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Research Article

Anthropogenic Transformations in Natural Landscapes of the Great Caucasus

Sadullayev Rashad Rahib[1]*, Ahmadova Gulnara Baratkhan[2], Abasova Nazifa Ali[1] and Aktorpak İrken Fatih[1]

[1]*Baku State University, Department of Geography, Baku, Azerbaijan*

[2]*Baku State University, Phd in Department of Geography, Baku, Azerbaijan*

***Corresponding Author:** Sadullayev Rashad Rahib, Baku State University, Department of Geography, Baku, Azerbaijan.

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Abstract

In the article, researched the modern state and dynamics of anthropogenic transformation in the semi-desert, dry steppe and intrazonal plain-forest landscapes of the northeastern slope of the Greater Caucasus based on satellite images (Landsat/Copernicus).

The modern natural-anthropogenic landscapes of the northeastern slope of the Great Caucasus form one of the unique geosystems, clearly reflecting the signs of the vertical belt. The modern natural landscapes of the region, especially the foothills and lowlands, were transformed by centuries old anthropogenic influences, as a result of which repeated-derivative landscapes and new landscape complexes created. The degree of anthropogenization of natural landscapes has increased accordingly with the involvement of people in the north-eastern slope of the Great Caucasus for farming, the expansion of residential areas, gardens, crops, vegetables, melons and plantations. At present, the maximum indicators of anthropogenicity are found in all landscape types where agrolandscapes and seliteb complexes located in the region.On the basis of Geographical Information Systems (GIS) and Landsat 7 satellite images, we have determined that the natural complexes of the sloping plains of the Gusar foothills, the wide river valleys of Gusarchay, Gudyalchay, Karachay and Valvalachay, and the Samur-Devachi lowland have gradually changed over the course of historical periods, and various intensively used replaced by agro landscapes, man-made and agricultural complexes.

Keywords: Anthropogenic Transformation; Plain-Forest Complexes; Northeastern Slope of the Great Caucasus; Geographical Information Systems (GIS); Semi-Desert; Dry-Steppe Landscapes

Introduction

Natural-anthropogenic complexes of the northeastern slope of the Great Caucasus researched by A.A. Mikayilov [14], B.A. Budagov [2,11], M.C. Ismayilov [5], M.A. Museyibov [13], Y.A. Garibov [7,8,11], I. Y Kuchinskaya [12], N.S. Ismayilova [6], R.R. Sadullayev [8,9,10,15,16] and other researchers. In the research of anthropogenic landscapes of the region, transformation of natural landscapes, Y.A. Garibov had important achievement [7]. Y.A. Garibov conducted systematic research on the northeastern slopes of the Greater Caucasus in 2000-2009, compiled maps of anthropogenic transformation of landscapes based on the decoding of aerial and space images, grouped landscapes according to the degree of anthropogenization (1. practically unchanged; 2. weakly anthropogenic; 3. moderately anthropogenic; 4. sharply anthropogenic and 5. fundamentally transformed) [8].

In recent years, we have been investigating the differentiating features of both natural and anthropogenic landscapes of the region based on the application of Geographical Information Systems (GIS) and satellite images. I hope that my scientific research and new accurate results obtained in this field are very useful for such sciences as physical geography and environmental protection.

Research methods and principles

In the research work, the differentiation characteristics of the plain-forest, intrazonal and dry desert landscapes of the northeastern slope of the Greater Caucasus were analyzed based on Geographic Information Systems (GIS) and Landsat 7 satellite images. With the application of ArcGIS software, vegetation was deciphered using the Normalized Difference Vegetation İndex (NDVI) and the unsupervised classification method, and the modern distribu-

tion areas of forest massifs were precisely determined. Also, on the basis of Google Earth (Landsat/Copernicus) satellite images, the modern state of natural complexes and signs of location, distribution and impact of various anthropogenic landscapes (agro-landscapes, seliteb-habitation, man-made, etc.) were researched.

Anthropogenic transformation of semi-desert landscapes

The semi-desert landscapes of the northeastern slope of the Great Caucasus cover an area of 35,985 ha (5.2% of the region's natural landscapes). The anthropogenization of the arid landscapes of the north-eastern slope of the Great Caucasus during historical periods has enriched the structure of the landscape and created new qualities in it.

From the coastal plains of the Caspian Sea to the foothills, significant anthropogenicization of semi-deserts is observed. Thus, ephemeral-saline complexes of coastal dunes and sand dunes are characterized by weak anthropogenicity (up to 1-10%). Vegetation on the coastal strip of the Samur-Devachi lowland stands out for its very poor development [6,7]. The sea coast from Gilazi to Nizova (average width of 250 m) is characterized by ephemeral-salty formations on dunes, sand dunes and low ridges. In the alluvial-meadow soils, swamp-lake plants (reed, sedge, cypress) and sparse oak, elm, and elm trees are common. (Figure 1).

Anthropogenicity is much higher (up to 86%) in the semi-deserts of the Samur-Devachi lowland, which have been irrigated since ancient times, with gray-grass, wormwood-saline and ephemerals [7,8].

Figure 1: Natural-anthropogenic landscapes in the alluvial-marine plains of the coasts (Khachmaz region, near the village of Nizova) [17]. 1. Ephemeral-salary plants of coastal dunes and sand dunes; 2. İn alluvial-meadow soils, swamp-lake plants (reed, sedge, sedge) and sparse oak, elm, and cypress trees; [1] 3. Agrolandscapes (grain, vegetable, melon, clover crops, etc.) on meadow-swamp, alluvial-meadow lands [7].

The exploitation and anthropogenic loading of semi-deserts is increasing towards the foothill plains. In most of the gray-brown, gray-meadow soils of Gusarchay, Gudyalchay, Garachay and Valvalachay, intensive use of semi-deserts of gray-brown, gray-meadow, wormwood-ephemeral semi-deserts, wide distribution of agro-landscapes and seliteb complexes (in Shabran and Siyazan regions) increase the anthropogenic factor delivers to by 60-80% [5,6].

The ratio of anthropogenization of wormwood-ephemeral semi-deserts in gray-meadow saline soils of accumulative plains between Gilgilchay and Boyuk Hamya increases to 50-60%. In complexes used mainly as winter pastures, anthropogenicity is less than 30%.

About 20% of the semi-desert complexes of the northeastern slope of the Greater Caucasus are used for grazing, 10% for cultivation, up to 25% for crops (grains, vegetables, melons, etc.), 15% for various man-made modifications (road, canal, pipeline, power lines, etc.), and 30% are badland areas - ravines, gobos, sandbars, river valleys, etc. covers.

Man-made modifications located close to each other sometimes occupy more than 25% of the semi-desert area. The passage of an internationally important oil export pipeline (Baku-Novorossiysk), automobile (Baku-Guba and Baku-Guba-Russia) and railways (Baku-Russia) through this area divides the vast areas of anthropogenic complexes into small parts. The dense network of huge man-made modifications of this type, especially between Tugchay-Devachichay, hinders the creation of both new socio-economic complexes and agro-landscapes (Figure 2).

Anthropogenic transformation of arid desert landscapes

Dry steppe landscapes cover an area of 87,100 ha (12.4% of the region). It was formed in alluvial, alluvial-prolluvial, delluvial plains in the Samur-Devachi lowland and Gusar sloping plains of extended terrace plains, bringing cones.

The dry desert landscapes of the region have been attracted to irrigated agriculture since ancient times and are one of the most appropriated complexes. At present, the open chestnut (light-gray-brown) and grass-brown soils of the majority of the dry steppes of the Greater Caucasus have been transformed into agrolandscapes (between 50-80%). The dry steppes with wormwood-limp, wormwood-shiav, topalot, and ephemeral on the less inclined slopes of Shabran and Siyaza have been replaced by mowing fields and crops (cereals, vegetables, melons) [6,8].

Figure 2: Modern natural and anthropogenic state of semi-desert landscapes (between Siyazan and Shabran) [17]. 1. semi-desert landscapes of marine and alluvial lowlands; 2. Grains, vegetables, melons, grapes and etc. agricultural landscape., are grown in weakly saline, meadow-swamp, alluvial-meadow soils of relatively smooth plains [6,12] 3. Wormwood, wormwood-ephemeral plants in the open-chestnut soils of lowlands and badlands [1].

In the gray-brown soils of the Gusar sloping plain and the Samur-Devachi lowland, steppe complexes dominated by blackthorn and wormwood have undergone transformation (up to 70%) under the influence of agrolandscapes. The ephemeral, wormwood-agote dry steppes formed on the grass-brown and light-brown soils of the plain have been subjected to more intensive economic effects. Only on the slopes of the Gusarchay, Gudilchay and Valvalechay valleys, in the stony-bush areas of more fragmented bringing cones (between Yasab-Badishgala), there are natural complexes (elm, blackthorn, thicket dominated by oak and steppe) [2,7,8]. Grazing in the anthropogenization of dry steppes, especially on low slopes, destroys the morphology of the surface and the integrity of the grass cover.

The dry-steppe and steppe landscape of the lowlands is between Gilgilchay-Keshchay (mountain-meadow-chestnut and open-chestnut mountain-soils of the low mountains and fragmented plateau, wormwood and various grasses) and Shabranchay-Gilgilchay (dark chestnut of the low mountains and fragmented plateau, agot, wormwood and phryganoids) [1] are common. The dry-steppe and desert landscape of the lowland between Shabranchay and Gilgilchay is distinguished by its weak anthropogenic (up to 30%) and consists mainly of winter pastures and badlands [6].

Anthropogenic transformation of intrazonal landscapes. The intrazonal landscapes of the northeastern slope of the Greater Caucasus cover an area of 142,107 ha (20.3% of the region) between Samurchay-Devachichay. Intrazonal landscapes are characterized by both high natural dynamics and sharp anthropogenic changes.

Anthropogenic transformations in natural intrazonal plain-forest landscapes are felt especially in recent centuries. Thus, until the first half of the 19th century, the natural intrazonal forests in the plains of Samur-Devachi and Shollar covered the plain as a whole massif almost from end to end. Since the second half of the 19th century, the economic activity of the population, the creation of large settlements (Khudat, Nabran, Khachmaz, Muqtadir, etc.) had a significant impact on the reduction of the area of plain forests [5]. Tel, Guneshli, Khanoba, Salimoba, Yalama, Turist, Shimal, Seyidlikand, Khurai, etc. seliteb complexes create windows in the natural intrazonal plain-forest. A dense network of seliteb complexes with a large area, combined with agricultural and vegetable fields and orchards, increases the anthropogenicity of plain-forest complexes up to 80%.

The forests of the Samur-Devechi lowland (Yalama) are spread from the shores of the Caspian Sea (-28 m) to an absolute height of 55 m. The main forest massif of the plain forms a strip 6-10 km wide from west to east and 25 km long from northwest to southeast. Cultural (anthropogenic) landscape types prevail in the territory of the Samur-Devachi lowland, which was covered with forest cover in the past.

Due to the long-term economic activity of people (establishment of agricultural fields, expansion of rural and urban settlement areas, creation of new recreation and resort-tourism centers, cutting of trees for firewood and fuel, animal grazing, etc.), the primary forest cover has undergone a serious transformation, and as a result, the forest the cover is thin. Also, widespread forest pests and diseases have led to the drying up of large areas of oak and elm for-

ests. The scarcity of forest areas and unsatisfactory sanitary conditions in the Samur-Devachi lowland make it necessary to protect the existing forests [3,4]. For this purpose, Samur-Yalama National Park (11773 ha) was established in the administrative territory of Khachmaz district in 2012 within the framework of the Ecoregional Nature Protection Program for the South Caucasus [18].

We have analyzed the differentiation characteristics of plain-forest landscapes of the Samur-Devachi lowland based on Geographic Information Systems (GIS) and Landsat 7 satellite images. Deciphered by the Normalized Difference Vegetation İndex (NDVI) and the unsupervised classification method, it was determined that the plain-forest landscapes of the Samur Devechi lowland (Yalama) remain in a total area of 20,700 ha. These intrazonal plain-forest complexes make up 14.3% of the total forest landscapes (144,900 ha) of the northeastern slope of the Greater Caucasus, and 10.2% of the area of the Samur-Devachi lowland (Figure 3).

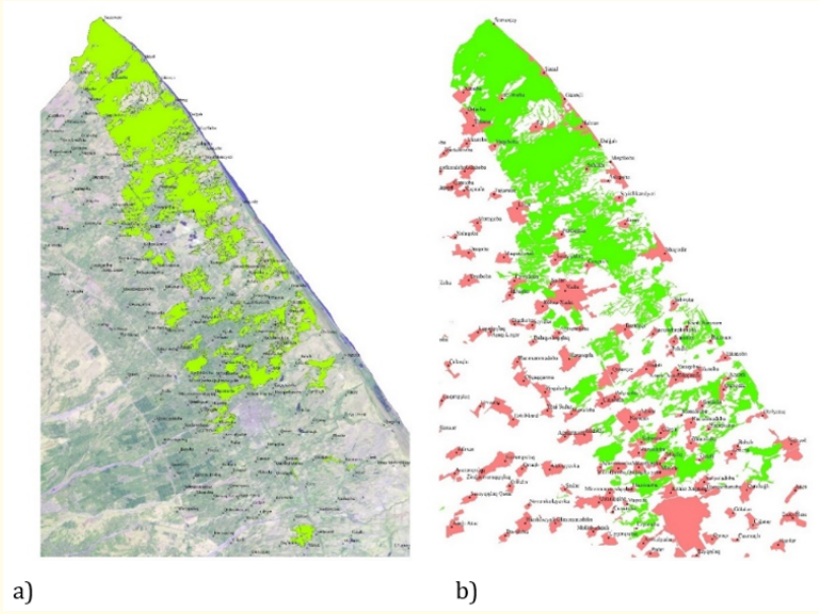

Figure 3: Effect of seliteb complexes on intrazonal plain-forest landscapes in Samur-Devachi and Shollar plains.
a) natural intrazonal plain-forests
b) seliteb complexes [15].

Anthropogenic transformation of meadow-swamp and plain-meadow complexes

Meadow-swamp and plain-meadow complexes once covered large massifs in the Samur-Devachi plain. Based on the 1:200,000 scale topographic map compiled in 1926, it was determined that meadows and swamps covered about 20% of the Samur-Devachi plain. As a result of the melioration measures carried out until the 50s of the 20th century, most of the meadow-swamps were drained for economic purposes, gardens, crops, mowing, etc. turned into agro-landscapes [2,5]. Currently, natural meadow-swamp complexes are preserved around Agzibirchala lake (1800 ha) in Shabran region and Kalogan (Galagan) lake-swamp (10 ha) in Karachay field in Khachmaz region. Most of the meadows and marshes of these areas are used as mowing and grazing land in the summer months. As a whole, meadow-swamp complexes are one of the mainly anthropogenic (between 50-80%) landscapes (Figure 4).

Most of the meadow-swamps have been fundamentally anthropogenic (more than 60%) by being located in ancient river beds. More than 45% of the areas of meadow-swamp complexes in the Samur-Devachi plain are used for grain and vegetable crops, 18% for wheat complexes, 15% for gardens and plantations, 10% for pastures and 12% takes man-made modifications.

Discussion

Differentiating features of both natural and anthropogenic landscapes of the northeastern slope of the Greater Caucasus have been studied by us in recent years on the basis of Geographical Information Systems (GIS) satellite images. I hope that these scientific studies and the obtained results will be useful for landscape science. Based on Google Earth (Landsat/Copernicus) satellite images, the current state of natural complexes and the dynamics of various an-

Figure 4: Main meadow-swamp landscapes of the region.
a) Galagan meadow-swamp in the Karachay field.
b) Agzibirchala lake-swamp.

thropogenic landscapes (agrolandscapes, residential, man-made, etc.) show that in the near future, human influence on the natural environment, as well as anthropogenic transformation of natural landscapes, will continue with an increasing trend. Therefore, it is necessary to prepare new projects and action plans for the protection and efficient use of natural complexes of the region.

Main results

- On the basis of Google Earth (Landsat/Copernicus) satellite images, the modern state of semi-desert, dry desert and intrazonal natural landscapes and the location and distribution areas of various anthropogenic landscapes (agro-landscapes, seliteb-habitation, man-made, etc.) were deciphered by us and the signs of their effects were studied.
- Semi-desert landscapes make up 5.2% of the natural landscapes of the region, ephemeral-saline complexes of coastal dunes and sand dunes are weakly anthropogenic (up to 10%), the anciently irrigated gray-grass, wormwood-saline and ephemeral meadows of the Samur-Devachi lowland semi-deserts are characterized by a high anthropogenic level (up to 86%).
- Dry desert landscapes cover 12.4% of the region. Steppe complexes with gray-brown soils of the Gusar sloping plain and the Samur-Devachi lowland have undergone high transformation (up to 70%) due to the influence of agro-landscapes. The dry-steppe and desert landscape of the lowland between Shabranchay and Gilgilchay is distinguished by its weak anthropogenic (up to 30%) and consists mainly of winter pastures and badlands.
- Intrazonal landscapes are located between Samurchay-Devachichay and cover 20.3% of the region. The dense network of seliteb complexes with large areas (Khudat, Nabran, Khachmaz, Tel, Guneshli, Khanoba, Salimoba, Yalama, etc.) combined with agro-landscapes (crops and vegetables, orchards, melons, etc.) reduces the anthropogenicity of plain-forest complexes to 80% increases.
- Plain-forest landscapes of the Samur-Devachi lowland were deciphered using Landsat 7 satellite images and the NDVI method, and it was determined that the modern distribution areas of the forest massifs remained in the area of 20,700 ha. This unique complex makes up 14.3% of the total forest (144,900 ha) landscapes of the northeastern slope of the Greater Caucasus.
- For a long time, meadow-swamp complexes covered large massifs (up to 20% of the plain) in the Samur-Devachi plain. As a result of the melioration measures carried out later, most of the meadow-swamps were turned into agro-landscapes, meadows and pastures.. Currently, natural meadow-swamp complexes are observed in Agjibirchala lake (1800 ha) and Kalogan (Galagan) lake-swamp (10 ha) (Google Earth: Landsat/Copernicus).

Conclusion

Yalama forests are considered the most unique among intrazonal landscapes. It is no coincidence that at the beginning of the 1980s academician H. A. Aliyev wrote: "Yalama forest, which is considered the most valuable water source of the capital in our republic, is about to be destroyed. In my opinion, this forest should be declared a reserve. Human economic activity should be completely stopped there, and the remaining areas should be protected except for the seaside recreation area. The forest should be restored, the animal world should be enriched" [3, 81]. This wish of the deceased scientist was fulfilled later. Thus, according to the Decree of the President of the Republic of Azerbaijan Ilham Aliyev dated November 5, 2012, Samur-Yalama National Park [18] was created.

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