the middle highlands of Talish	The meadows of Zangezur highlands	Subalpine meadow and subalpine sparse forest-shrub	1800-2500

22

Table 1 continued

40-45		Xerophytic steppes of the middle highlands	Mountain meadows after the forest	Mountain meadows after the forest	Upper mountain forest zone	1200-1800
45-50		Xerophytic arid steppes of the low highlands	Lowland forest steppes and arid forests	Lower mountain-forest zone	Subtropical relic Hyrkan forests	500-1200
50-55	Lowland semi-deserts	Dry steppes of the low highlands	Arid forests of low mountains and foothills		Subtropical relic Hyrkan forests	200-500
55-60	Plain semi-deserts	Plain dry steppes	Introzonal and tugai forests		Subtropical meadow-forest and forest-steppe	200<

Geophysical observations and research differ in their regional and local characteristics. Conducting landscape geophysical research in this direction provides more efficient utilization of the natural resource potential of geosystems, effective management, and timely identification of ecological disturbances.

The structural-genetic characteristics of landscapes in the Kura Depression have been significantly influenced by orotectonic processes occurring within the basin. Conducted field research and elevation data, processed using ArcGIS software, resulted in the first large-scale (1:100,000) landscape map of the Kura Depression. Classification units of class, type, subtype and species were used in the grouping of landscapes, and as a result, 131 landscape types were separated in the area (Fig. 3).

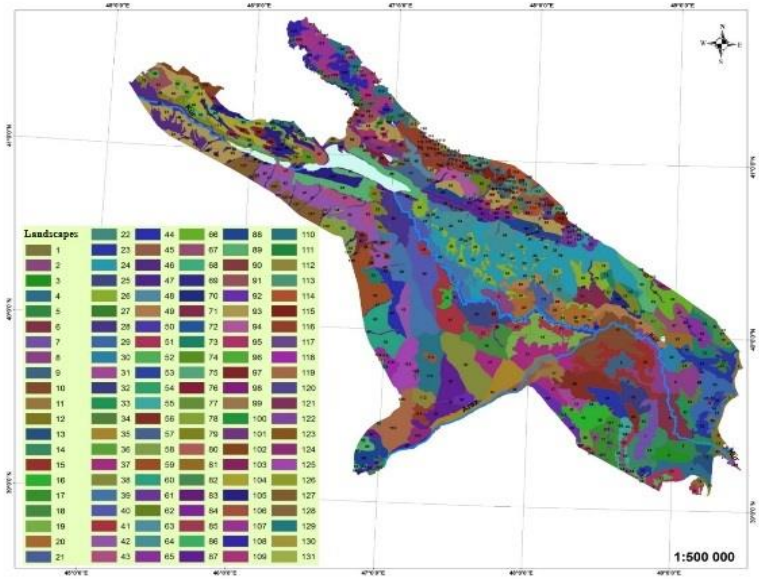

Figure 3. Landscape map of the Kura valley depression

In the Kur-Araz lowland, the semidesert landscapes of flat areas occupy a larger area, covering 48.5% of the total area or 18.8 thousand km^2. The flat semideserts, from a hypsometric perspective, range from -27 m to 300-400 m. In the Mugan plain, the upper

boundary of the semidesert landscape corresponds to a 20 m horizon, while in the Shirvan plain, it extends from an absolute elevation of 120 m. The highest boundaries of the flat semideserts are found in the Karabakh and Ganja-Gazakh plains, reaching 150-250 m.

The mountain semidesert landscape type continues the elevation of flat semideserts towards higher altitudes, primarily covering the low mountainous areas. However, in the Kur-Araz lowland, mountain semideserts are most commonly found in the Ajinohur-Ceyranchol foothills. This region is notable for its hypsometrically low areas. In the Ajinohur-Ceyranchol foothills, semideserts are relatively low in elevation, ranging from 100-200 m to 350-450 m, primarily occupying the area from Palantoken ridge to the Dehne river in the east. Mountain semi-deserts can rise up to 550-650 m on some steep slopes.

Steppe landscapes of the plains. From a hypsometric perspective, dry steppe landscapes extend above the semideserts. In the Kur lowland, this area covers 2850 km^2. Plain steppe landscapes were formed in relatively sloping hilly plains in the south-western foothills of the Langebiz range and the northern and northeastern foothills of the Talish mountainous area, bordering the Mughan plain. The absolute height of the mentioned sloping plains varies from 0 m in the parts adjacent to the Kura-Araz plain to 250-300 m in the foothills.

Gray, gray-brown, chestnut, light-chestnut soils are spread within the landscape complex (M.A. Salayev, B.M. Aghayev, 1963). One of the areas where the lowland steppe landscapes of the Kura valley depression occupies a larger area is the front foothill plains of the Lesser Caucasus Mountains.

Mountain steppe landscapes. Researched areas of mountain steppe landscapes are more commonly found in the Ajinohur-Jeyranchol lowland region. The climate in the Ajinohur foothills to the north of the Ajinohur front mountains is characterized by a semi-arid warm summer and a mild winter in the north, while in the remaining areas, it is a semi-arid to arid steppe climate. The average July temperature ranges from 22-25°C, while in January, it varies

between 0-3°C. Atmospheric precipitation is 350-450 mm. With the exception of transit rivers cutting across the area, the region does not have a free-flowing river.

Based on the relief and hydrothermal conditions, the researched area within the mountain steppe landscape type has been divided into three landscape-ecological subtypes: 1. Typical steppe landscapes, 2. Dry steppe landscapes, and 3. Xerophyte-shrub steppe landscapes.

Typical steppe landscapes cover a small area in the researched region, mainly occupying scattered areas. In the low mountains of Jeyranchol, typical steppes have developed on the relatively high slopes facing north along the mountain ranges extending along the border with the Republic of Georgia. They are also found in the dissected areas of mountain peaks such as Small Udabno (87 m), Big Udabno (764.5 m), Garatapa (729 m), Damirtapa (723 m), Goytapa (831 m), Chobandag (891 m), and Taxtatapa (720 m).

The dry steppe landscapes in the low mountains of Jeyranchol-Ajinohur are the most widely spread landscape subtype. Within these landscapes, due to the impact of intensive erosion and arid denudation processes under arid climate conditions, soil-vegetation cover has relatively weak development on steep slopes. Dry steppe landscapes in Ajinohur lowland are better developed on the northern and southern slopes of the Dashuz-Amirvan range, while they are also found in a fragmented form in the eastern direction. Xerophyte-shrub dry steppe landscapes are more commonly found on the steep slopes of anticlinal ranges and synclinal plateaus. The xerophyte shrublands here have originated from the regrowth of ancient arid forests over time. In fact, the transformation of arid forests has occurred as follows:

Arid forests and shrubs → Xerophyte-shrub steppes → Dry steppes

This is related to the weak structural-functional resilience of forests and shrubs.

Plain forest landscapes. In the Kur-Araz lowland, plain forests are mainly found in the Ganikh-Ayrichay valley. In addition, in small areas, remnants of ancient plain forests, such as the

Sultanbud forest in the Karabakh plain, the natural long-stemmed oak forest on the left side of the road at the 18th kilometer of the Aghjabadi-Imishli highway, and others can be observed. These plain forests have different structural-functional characteristics based on their respective physical-geographical conditions.

In forest landscapes, the potential wood reserve reaches 650-850 m^3 per hectare. The area of the plain forest landscape in the Ganikh-Ayrichay is 650 km^2, and the forest coverage degree is 19 percent. In recent years, due to the expansion of vineyards, cultivated areas, roads, and residential areas, the area of forests and forest cover has rapidly decreased.

Arid forest landscapes. This landscape type has been identified and described under the name "lowland arid forests" by B.A. Budagov (1988), Q.S. Mammadov, and M.Y. Khalilov (2002). However, in reality, this landscape is a relatively independent natural system that forms a transition between forest and steppe landscapes, known as the forest-steppe (forest-desert) landscape intersection, and its zone.

The forests and forest-shrubs formed along the rivers that cross the arid and semi-arid climatic semi-desert and dry-steppe landscapes of the Kura valley depression are called tugai (G.Sh. Mammadov and M.Y. Khalilov (2002)). The plains where Tugai forests are formed are composed of young alluvial sediments. Tugai forests have quite a different quality from plain forests due to their structural and functional characteristics. Tugai forests can have a ribbon-shaped area structure, and plain forests can be structured and spread over a wider area.

Ownership of a sufficient heat reserve in the Kura Depression leads to partial changes in the groundwater level near the surface, resulting in the development of hydromorphic natural complexes that sharply differ in their structural-functional characteristics, morphological structure, biomass productivity, and eco-diversity from the dominant semi-desert landscape. In the research area, hydromorphic landscapes of various types such as swamp-marsh, swamp-meadow, swamp-lake, and swamp-lagoon are widespread. The infiltration of water from irrigation networks, drainage water,

and uncontrolled drainage water also plays a significant role in the development of hydromorphic landscapes.

The main reason for the creation of the ecological conditions in existing geosystems in the IV section called "Theoretical problems of the dynamics and transformation of landscapes" is the inappropriate impact of humans on the structural-functional characteristics of these systems, as well as the disruption of ecological sustainability between natural and anthroposystems. This is also due to insufficient depth in the scientific study of the legal compliance of geographical technologies that determine the dynamics and activity of natural geosystems.

The key to the rational and thoughtful use of geosystems lies in determining the temporal and spatial tendencies of changes in the structural-functional and genetic characteristics of landscapes[4]. In the geographical layer, human intervention in the dynamics of landscape development through economic activities exacerbates the mentioned problem.

The study of the landscape components, the interaction between the landscape and the environment, the regime of process and the mechanism of dynamics allows to forecast the changes of landscapes under these or other conditions, to scientifically justify the type of land use, to determine nature protection measures, and to determine the norm of ecological loading in landscapes[5].

In Azerbaijan, the problems of landscape dynamics have been studied since the 70s of the 20th century. M.A. Museyibov, M.A. Suleymanov, Y.A. Garibov, M.J. Ismayilov, E.Sh. Mammadbeyov and others have conducted studies determining the role of anthropogenic factors in the dynamics of natural landscapes.

Their environment is studied in order to study the various mechanisms of geosystems' interactions, nature's reaction and the course of processes. The study of these issues makes it possible to

[4] E.Yu.Klbovsky. Unresolved issues of landscape science and landscape planning. Izv. RAS. ser. Geogr., -2013. No. 5, pp. 19-29.

[5] D.J.Bender, L.Fahrig. Using patch isolasion metrics to predict animal movement in binary landscapes // Landscapes Ecology, 2003. Vol.18, p.17-39.

predict the behavior of geosystems from the beginning, to study their dynamic regularities and evolutionary trends, that is, to solve the problems of forecasting geosystems.

The great demand for irrigation water in the arid and semiarid climatic conditions of the Kura valley depression has caused a fundamental transformation of the surface flow of the rivers in the area. The transformation of the surface flow in the studied area occurs under the influence of both natural and anthropogenic factors. However, the transformation and dynamics of the surface flow network under the influence of natural factors is different in that it is long-term. The main reason for such transformations is the slow tectonic movement of the Kura depression in the conditions of a smooth, very weak relief. The tectonic movements in the Kura depression, which occur in fractions of a millimeter in a year, have caused the displacement of river beds and the creation of new meanders and oxbow lakes.

Such changes in the relief of the area became the basis for the formation of new elements in the structure of semi-desert landscapes.

It has been studied that the location of the groundwater level close to the surface of the earth in the Shirvan, Karabakh, Mil, Mugan, Selyan and Ganja-Gazakh plains of the Kura valley depression and the example of the Ganikh-Eyrichay valley plays a significant role in the formation of the structural-functional and genetic characteristics of natural-anthropogenic landscapes. Small transformations in the regime, level and chemical composition of underground water with natural and anthropogenic effects lead to fundamental structural changes in landscapes and the formation of qualitatively new hydromorphic and saline landscapes.

According to the slope of the relief in the Shirvan plain, groundwater moves from the north and northwest to the southeast in the direction of the Kura River. In the direction of movement, the ground water level decreases on the depressions of the relief and sometimes comes to the surface in the form of " Gara Su (black water)" and forms vast swamp-meadow and thicket-meadow landscapes. In the Shirvan plain, agro-landscapes with a

groundwater depth of 1-2 m prevail.

In the semi-desert landscapes of the alluvial-marine and eolian plains of the South-Eastern Shirvan plain, the depth of the groundwater varies mainly from 0-1 m to 3-5 m. Semi-desert landscapes, generally with a bed depth of up to 2 m, increased by more than 30.5% in 1990-1995 compared to 1930, covering 57% of the total area of the plain. This is due to the increase in the area of agro-irrigation landscapes during this period.

During our observations in the Kura-Araz plain during 2005-2010, we observed that agro-irrigation landscapes, which gave a high yield in time, gradually turned into salt marshes during the 10-15 years of non-use. In this period, the failure of the collector-drainage system also had its effect.

The depth of the underground water table varies from 40-60 m in the foothills to 1-2 m and less towards the Kura river. As in other areas, the level of underground water has an important role in the formation of structural-functional and genetic characteristics of natural economic systems.

The process of raising the ground water level to the ground surface has taken place throughout the entire area in the Mil plain. Thus, in 1930, in 86.6% of the area of the plain, groundwater was spread at depths of more than 3.0 m from the surface of the ground. Due to the development of irrigated agriculture, the area of the areas with a groundwater depth of more than 3.0 m due to filtration from canals and infiltration water from direct irrigation areas decreased from 35.6% to 26.5% from 1950 to 2000. Such a situation often creates conditions for agroecosystems with unpleasant cases. The geo-ecological balance in the landscapes is disturbed, the soils are flooded, and re-salinated.

River-valley landscapes are formed in zones where aquatic and terrestrial ecosystems are more directly in contact with each other. In this type of landscapes, there are three landscape subtypes that differ structurally-functionally and genetically: 1. Canal landscapes; 2. Subdominant landscapes close to the watershed; 3. Landscapes of accumulative river plain and terraces.

The underwater landscape of the Kura River serves as a

natural channel and drainage. This natural channel differs sharply from the surrounding landscapes due to its composition of fauna and flora. Recently (after the 1950s), the Varvara, Mingachevir, Yenikend, and Shamkir reservoirs created on the Kura River disrupted the exchange of substance and energy between the riverside landscapes. As a result, the physical-chemical properties of water, biodiversity, etc. in channel ecosystems has changed drastically.

In the section from the Mingachevir reservoir to the Caspian Sea, the hydromorphic river plain landscapes of the Kura River stretch along the river in the form of a wider strip. A network of artificial soil dams was created in order to protect the economy and the population from the floods of the Kura River. The height of soil dams sometimes reaches 4-5 m. The width of the dams in the upper part varies between 3-6 m. However, the dams have recently been destroyed by anthropogenic influences in a number of areas, and have been turned into agricultural fields or seliteb landscapes.

The dynamics and degree of transformation of along the Kura river-valley landscapes and their development trends were studied by herba alba the satellite images of the area from different years and the change of vegetation coverage index based on the analysis of field research materials conducted by the author in different years. Analyzes of the vegetation cover index of the studied area were carried out based on the herba alba of images obtained from the Landscape 5 (June 14, 2002) and Landscape 8 (June 9, 2019) satellites, and anthropogenic dynamics and transformation were studied. The researched satellite images were analyzed with ArcGIS 10.3 software technologies and numerous maps reflecting the vegetation cover (NDV) index for the mentioned periods were drawn up.

Currently, 60% of the world's territory has been changed by anthropogenic influences to one degree or another. This number is more than 75% in the territory of Azerbaijan and up to 85% in the Kura valley depression. The anthropogenic transformation of Kura depression landscapes can be classified relatively simply as follows (Figure 4).

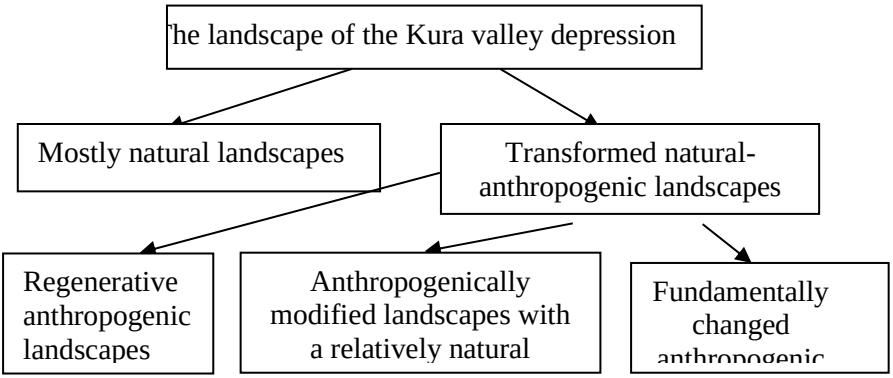

Figure 4. Scheme of anthropogenic transformation of Kura depression landscapes

B.A. Budagov, Y.A. Garibov, M.C. Ismayilov, E.Sh. Mammadbeyov, M.I. Museyibov, S.Y. Guliyeva, I.Y. Kuchinskaya and others investigated anthropogenic transformation of landscapes in Azerbaijan. In the structure of natural-anthropogenic systems, it is possible to distinguish three different main subsystems: 1st subsystem consisting of natural elements, 2nd anthropogenic subsystem, 3rd information subsystem. The natural subsystem incorporates the natural features of the landscape. The anthropogenic subsystem is related to human activity that gives a new quality to the structure of the landscape. The information subsystem combines physical-geographical processes. The relationship between the mentioned subsystems ensures the integrity of the landscape and its existence as a system.

In order to analyze the dynamic changes occurring in the territorial structure of landscapes, the relationship between the natural climate humidity conditions (NCHC) and modern (existing) landscape formation processes was studied. According to this purpose, in order to determine the degree and dynamics of natural landscapes possible undergoing anthropogenic transformation in the territory of the Republic of Azerbaijan, natural landscapes in NCHC have been determined. Because of this, attention was paid to the humidity index of the climate, which expresses the ratio of heat and humidity in the area. Therefore the main goal is to evaluate the dynamic changes occurring in the territorial structure of natural landscapes without taking into

account modern anthropogenic transformations and to determine development trends. The natural digital landscape map, which can be formed under the conditions of natural climate humidity, was compared with the digital modern natural landscape map layers compiled in 2017[6]. The results obtained from the comparison of these landscape maps are shown in table 2.

From the analysis of the table, it is clear that 19.9% (17276 km^2) of the landscapes that can be formed in NCHC in the territory of Azerbaijan are semi-desert, 29.8% (25829.7 km^2) are dry steppes, 14.21% (12320 km^2) xerophytic shrub steppes, 10.9% (9459.8 km^2) arid sparse forests and thickets, 20% (17413.5 km^2) forests, 37% (3179.1 km^2) mountain-meadows, 1 9% (764.4 km^2) are subnival-nival rocky glacial landscapes. In total, the area of arid forests and humid forest landscapes together is 26873.3 km^2. Under these circumstances, forest coverage in our Republic is equal to 30.9%.

In order to study the anthropogenic transformation of natural landscapes in the Kura valley depression, the transformation of smaller landscape units was studied by using the algorithm designed on the basis of the relationship between the economic activity of people and the degree of change of the natural components that make up the landscapes.

The impact of anthropogenic loading on natural components is graded as follows, taking into account the current ecological norms: 0-insignificant, 1-weak, 2-moderate, 3-high, 4-strong and 5-critical.

Based on the sum of the quantities obtained from the assessment, the landscape transformation coefficient was calculated using the following formula:

$$T_i = \frac{B}{K}$$ where

Ti-transformation index

B-score value of transformation of natural components

K-Score of non- transformed components

[6] M.J.Isamayilov, S.M.Zeynalova, L.A.Ismayilova. Dynamics of the relic forest landscape Azerbaijan and ways to solve environmental problems//-News of the Academy of Sciencs of Republic of Kazakhstan. Series of Geology and Techical Sciences, -2019.2 (434). pp.48-54.

Table 2

Comparative analysis of digital maps of natural landscapes that can be formed under conditions of natural climate humidification (NCHC) and natural landscapes that exist in modern conditions

Humidification index, Md (according to A.J.Ayyubov)	Humidification conditions	Landscapes formed in NCHC	Area of landscapes created in NCHC, km²/% (S1)	Modern landscapes	Area, km² % (S_2)	Index of transformation S_1 / S_2
1	2	3	4	5	6	7
<0,10	Arid	Semi-desert	17276,6 19,9	Semi-desert	17276,6 19,9	1,0
0,10-0,15	Semi-arid	Arid steppes	25829,7 29,8	1. Semi-desert	23468,6 27,1	0,09
				2. Arid steppes	2361,7 2,7	
0,15-0,25	Drought	Xerophytic steppes	12320 14,21	1. Arid steppes	85649,99,9	0,3
				2. Xerophytic steppes	3755,1 4,3	
0,25-0,35	Semi-drought	Arid forest and bushes	9459,8 10,9	1. Arid forest	420,50,5	0,04
				2. Xerophytic steppes	4165,9 4,8	
				3. Arid steppes	4873,4 9,6	

34

1	2	3	4	5	6	7
0,35-0,45	Semi-humid	Semi-humid forest	7472,6 8,6	1. Forest thicket	3117,6 3,6	0,57
				2. Semi-humid forest	4330,0 5	
0,45-0,60	Humid	Moist forest	6824,5 7,8	1. Moist forest	3464,0 4,0	0,51
				2. Mountain-meadow	3290,8 3,8	
>0,60	Extremely humid	1. Extreme humid forest	3116,4 3,6	1.1. Extreme humid forest	1620,5 1,9	0,52
				1.2. Mountain-meadow and meadow-bush	1495,9 1,7	
		2.Mountain-meadow	3179,1 3,7	2. Mountain-meadow	3179,1 3,7	1,0
		3. Subnival and nival	764,4 0,9	3. Subnival and nival	764,4 0,9	1,0

35

Based on the transformation coefficients obtained from the calculation with this formula, an anthropogenic transformation map of the Kura depression was drawn up. (Figure 5).

Chapter V called "**Assessment of the natural resource potential of landscapes**" is devoted to the theoretical problems of determining the natural resource potential of landscapes, that the natural resources of the landscape are important for it to perform certain economic and social functions. By means of natural resources, natural complexes satisfy various material needs of the economy and people.

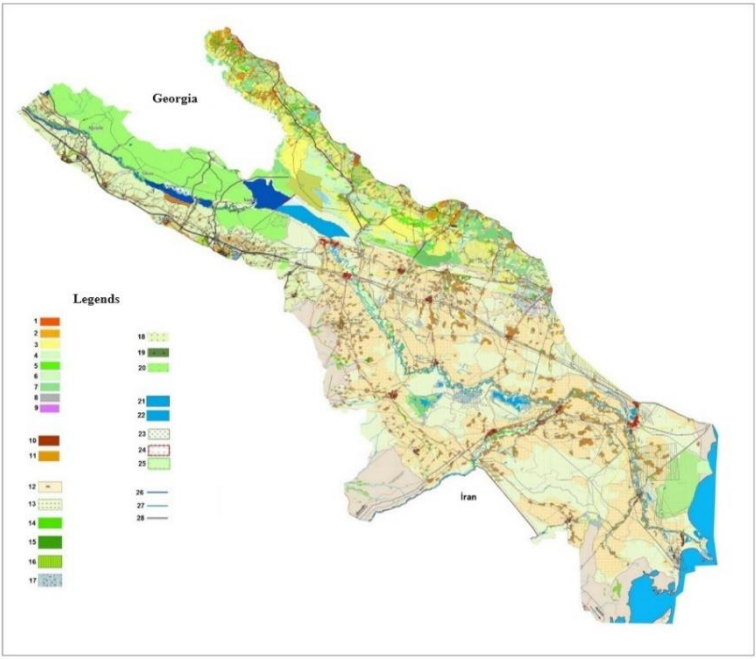

Figure 5. Anthropogenic transformation of natural landscapes in the Kura depression basin

The natural resource potential of landscapes should not be understood as the maximum amount of natural resources. The natural resource potential is determined by the permissible environmental

norm during its use. If the natural resource potential of the geosystem is used to the maximum, it can lead to its depletion, ultimately to the degradation of the geosystem itself. When evaluating the natural resource potential of geosystems, environmental factors, balance, stability, and functional characteristics of the landscape must be taken into account.

When assessing the natural resource potential of geosystems, the applied geographic technologies should be selected for their universality and complexity[7]. Here, the application of purely mathematical-geographical, mathematical-economic evaluation technology is not always justified. The reason for this is that each geosystem has unique structural functional characteristics and resource potential.

Approaching each geosystem objectively, its structure and functional characteristics have relatively clear favorable and unfavorable factors for human life activity and economic development. Favorable and unfavorable factors of the geosystem for farming can be evaluated on a 5-point scale (Table 3).

Favorable: +1 point – less favorable; +2 points – relatively favorable; +3 points – moderately favorable; +4 points – very favorable; +5 points – more favorable.

Unfavorable: -1 point – less unfavorable; -2 points – relatively inconvenient; -3- points – medium unfavorable; -4 points – very unfavorable; -5 points – more unfavorable.

The final relative score coefficients were calculated using the following formula: $N = \sum \frac{B_1}{B_2}$ where N is the relative score coefficient, B1 is the sum of favorable scores, and B2 is the sum of unfavorable scores.

Since natural landscapes with high natural resource potential are intensively used by people, most of them could not restore their original natural structures, ecological balances and natural resources, and turned into secondary landscapes in the main areas.

[7] M.Marleveld, C.Dangbegnon. Managing natural rescurces: a social learning perspective // -Agriculture and Human, -1999.16, p.267-280.

Table 3

Assessment of natural resource potential of Kura valley depression landscapes

Type of landscape	Relief	Climate	Groundwater	Surface flow	Soil	Vegetation	Aesthetics	Total points available	Total of unfavorable points	Relative point coefficient
Plain semi-desert	+2	+4	-5	-5	-3	-3	-4	Σ 5	Σ 20	0,25
Mountain semi-desert	-5	+5	-	-4	-4	-5	-2	Σ 5	Σ 20	0,25
Arid plain steppe	+5	+5	+3	-2	+4	-2	-3	Σ 17	Σ 6	2,2
Arid mountainous steppe xerophytic shrub	-3	+3	-	-1	+5	-3	-3	Σ 8	Σ 10	0,8
Plain forest and forest-steppe	+4	+5	-2	-3	+4	+4	+4	Σ 22	Σ 5	4,4
Mountain forest and forest steppe	-3	-3	-	+4	+2	+5	+5	Σ 11	Σ 6	2,6

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For the efficient use of their natural resources, the main attention should be paid to the preservation of the natural balance of landscapes during the implementation of landscape planning on scientific grounds, the application of ecological management, and the organization of particularly protected areas.

Analyzing the structural-genetic characteristics of geosystems in the geographical information environment on the example of the Jeyranchol low mountains enables to evaluate their potential for the development of various areas of the economy. With the help of computer programs, the natural reserve potential of the structural-genetic units of the geosystem was evaluated, and as a result, more integral quantities at the species level were obtained for the landscapes spread in the area. The geosystems corresponding to the received integral numbers were grouped and finally a large-scale (1:100000) digital map was compiled by evaluating them according to a five-point system. The points value of the natural resource potential of geosystems are ranked as follows: 1 point for landscapes with very little potential, 2 points for low potential, 3 points for medium, 4 points for high and 5 points for landscapes with very high natural resources.

1. Landscapes with very poor or low natural resource potential cover 21% of the studied area (545.5 km^2). These types of landscapes are found on the southern slopes of the Ortagash - Quyrugenchi, Eldaroyugu, Agtakhtatepe ridges, on the intensively fragmented slopes of the Western and Eastern Palantoken ridges, in the depressions of strongly salinized interalpine plains, in the interstripe hills where the salt layer comes to the surface, and mainly in semi-desert landscapes.

2. Landscapes with poor natural resource potential cover 25.8% (670.2km^2) of the studied area. These types of landscapes are mainly found in semi-deserts of mountain and subalpine plateaus and plains, partly in dry steppes of low mountains and multi-grass steppes with xerophytic bushes. Semi-deserts on gray-brown loamy soils of weakly fragmented plains, low-inclination (less than 15^0) slopes, flat surfaces, open chestnut, chestnut-meadow, fennel-ephemeral, wormwood on loamy gray soils of smooth, very weakly

inclined (less than 5^0) plains -currant, winter grass semi-deserts, semi-deserts of barren forests belong to the group of landscapes with weak natural resource potential.

3. Landscapes with moderate natural resource potential cover 29.5% of the territory (770.1 km^2). The landscape types of dry steppes and xerophytic shrub steppes mainly in the plains and on the northern slopes of mountain ridges belong to this type. These types of landscapes include herba alba on the chestnut soils in the western part of the area of the same name in the north-east of the Saloglu mountain, dry steppes with furrows and lame with wormwood, absolute height of 300-450 m, dry steppes with wormwood and herba alba of the Black desert plain, cold spring, Keshish dag. , covers the flat watersheds of the Garatepe mountain ranges and the herba alba-furrowed dry steppes of the northern and northwestern slopes of the Yaylacik mountain.

4. Landscapes with high natural resource potential occupy 12.6% (327.3 km^2) of the study area. These types of landscapes include humid deserts in the area, dry deserts in small areas, dry deserts with some xerophytic bushes, and arid sparse forest thickets. The amount of precipitation in these landscapes, distinguished by high natural resource potential, is more than 350-400 mm. The productivity of phytomass and soil is higher.

5. Landscapes with very high natural resource potential occupy a very small part of the total area, i.e. less than 11% (287.7 km^2). This mainly includes tugai forests and marshy meadows along the Kura and Gabirri rivers with high natural biological productivity. The formation of dense forest thickets and marshy meadows is more related to the transit elements that form the structure of the landscape.

Chapter VI called "**Geoecological problems of landscapes, ways of effective management and improvement**" is devoted to geoecological problems of Kura depression landscapes, ecology of landscapes, study of ecological diversity, creation of ecologically sustainable landscapes. Researches were conducted in plains and mountainous areas. Although the factors affecting the geoecological

condition of the landscapes in these areas are the same in origin, they are quite different in terms of form and intensity.

Our researches in the Ajinohur foothills, Kura-Araz lowland, Caspian coastal plains and the northeastern slope of the Great Caucasus clearly prove this[8]. The main orographic units of the Kura valley depression are Kura-Araz lowland, Ganikh-Eyrichay and Ajinohur-Jeyranchol low mountains. Ecological diversity was studied in the example of Ajinohur foothills, which is sharply different from the mentioned areas in terms of landscape structure and has its own landscape differentiation.

Factors affecting geoecological conditions in the area are grouped as follows. The first main factor affecting the geoecological conditions is that the mountain ridges here are more in contact with the Greater Caucasus mountains from west to east. The semi-desert geoecological complexes, distinguished by their simple biodiversity occupying a large area in the western part of the low mountains, are gradually replaced by arid forest-shrubs, arid forests and forest-steppes with a more complex geoecological structure towards the east. The second factor that forms the geoecological landscape structure is the morphometric structure of the slopes. Different geoecological conditions have formed on the northern and southern slopes of the mountain ranges. On the southern slopes of the mountain ridges, mainly wormwood-ephemeral semi-deserts dominated by arid-denudation processes, steppes with various grasses and xerophytic bushes (phryganoid), on the northern slopes, the level of fragmentation of the relief decreases and oak-elm forests, sometimes arid forest thickets, arid forests developed.

The third major differentiating factor is the geographic latitude difference between the mountain ranges, and the fourth is the absolute height of the area. One of the reasons for the formation of sub-deserts with sauerkraut, manere salsa, and ephemeral in the

[8] M.J. Ismailov Geoecological state of landscapes of intermountain basins in conditions of regional climate changes. Global climate changes: regional effects, models, forecasts. Materials of the international scientific and practical conference in Voronezh October 3-5 Publisher: “Digital Printing”, 2019, pp. 76-79.

synclinal Ajinohur plain is that the absolute height of the relief is less than the surrounding areas. The fifth factor is related to the lithological composition of rocks and has an important role in landscape differentiation. The lithological composition and sorting of rocks in the Akhar-Bakhar and Dashuz-Amirvan ranges differ from each other. This is one of the main factors for landscape-ecological diversity.

Ajinohur, the largest lake in the area, has an important role in climate moderation and the enrichment of ecological diversity. The wetland birds and other wild animals here can be considered an important source of increasing the biodiversity of the surrounding dominant semi-desert landscape. Recently, the gradual reduction of the lake's water level and its complete drying up in the summer months have led to the emergence of a new ecological crisis.

Regionalization was carried out according to the ecogeographic characteristics of the Kura valley depression. There is a need for a single indicator summarizing the integral aspects of the components - relief, lithological composition, hydro-climatic conditions, soil cover, biological world, and human activity - which are sharply different from each other due to their formation, physical-geographical characteristics, development and dynamics, and structure. Quantities of ecological and bioclimatic potential, which more integrally reflect the interaction of the mentioned components and can be expressed numerically, have been developed.

8 ecogeographic regions and 27 sub-regions were separated in the Kura-Araz valley depression by summarizing the various directional factors, and a large-scale (1:100,000) "Ecogeographical zoning of the Kura valley depression" digital map was drawn up (Figure 6). I hydromorphic along the Kura river-river landscapes; II Zonal accumulative plain Shirvan; III Low mountainous Ajinohur-Jeyranchol; IV Pre-mountainous accumulative Ganja-Kazakh plain; V Zonal Mil-Mugam; VI Sea coast Salyan-Neftchala; VII Intrazonal Kanikh-Eyrichay; VIII Pre-mountainous Karabakh plains.

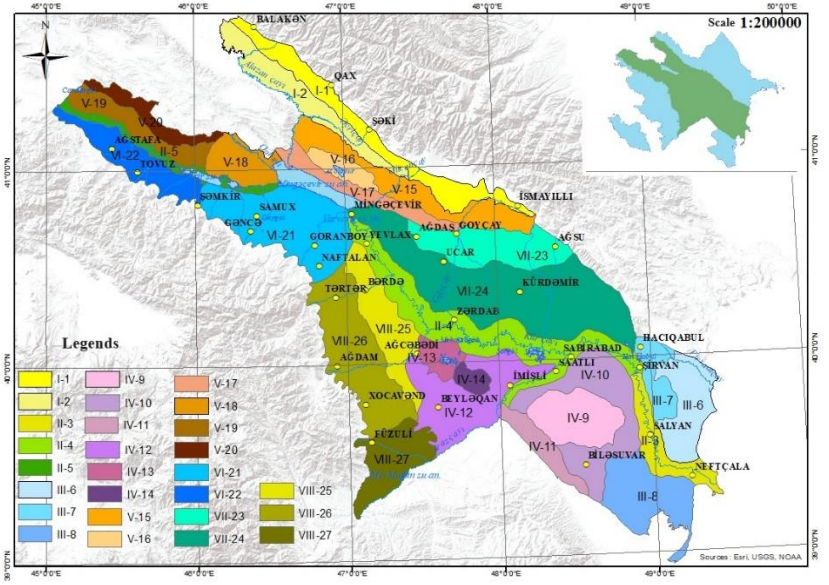

Figure 6. Ecogeographical zoning of the Kura valley depression

1. Introzonal Kanikh-Ayrichay. In the north of the Kura-Araz intermountain depression, it covers the depression extending from Mazimchay to Girdimancha between the southern foothills of the Greater Caucasus and the Dashuz range and the Sheki plateau. Plain forest, meadow-forest landscapes have formed in the area. Two sub-regions are divided within the region: 1. Forests of the temperate-warm alluvial-proluvial plain; 2. Forests and meadow-forests of the temperate warm semi-humid alluvial plain.

2. Hydromorphic the Kura river-valley landscapes region. Its width varies from 1.5 km to 5-6 km, depending on the topography of the river valley and the coast. The region consists of three ecogeographical sub-regions: 1. Re-shrub meadows of fairly warm delta plains and riverine areas 2. Re-forest-shrubs of fairly warm and humid riverine areas 3. Re-forest thickets of moderately warm, semi-arid hard-slope river valleys.

3. The coast of Salyan-Neftchala covers the southeastern Shirvan and Salyan plains. It emerged from under the sea after the New Caspian transgression. The relief of the surface is smooth and

weakly inclined. The lithological composition of the rocks is dominated by marine sediments. The main background landscape is semi-deserts with desert elements. Due to fluctuations in the level of the Caspian Sea, it has become an ecologically risky region. There are three sub-regions within the region: 1. Dune, sand dune semi-deserts of the warm, dry sea plain, 2. Dashed, hilly semi-deserts of the warm, dry alluvial plain, 3. Warm, semi-dry semi-deserts of the smooth sea plain.

4. Zonal Mil-Mughan. The main environmental threat is the rise and pollution of groundwater levels, soil salinization and desertification. The zonal Mil-Mughan district is divided into six sub-districts: 1. Very hot, dry, submerged and smooth sea plains of saline and shourakat semi-deserts, 2. Semi-arid, warm alluvial plain semi-deserts, 3. Semi-arid, moderately warm steppes and semi-deserts of the steppe plain, 4. Semi-arid, warm, alluvial-proluvial smooth plains semi-deserts, 5. Semi-arid, temperate warm lake and alluvial swamps and salt marshes, 6. Semi-arid, warm sand dune accumulative plains deserts and semi-deserts

5. Low mountainous Ajinohur-Jeyranchol. The absolute height above sea level varies from 80 m to 900 m. Arid-denudational landforms characteristic of low mountainous areas – ravine and balka – are widespread. The main landscape type is sharply divided lowland dry steppe and partial semi-desert. Arid forests and thickets are found.

6. Pre-mountainous accumulative Gazakh-Ganja plains. The absolute height of the relief in the area varies between 200-400 m. In the foothills of the territory, various grassy steppes on chestnut soils are replaced by semi-deserts in the north, and forest-shrubs on alluvial-meadow and alluvial-meadow-forest soils along the Kura River. It is divided into two subregions: 1. semi-deserts of dry and moderately warm hilly and undulating plains; 2. Xerophytic steppes of semi-humid and warm-denudation plains.

7. Zonal accumulative plain Shirvan ecogeographical region has an area of 6414 km^2 and extends to the low mountainous Ajinohur-Jeyranchol region in the north and to the Hydromorphous the Kura river valley landscapes region in the south. Its absolute

height above sea level increases from 15 m in the south to 160 m in the north. This ecogeographical region is divided into two ecogeographical regions according to the relief, landscape-ecological conditions, settlement and economic development trends: 1. Semi-deserts of the dry, warm, undulating accumulative plain with warm hills, 2. Dry steppes and semi-deserts of the semi-humid, warm, accumulative-denudation plain.

8. The area of Pre-mountainous Karabakh plains ecogeographical region is 5221 km^2, it stretches from Incechay in the north to the Araz river in the south, from the ancient coastal ridges corresponding to the 20 m zonal in the east to the foot of the Little Caucasus mountains in the west..

There are three sub-districts within the district: 1. Semi-deserts of the dry, warm undulating, stepped accumulative plain, 2. Semi-arid, relatively warm dry steppe landscapes of the foothill denudasion alluvial-proluvial plain, 3. Semi-arid hot steppe landscapes of the denudasion proluvial-delluvial plain.

In our interaction and mutual relationship with the components of the environment, we exist under certain risk conditions at any given time. Taking this into account, the territory of the Republic of Azerbaijan has been categorized based on landscape-ecological risk levels, and the corresponding map has been prepared (Figure 7).

Before the map was prepared, natural and anthropogenic sources creating ecological risks were identified in the Kura lowland and, generally, across the territory of Azerbaijan. The study of the level and distribution of ecological risks utilized data from field research conducted between 2010 and 2020, as well as information from Landsat 7 and 8 satellite images. In addition, a database consisting of various thematic maps (GIS) specifically created for this purpose was employed. Based on the provided data, a digital landscape-ecological risk map was generated, with each ecological risk source classified into three levels: 1 - low, 2 - moderate, and 3 - high. Subsequently, the distribution of risk sources across the territory of Azerbaijan was explored, and the corresponding table was compiled (Table 4).

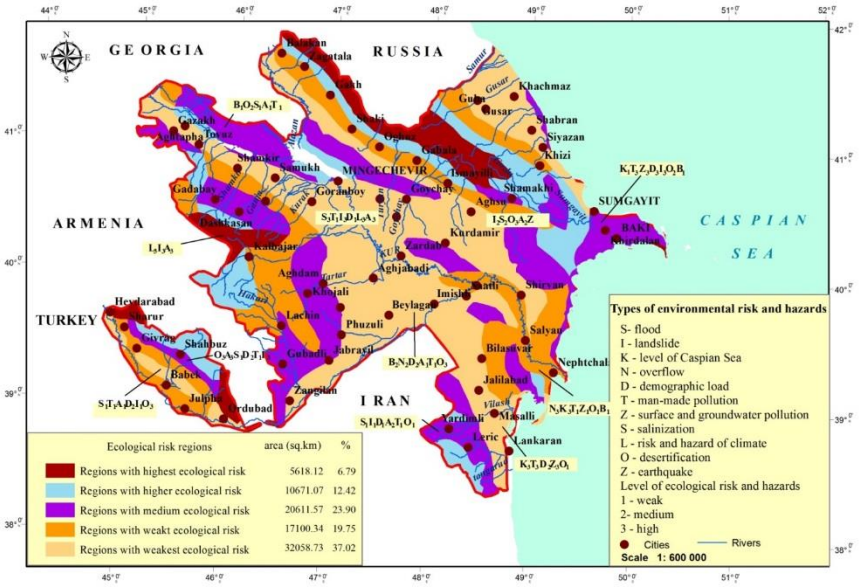

Figure 7. Landscape-environmental risk zoning map in the territory of the Republic of Azerbaijan

Table 4

Assessment of environmental risks in the territory of the Republic of Azerbaijan

Type of risk and hazard	Assessment of risk and hazard						In total		Index of risk and hazard
	Low		Moderate		High		km^2	%	
	km^2	%	km^2	%	km^2	%			
1. Landslide and avalanche	25720	29,7	17147	19,8	7361	8,5	50228,2	57	0,5
2. Mudflow	14289	16,5	12470,4	14,4	6235,2	7,2	32994,6	38	0,3
3. Erosion	13900	16	8220	9,5	12600	14,5	34708	40	0,4
4. Salinization (in irrigated agro-landscapes)	3873	4,5	1693	2,0	1053	1,2	6619,0	7,7	0,1
5. Desertification	24161,4	27,9	19744,8	22,8	14981,8	17,3	58816	68	0,6

In Table 4, environmental risks in the territory of Azerbaijan are classified and evaluated based on the levels of risk sources, and, finally, the environmental risk index has been calculated. In Azerbaijan, the total area of land prone to landscape-ecological landslide risk constitutes 57% of the total area (50228.2 km^2), of which 29.7% (25720 km^2) are areas with low erosion risk, 19.8% (17147 km^2) are areas with moderate erosion risk, and 8.5% (7361 km^2) are areas with high erosion risk.

In the Kura lowland, desertification is characteristic in more than 80% of the total area. Overall, desertification manifestations are encountered on 68% (58816 km^2) of Azerbaijan's territory. Of this, 27.9% (24161.4 km^2) is areas with low desertification risk, 22.8% (19744.8 km^2) is areas with moderate risk, and 17.3% (14981.8 km^2) is areas with high desertification risk.

The ecological risk index for the territory of Azerbaijan, including the landscapes of the Kur-Araz lowland, has been calculated using the following formula:

$$E_{ri} = \frac{\sum S1+S2\ldots Sn}{S\ ü}$$

In the formula

E_{ri}- ecological risk index

$S_1+S_2....S_n$- sum of areas of ecological risk and hazard sources

$S_{ü}$- general area involved in the study

The calculations have revealed that the risk and hazard index of landslide and mudflow processes in the territory of Azerbaijan is 0.5. This value is determined to be 0.3 for mudflow events, 0.4 for erosion, 0.1 for avalanches, and 0.6 for desertification. The ecological risk index for the territory of Azerbaijan has been evaluated as follows: very low when <0.2, low when between 0.2-0.3, moderate when between 0.3-0.4, high when between 0.4-0.5, and very high when >0.5.

The principles of optimizing the utilization of natural resource potential in landscapes and organizing ecological management**.** It is necessary to determine the formation, structural-genetic

characteristics, and main trends in the development of the landscapes of the Kura depression to optimize the natural resource potential of landscapes, assess their transformation as a result of anthropogenic impacts, and establish environmentally sustainable anthropogenic landscapes.

Depending on the characteristics of the landscape, a specific element of the natural reserve potential may stand out. The key to sustainable use of the landscape's natural and ecological potential lies in its optimization. The important principles to consider here are:

Firstly, any reserve obtained from landscapes should not exceed its natural recovery capacity.

Secondly, maintaining a balance between anthropogenically altered and naturally preserved landscape components.

Thirdly, the application of ecological engineering principles is crucial.

Taking these into account, we have identified four main directions in optimizing landscapes:

1. Preservation of the natural structural-functional characteristics of the landscape.

2. Utilization of natural reserves by maintaining ecological balance in the landscape.

3. Increasing productivity in anthropogenized landscapes through ecomeliorative measures.

4. Achieving the long-term and sustainable restoration of the landscape's natural gene pool through ecosystem services.

The optimization of landscapes involves measures aimed at ensuring the socio-economic function of geosystems by restoring their natural reserves and preserving their functions in creating an environment.

Taking these into account, a model for optimizing landscapes has been developed, using the example of the Kura depression for the first time. Three main directions for land use in the studied area have been identified: 1. demographic load; 2. technogenic load; 3. agrotechnogenic load.

Population migration to other places increases when the

demographic load exceeds the limit allowed by the landscape potential. With the exception of some administrative regions of the Kura depression, the balance of population migration in the main areas is estimated as negative.

The Kura depression has been subjected to technogenic loads, including oil and iodine-bromine deposits, industrial zones and parks, sand and gravel quarries, hydro-technical structures, canals, collector-drains, road-communication systems, etc. The area also faces agro-technogenic loading attributed to various irrigation systems, including comprehensive agricultural irrigation complexes.

For the optimization of landscapes in the Kura depression, it is crucial to determine and assess their ecological potential. The landscapes in the area have been grouped into five categories based on their ecological potential and optimization directions: 1. very high; 2. relatively high; 3. moderate; 4. weak; 5. Very weak. During the assessment of the optimization potential of landscapes, factors such as productivity, biodiversity, demographic load, degree of anthropogenic disturbance, climate reserves, water supply, groundwater mineralization level, and the level of its surface, as well as the medical ecogeographic condition of the landscape, have been taken into account. Specific optimization measures have been developed for each landscape group.

Landscapes with very high optimization potential cover 9.5% of the Kura Depression area. Landscapes with high ecological potential are riverbank areas along the Kura and Aras rivers that are very weakly exposed to danger during floods and river overflow. Such landscapes cover areas within 200-300 m and sometimes 400-500 m from the current course of the river. Mainly, these are semi-desert areas with fragmented alluvial plains on alluvial-meadow, meadow-gray soils, supporting vegetation like tamarix, alhagi, and saltwort.

Landscapes with relatively high optimization potential cover 18% of the total area. This group includes landscapes located relatively away from the riverbed on the right bank of the Kura and Aras rivers, sometimes encompassing partially depressed areas along the riverbed with a weak slope. These landscapes are

characterized by favorable irrigation opportunities.

Landscapes with a moderate level of optimization potential cover a significant area in the researched territory, encompassing a variety of environments. This group includes alluvial-proluvial, proluvial-delluvial partly sloping, hilly plains of the Mugan plain in the southwest of the Republic of Azerbaijan, along the border with the Islamic Republic of Iran, extending from Bilasuvar to the town of Bahrampet. It also covers alluvial-marine and semi-deserts of the maritime plains of the South-Eastern Shirvan plain along the Kura River; the semi-desert areas along the Bala Kura River in the Salyan plain; dry steppes and steppes with xerophytic bushes of mountain slopes and hilly plains; and the semi-deserts of the Ajinohur plain.

Landscapes with weak optimization potential are relatively widespread in the researched area, covering more than 26% of the total area. Typologically, these landscapes include semi-desert areas on the slopes of low hills and partially exposed ridges, covered with wormwood and grasses. They also include semi-desert areas consisting of mobile and immobile sand dunes with psammophytes and halophytes, as well as moderately salinized landscapes of flat plains.

Principles of Ecological Management Organization. Globally, as well as at the level of individual countries, regions, and localities, there is a need for the organization and modeling of a landscape-ecological framework based on geographical spatial information to preserve the ecological diversity of the world and the countryThe landscape-ecological framework should be transformed into a guarantor for the preservation and delivery of the natural gene pool and integrity of the ecosystem to future generations. The structure of the ecological framework and the organizational structure of management can vary depending on the regional geographical features.

In Azerbaijan, we consider grouping the structural elements of the landscape-ecological framework at four levels: national, regional, local, and individual farmer levels. Each management level has corresponding structural elements for the preservation of the natural gene pool, depending on the area it covers (Figure 8, 9).

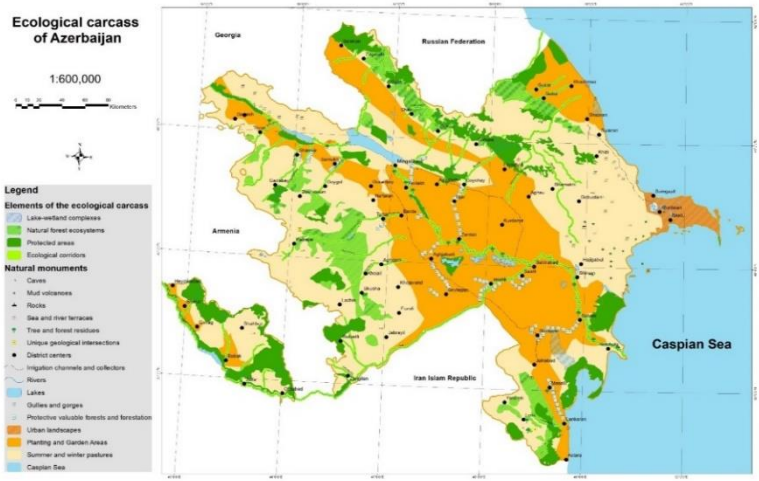

Figure 8. Landscape ecological framework of Azerbaijan

The presented model of the ecological framework connects environmental management with political and economic governance structures in the country, ensuring balanced and sustainable development. At the regional level of environmental management, regulation of anthropogenic loads should be implemented with the goal of preserving the natural balance of landscape subtypes and species. In Azerbaijan, a system of measures is envisaged to harmonize anthropogenic loads with ecological norms in landscapes such as non-protected forests, wetlands (hydromorphic), xerophytic-shrub steppes, mountainous meadows, etc. Taking these considerations into account, a large-scale (1:100,000) Ecological Framework Map has been prepared based on the landscape-ecological framework model of the Kur depression. The map has been designed, considering the main strategic directions of the environmental policy essential for implementation in Azerbaijan, particularly in the Kur depression.

The structural elements of the ecological framework are classified based on their role and functionality in the system: 1. Ecological corridors; 2. Landscape areas playing a conservation role; 3. Reconstruction elements; 4. Regulated landscapes.

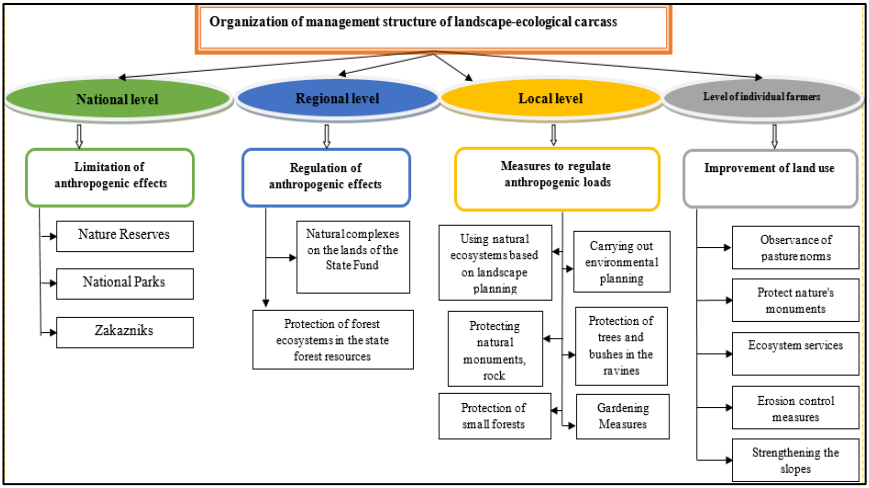

Figure 9. Organization of the management structure of the landscape ecological framework

The ecological corridors of the landscape-ecological framework include river-valley landscapes, large forest belts, and massifs that serve the ecological corridor function. Ecological corridors ensure connections between various elements of the framework, preserving and maintaining its integrity. On the other hand, ecological corridors, varying in scale, can be categorized into transit and local significant functional types. Transit functional corridors facilitate connections between several landscape zones or types. In the Kur depression, rivers and river-valley landscapes like the Kura, Aras, Turyanchay, Goychay, etc., play a crucial role in establishing connections between Azerbaijan's and the region's main landscape types.

Local significant ecological corridors ensure the integration of smaller units of the landscape into natural systems. In the Kur depression, rivers and river-valley landscapes such as Injachay, Goranchay, and others, along with small forested areas, fall into this category of elements.

The conservation function of the ecological framework is fulfilled by specially protected areas. These areas are the main elements of eco-geographic stability in the country and regions.

Serving as the primary function of natural complexes, these areas play a crucial role in the restoration of biomass and the preservation of biodiversity, as well as in the regulation of the migration and transformation of geochemical elements, soil restoration, regulation of microclimate characteristics, and preservation of natural resource potential.

CONCLUSION

1. Based on satellite images, topographic maps (1:100,000 scale), several key thematic maps (land use, soil, climate, hydrogeology, vegetation cover, etc.), and field research materials (landscape-ecological and landscape-ecological framework maps, soil erosion map, etc. with a scale 1:100,000), a geographic information database of the research area was created. On this basis, the classification of landscapes subjected to natural and anthropogenic transformations, and the development of a structural-functional model was drawn up.

2. Natural-ecological and structural-genetic characteristics of landscapes along the Kura River were studied taking into account buried uplifts, contemporary tectonic movements, transversal and pan-Caucasian tectonic faults and anthropogenic influences. In recent years, the fundamental regularities of landscape differentiation and development trends have been determined.

3. For the first time, in the example of the Kura Depression, natural landscapes have been divided into two landscape groups based on their structural-genetic and functional characteristics: morphogenetic and submorphogenetic. Additionally, four landscape subgroups have been identified: zonal, intrazonal, transit, and hydromorphic.

4. For the first time, natural and anthropogenic sources of risk threatening human activities have been classified, and the ecological risk database has been created using GIS technologies. A medium-scale ecological risk map of the Republic of Azerbaijan was compiled based on the decoding of satellite images with different resolutions, the analysis of field research materials and the analysis

of numerous thematic maps. It has been determined that 57% of Azerbaijan's territory consists of geosystems with low ecological risk, while 19.2% consists of geosystems with high ecological risk.

5. For the first time, medium-scale digital map layers reflecting the differentiation of existing landscapes were compared with the landscape map that can be formed under the conditions of natural climate humidification without taking into account anthropogenic influences. With the help of a special formula, the index of the transformations that took place in the structural territorial differentiation of landscapes with anthropogenic influences during the last 100-150 years was calculated. It was found that semi-deserts with arid elements in their structure have increased by 1.5 times, mountain meadows and meadows-steppes by 2.5 times, on the contrary, arid forests have decreased by 3.5 times, and forests by 4 times.

6. Modeling of vertical and horizontal interactions between geosystems and, accordingly, the analysis of different levels of morphogenetic and submorphogenetic landscape complexes is important in the theoretical justification of the assessment of their natural resource potential. It was determined that the natural resource potential is higher in submorphogenetic landscapes, and its volume is determined by the permissible ecological limits of use. Factors affecting human life within the geosystem are evaluated at two levels: favorable and unfavorable. Information obtained from these evaluations is used to calculate the relative integral relative coefficient of natural resource potential using the formula $N = \sum B_1/B_2$. The landscapes are classified into five levels of natural resource potential: very high, high, moderate, low, and very low. In the Kura-Araz lowland, 25.4% (11139.4 km^2) of the landscape has a very high natural resource potential (with a relative coefficient greater than 4), 3.9% (1694.2 km^2) has a high potential (N=3-4), 15.0% (6569.7 km^2) has a moderate potential (N=2-3), 10.9% (4798.1 km^2) has a low potential (N=1-2), and 44.8% (19635.9 km^2) has a very low potential (N=<1).

7. Based on the conducted research, the ecogeographical classification of modern landscapes reflecting the geomorphological

and paleogeographic conditions of the area and its historical development, which determine the landscape differentiation, was implemented. Based on the relief characteristics and ecological potential of the landscapes, 8 ecogeographic landscape regions was identified: 1. Hydromorphic river-valley landscapes along Kura riverbanks. 2. Zonal accumulative plains of the Shirvan. 3. Low mountainous landscapes of Ajinohur-Jeyranchol. 4. Mountain foot accumulative plains of Ganja-Gazakh. 5. Zonal landscapes of Mil-Mughan. 6. Coastal landscapes of Salyan-Neftchala. 7. Intrazonal landscapes of Ganikh-Ayrichay. 8. Mountainous landscapes of Karabakh plains. The ecogeographic regions are further subdivided into 27 subregions. Based on this classification, an ecogeographic zoning map at a scale of 1:100,000 was prepared. The maps and obtained results can serve as a fundamental basis for landscape planning of agroecosystems, seliteb landscapes.

8. For the first time, a cartographic model of the ecological framework, along with the spatial structure of management, has been developed for the application of ecological management. The main elements of the ecological framework include ecological corridors, specially protected landscapes, landscapes requiring reconstruction, and regulated landscapes, which are subdivided into 19 subgroups. The spatial structure of ecological management is divided into four levels: national, regional, local, and individual farmer levels. This ecological landscape framework is crucial for establishing sustainable natural-resource systems and for the preservation of the natural gene pool.

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The defense of the dissertation work will be held on the 13 June, 2025 at 11[00] at the meeting of the Disposable Dissertation Council BED 2.51 of Supreme Attestation Commission under the President of the Republic of Azerbaijan operating at the Baku State University.

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The dissertation is accessible at the library of the Baku State University.

Electronic versions of the dissertation work and its abstract are available on the official website of Baku State University: bsu.edu.az

The abstract was sent to the required addresses on the 12 May 2025.

Signed for print: 23.04.2025

Paper format: A5

Volume: 78932

Number of hard copies: 20