

Imanova Gulsare

ANAS Institute of Geography named after Academician H.A. Aliyev, Baku,  
Azerbaijan, e-mail: gulsareimanova@mail.ru*ANALYSIS AND ASSESSMENT BASED ON THE GIS PROGRAM OF ANTHROPOGENIC LOAD IN SOME LANDSCAPE COMPLEXES OF THE LENGEBİZ RIDGE*

*Purpose.* GIS program-based analysis and evaluation of anthropogenic load in some landscape complexes of the Lengebiz ridge.

*Methodology.* The study was carried out in three stages: cameral preparatory, field laboratory, and final. At the final stage, a landscape map of the area at a scale of 1:100,000 was compiled. The boundaries of landscapes and contours of anthropogenic origin within them were calculated based on the GIS program.

*Conclusion.* Within the object of study, the following types of landscape are identified: low-mountain forests; low-mountain forest shrubs (arid-sparsely wooded and shrub complexes); low-mountain steppes; xerophytic dry steppes of upland plains; low-mountain semi-deserts; dry steppes of accumulative plains; river-valley landscapes. The low-mountain forest landscape is represented by a mixture of oak and hornbeam oak. Among anthropogenic factors, settlements, communication routes, as well as agricultural land, especially arable land, have a significant impact on landscape complexes. the total area allocated for settlements, roads, etc., structures is 76.19 hectares, or 0.83% of the area of this landscape type. However, depending on individual types of landscapes, this indicator is 0.56% -1.09%. And the total area of agricultural land on the territory of the studied object is 2102.9 hectares, which is 22.96% of the landscape type area. Depending on individual landscapes, this indicator increases from 13.21% to 31.96%. Due to the great interest in arable land, their share in landscapes ranges from 0.31% to 3.04%, and hayfields and pastures - from 11.29% to 27.24%. 442.05 or 8.99% of the territory of this type of landscape is located on slopes with a slope of more than 40°. 1871 thousand hectares or 38.05% of the area were subjected to anthropogenic load. However, this indicator has different values depending on the type of landscape: 23,63%-65,92 %. The total area occupied by settlements, roads, communication lines and man-made structures of the district was 100.5 hectares or 2.04%. The total area of agricultural land (arable land, hayfields, pastures) within this landscape amounted to 1771.3 hectares (36.01%) were subjected to anthropogenic influence.

*Scientific novelty.* For the first time, based on the GIS program, the anthropogenic load in some landscape complexes of the Lengebiz range of Azerbaijan was analyzed and evaluated.

*Keywords:* Lengebiz ridge, anthropogenic load, anthropogenic landscape, GIS, aerospace and orthophotomaterials.

*Relevance of the topic.* The Lengebiz ridge is characterized by a complex relief, diverse vegetation and land cover, and a unique landscape [2, 3]. This is reflected in the landscape complexes characteristic of the Lengebiz ridge. However, in this geographical area, due to anthropogenic impact, landscape complexes are being transformed and in some places their complete and partial degradation is taking place. This manifests itself in the destruction of natural vegetation, erosion of the land cover, as well as in the expansion of settlements and infrastructure, in short, the replacement of natural landscapes with anthropogenic landscapes.

*Object and methodology of the study.* The Lengebiz ridge covers the southeastern tip of the Greater Caucasus. The maximum height of the Lengebiz ridge is 929 m, the total length is 75 km. The studies were carried out at chamber-preparatory, field, laboratory and final stages. At the cameral stage, the area of settlements and infrastructure within landscapes was calculated on the basis of orthophoto materials. At the stage of field and laboratory studies, landscape and soil studies were carried out. At the final stage, a landscape map of the area was compiled at a scale of 1:100000. The boundaries of the landscape and the contours of anthropogenic impact within them were calculated based on the GIS program.

*Analysis and discussion.* The landscape cover of the Lengebiz range was studied by B.A.Budagov [4, 17], M.A.Museyibov [15], E.K.Alizade [15], Y.A.Garibov [12, 13, 14] etc. [5, 6, 7, 8, 9]. According to a number of researchers, anthropogenic impacts play an important role in the formation of the landscape cover. For this purpose, the degree of anthropogenic impact on landscape types in the area was calculated and evaluated.

*Low-mountain forest landscape.* This complex includes areas of broad-leaved mountain forests. The forest-forming trees here are represented by a mixture of oak and hornbeam oak. Currently, various areas of agricultural land are being developed on the sites of mountain and forest complexes. Here, the natural plants either remained in fragmentary form, or were replaced. Six landscape types are distinguished in low-mountain forests (Table 1). The climate of this landscape is temperate-warm. The average annual temperature is 10.9-11.90° C. The average amount of precipitation ranges from 700-800 mm. Temperatures

are above 10<sup>0</sup> C in the region of only 3300-34000<sup>0</sup> C. Areas of mountain forest landscapes are characterized by a strong dissection of the relief [20,21]. Among anthropogenic factors, settlements, communication routes, and agricultural lands, especially arable lands, have a significant impact on landscape complexes (Table 1).

Table 1

Parameters of anthropogenic factors on individual landscapes of low-mountain forests

Types of landscape	Area, ha	Parameters of anthropogenic factors, area /%					
		Localities, roads, trails, communication lines, etc.	Agricultural land				General
			Crop	Perennial Plantations	Hayfields and pastures	Agricultural in total	
Partially transformed oak-hornbeam forest on typical brown mountain-forest soils of intensively dissected landslide slopes of mountains	1560,34	<u>10,41</u> 0,67	-	-	<u>312,3</u> 20,01	<u>312,3</u> 20,01	<u>322,71</u> 20,68
Partially transformed oak-hornbeam forest on medium-sized typical mountain-forest soils moderately dissected relatively inclined mountain slopes	1796,13	<u>12,61</u> 0,70	<u>5,6</u> 0,31	-	<u>307,1</u> 17,10	<u>312,7</u> 17,41	<u>325,31</u> 18,11
Partially transformed oak-hornbeam forest on powerful typical brown forest soils of poorly divided low-mountain watersheds	411,6	<u>2,31</u> 0,56	<u>10,5</u> 2,55	-	<u>101,1</u> 24,56	<u>111,6</u> 27,11	<u>113,91</u> 27,67
Partially transformed oak-hornbeam forest on thick typical brown mountain forest soils in slightly dissected lowlands	1793,55	<u>18,91</u> 1,05	<u>34,5</u> 1,92	-	<u>202,5</u> 11,29	<u>237,0</u> 13,21	<u>255,91</u> 14,27
Oak, hornbeam, ash, hawthorn, etc., on partially transformed thick calcareous brown mountain forest soils of weakly dissected watersheds	1352,78	<u>14,82</u> 1,09	<u>41,2</u> 3,04	-	<u>391,1</u> 28,91	<u>432,4</u> 31,96	<u>447,22</u> 33,06
Partially transformed oak-ash forest on thick calcareous mountain forest soils of weakly dissected watersheds	2243,18	<u>17,13</u> 0,76	<u>42,9</u> 1,91	-	<u>611,1</u> 27,24	<u>696,9</u> 31,07	<u>714,03</u> 31,83
Total:	9157,58	<u>76,19</u> 0,83	<u>134,7</u> 1,47	-	<u>1925,2</u> 21,02	<u>2102,9</u> 22,96	<u>2179,0</u> 23,79

Thus, due to unfavorable conditions, there are fewer anthropogenic objects, including settlements, roads, agricultural land, etc. Calculations show that the total area allocated for settlements, roads, etc., structures is 76.19 hectares, or 0.83% of the area of this landscape type. However, depending on the individual types of landscapes, this figure is 0.56% -1.09%. And the total area of agricultural land on the territory of the studied object is 2102.9 hectares, which is 22.96% of the landscape type area. Depending

on individual landscapes, this indicator increases from 13.21% to 31.96% (Table 1). Due to the great interest in arable land, their share in landscapes ranges from 0.31% to 3.04%, and hayfields and pastures - from 11.29% to 27.24%.

*Landscape of arid woodlands and shrubs.* In connection with the intensive agriculture and animal husbandry activities of the population, the arid type primary forest cover has undergone anthropogenic changes and the existing plant formations are mainly derivatives representing the steppe-xerophyte type. [20, 21]. In general, the vegetation of dry woodlands and shrublands is diverse. The main trees that make up this landscape complex are various types of juniper, rubber plant, blackthorn and a number of other shrubs and herbs. [18, 19]. The climate of this territory is moderately warm. The average annual temperature is 11,5-12,0<sup>0</sup> C. The average amount of precipitation ranges from 500 to 600 mm . Temperatures above 10<sup>0</sup> C in the area are more than 3700<sup>0</sup>C. Annual relative humidity 70%. In winter, precipitation falls in the form of snow 10-15 cm thick.

The arid-sparsely forested and shrubby type of landscape is characterized by moderate and weak dissection of the relief in areas where it is common. River valleys, terraces, watersheds, erosional slopes, narrow valleys cut by ravines, and other relief forms are widespread in the region. 442.05 or 8.99% of the territory of this type of landscape are located on slopes with a slope of more than 40<sup>0</sup>. The remaining areas with a slope are distributed as follows: 250 - 68.43% or 2365.84 ha; 150-22.6% or 1110.97 ha.

According to our calculations, 1871 thousand hectares or 38.05% of the area were subjected to anthropogenic load. However, this indicator has different values depending on the type of landscape: 23,63%-65,92 % (Table. 2). The total area occupied by settlements, roads, trails, communication lines and man-made structures of the district was 100.5 hectares or 2.04%. The total area of agricultural land (arable land, hayfields, pastures) within this landscape amounted to 1771.3 hectares (36.01%) were subjected to anthropogenic influence.

The regional indicators of agricultural land by land type varied as follows: oak-hornbeam, hawthorn, alychevy forest trees and shrubs on the settled brown soils of the moderately dissected steep slopes of antecedent valleys - 101.4 ha (22.94%); oak, hornbeam, hold the tree, hawthorn, etc.on strongly settled brown soils of weakly dissected medium-slope mountain slopes - 521.7 ha (25.92%) oak, hornbeam, hold tree, dogwood, hawthorn on medium-sized settled brown mountain-forest soils of medium-divided, medium-slope low-mountain slopes - 457.9 ha (33.84%); blackberry bushes, dogwood, pear, dogwood on medium-sized brown mountain-forest soils of poorly divided low-mountain slopes - 690.3 ha (62.13%).

This landscape is considered relatively more developed in agricultural terms (36.01%). 339.0 ha or 6.89% of these lands are arable land, 25.4 ha or 0.52% are perennial plantations, 1406.9 ha or 28.6% are hayfields and pastures. The share of arable land of this type of landscape is higher than other types.

Table 2

Parameters of anthropogenic factors on the landscape of arid woodlands and shrubs

Types of landscape	Area, ha	Parameters of anthropogenic factors, area /%					
		Settlements roads, trails, communication lines, etc.	Agricultural land				General
			Crop	Perennial plantations	Hayfields and pastures	Agri-cultural in total	
Oak, hornbeam, blackthorn, hawthorn, etc. on powerful steppe mountain-brown soils of slightly dissected medium-sloping mountain slopes.	2012,89	<u>32,8</u> 1,63	<u>102,7</u> 5,10	<u>5,8</u> 0,29	<u>413,2</u> 20,53	<u>521,7</u> 25,92	<u>554,5</u> 27,55
Oak, hornbeam, hold a tree, cotoneaster, hawthorn bushes on	1352,95	<u>22,5</u> 1,66	<u>98,1</u> 7,25	<u>3,1</u> 0,23	<u>356,7</u> 26,36	<u>457,9</u> 33,84	<u>480,4</u> 35,5

medium-thick steppe mountain brown soils of medium-dissected medium-slope low-mountain slopes							
Oak, hornbeam, hawthorn on steppe brown mountain forest soils on steep, moderately dissected slopes of antecedent valleys	442,05	<u>3,1</u> 0,70	-	-	<u>101,4</u> 22,94	<u>101,4</u> 22,94	<u>104,5</u> 23,63
Hold a tree, dogwood, pear on steppe medium-thick brown mountain forest soils of slightly dissected, slightly inclined slopes	1110,97	<u>42,1</u> 3,79	<u>138,2</u> 12,44	<u>16,5</u> 1,48	<u>535,6</u> 48,21	<u>690,3</u> 62,13	<u>732,4</u> 65,92
<b>Total:</b>	4918,86	<u>100,5</u> 2,04	<u>339,0</u> 6,89	<u>25,4</u> 0,52	<u>1406,9</u> 28,60	<u>1771,3</u> 36,01	<u>1871,8</u> 38,05

The steppe landscape covers slightly dissected mountain slopes, undivided watersheds, and southwestern piedmont sloping plains [1]. The surface of the plain has a slight slope (3-5<sup>0</sup>), gradually increasing to the north, north-west, i.e., to the foot of the mountain (8-10<sup>0</sup>). On the territory of the Lengebiz Ridge, different types of steppe landscape are located in areas with varying degrees of slope: they make up 0-10<sup>0</sup>-12,62 % or 3057,5 ha; 10-20<sup>0</sup> - 35,73% or 8652,68 ha; 20-30<sup>0</sup> - 51,64% or 12506,37 hectares of area..

This type of landscape is characterized by steppe and semi-steppe vegetation. However, under the influence of human economic activity and as a result of natural processes, landscape complexes have been transformed here [10,11].

The average annual temperature here is 12-13<sup>0</sup>C, the average annual amount of solar radiation ranges from 125-135 kcal/cm<sup>2</sup>. The annual sum of positive temperatures above 10<sup>0</sup> is 3800-4200<sup>0</sup>, the radiation balance of the surface varies within 38-48 kcal/cm<sup>2</sup>. The average annual rainfall ranges from 400-500 mm.

Irrigated lands in this type occupy a large area. Although the proportion of anthropogenic factors - settlements, roads, communication lines and other structures in the steppe (steppe) landscape is high, the impact of agricultural land, especially arable land, on landscape complexes is more pronounced. This is natural, because this type of landscape is more mastered and modified by man. Thus, the total area subject to anthropogenic impact within this landscape type is 13,054.75 ha, or 53.91% of the landscape type (Table 3).

The area of settlements, roads, paths, communication lines and other technical structures within the landscape type is 456.61 hectares, or 1.88%.

Sagebrush, alfalfa, camel thorn, etc. are common on typically gray-brown soils of poorly articulated low-mountain slopes and hilly-wavy watersheds. They have a higher weight than other species (3.51%) on the same soils. The landscape type, developed on light gray-brown soils of medium-dissected low-mountain slopes, which is weakly affected by technogenic installations (1.08%), is represented by such types of vegetation as wild rose, blackberry, bearded vulture, clover, wormwood, etc., occupy the total area under settlements and other technical structures in 456.61 ha.

As already noted, the impact of agricultural land on natural biocenoses is very significant for all types of landscapes. On the Lengebiz ridge and in the surrounding areas, this indicator is higher than in previous landscapes. The area of agricultural land (cultivated and intensively grazed) is 12,598.14 hectares, 52.02% of the area is under the influence of this anthropogenic factor. Here, this form of load is also unevenly distributed across landscape types (40.16–61.65%).

So, for example, this indicator for a landscape type represented by plants such as wormwood borodach, oatmeal, etc., growing on dark gray-brown soils of dissected, slightly inclined watersheds, is 61.65%, and the indicator for a landscape type, including such plant species as hold a tree, dogwood, wormwood, borodach, etc., growing on typical gray-brown soils of poorly divided slopes, is only 40.16%.

The share of arable land among agricultural lands was 9.97%, and the total area was 2414.22 hectares. Wormwood, bearded, clover, oatmeal, etc. growing on dark gray-brown soils of undifferentiated weakly inclined watersheds, occupy a large share of cultivated land among other landscape types (22.55%).

Table 3

*Parameters of anthropogenic factors of different types of steppe landscape of the Lengebiz ridge and adjacent territories*

Types of landscape	Area, ha	Parameters of anthropogenic factors, area /%					
		Settlement, roads, trails, communication lines, etc.	Agricultural land				General
			Crop	Perennial plantations	Hayfields and pastures	Agricultural in total	
Keep a tree, dogwood, wormwood, bearded on medium-sized dark gray-brown soils of poorly dissected mountain slopes.	6190,81	<u>114.5</u> 1,85	<u>501.46</u> 8,10	<u>79.24</u> 1,28	<u>1905.53</u> 30,78	<u>2486.23</u> 40,16	<u>2600.73</u> 42,00
Wormwood, borodach, alfalfa oatmeal, etc. on powerful dark gray-brown soils of dissected weakly inclined watersheds.	2073,22	<u>32.5</u> 1,57	<u>467.51</u> 22,55	<u>25.08</u> 1,21	<u>785.54</u> 37,89	<u>1278.13</u> 61,65	<u>1310.63</u> 63,22
Steppe plants wormwood, clover, on powerful typical gray-brown soils of weakly divided wavy low mountains	1057,75	<u>14.38</u> 1,36	<u>244.45</u> 23,11	<u>12.69</u> 1,20	<u>262.85</u> 24,85	<u>519.99</u> 49,16	<u>534.37</u> 50,52
Keep a tree, hawthorn, bearded, steppe plants on powerful dark gray-brown soils of weakly dissected shallow watersheds.	984,28	<u>20.77</u> 2,11	<u>207.88</u> 21,12	<u>13.38</u> 1,36	<u>279.63</u> 28,41	<u>500.89</u> 50,89	<u>521.66</u> 52,99
Wormwood, kengis, tree saltwort, etc. on light gray-brown washed soils of medium and intensely dissected low-mountain slopes.	4109,23	<u>80.95</u> 1,97	<u>265.87</u> 6,47	<u>53.83</u> 1,31	<u>1997.08</u> 48,60	<u>2316.78</u> 56,38	<u>2397.73</u> 58,35
On light gray-brown soils of slightly dissected low-mountain slopes and hilly-wavy watersheds wormwood, alfalfa, camel thorn on powerful light gray-brown soils.	328,85	<u>11.54</u> 3,51	<u>30.16</u> 9,17	<u>4.24</u> 1,29	<u>132.43</u> 40,27	<u>166.83</u> 50,73	<u>178.37</u> 54,24
Wormwood, oatmeal, foxtail, rare tree, etc. on medium-thick gray-brown soils of moderately dissected low-mountain slopes.	3686,18	<u>86.25</u> 2,34	<u>298.58</u> 8,10	<u>11.43</u> 0,31	<u>1740.24</u> 47,21	<u>2050.25</u> 55,62	<u>2136.5</u> 57,96
Wormwood, bearded man, alfalfa, a rare tree, etc. on medium-thick, ordinary gray-brown soils, the average of dissected mountain slopes.	3476,74	<u>67.45</u> 1,94	<u>212.08</u> 6,10	<u>10.08</u> 0,29	<u>1689.70</u> 48,60	<u>1911.86</u> 54,99	<u>1979.31</u> 56,93

Wormwood, bearded vulture and various shrubs on medium thick light gray-brown soils of slightly dissected mountain slopes.	1075,27	<u>14,95</u> 1,39	<u>97,74</u> 9,09	<u>14,08</u> 1,31	<u>549,89</u> 51,14	<u>661,71</u> 61,54	<u>676,66</u> 62,92
Sparse wild rose, blackberry bushes, bearded man, clover, wormwood on light gray-brown soils of moderately dissected low-mountain slopes.	1234,22	<u>13,32</u> 1,08	<u>88,49</u> 7,17	<u>4,81</u> 0,39	<u>612,17</u> 49,60	<u>705,47</u> 57,16	<u>718,79</u> 58,24
Total:	<u>24216,55</u> 100	<u>456,61</u> 1,88	<u>2414,22</u> 9,97	<u>228,86</u> 0,94	<u>9955,06</u> 41,10	<u>12598,14</u> 52,02	<u>13054,75</u> 53,91

A type of landscape with a low index of arable land, represented by bearded vulture, clover, rarely kept by a tree, wormwood, etc. on light gray-brown soils of moderately dissected mountain slopes. The share of perennial crops in this type of landscape is small (0.94%), and the total area of these agricultural lands is only 228.86 hectares. However, the distribution of perennial plantings within the steppe landscape is different: on the light gray-brown soils of the medium-jointed slopes of the mountains-wormwood, borodach, clover, partly hold a tree, etc. Perennial shrub crops occupy 10.08 hectares, which is 0.29% of the area of this landscape type. Its share in the landscape of such shrubs as the holden tree hawthorn, bearded and other steppe plants growing on dark gray-brown soils of weakly divided slightly inclined watersheds is 1.36% or 13.38 hectares.

As in the previous types of landscape, in the steppe landscape of the Lengebiz ridge and adjacent territories, the share of pastures and hayfields was high (41.1%) and amounted to 9955.06 hectares. Wormwood-bearded and mixed shrub landscapes on ordinary gray-brown soils of slightly dissected mountain slopes are more susceptible to anthropogenic impact than other landscapes (51.14%), and the total area of land under pastures and hayfields within this type of landscape is 549.89 ha.

**CONCLUSION 1.** The landscape cover of the Lengebiz ridge was studied in field and chamber conditions, its boundaries were clarified and the transformation of soils and vegetation in landscape complexes under the influence of anthropogenic factors was revealed.

2. The following types of landscape are identified within the object of study: low-mountain forests; low-mountain forest shrubs (arid-sparsely wooded and shrub complexes); low-mountain steppes; xerophytic dry steppes of mountain plains; low-mountain semi-deserts; dry steppes of accumulative plains; river-valley landscapes.

3. On the basis of GIS, anthropogenic loads for some landscape complexes of the Lengebiz ridge are analyzed and evaluated. Based on aerospace and orthophotomaterials, the area of farms, settlements, infrastructure within landscapes was calculated, the boundaries of natural and anthropogenic landscapes were clarified; a landscape map of a scale of 1:100,000 has been compiled, and the boundaries of the landscape and the contours of anthropogenic origin within them were calculated based on the GIS program.

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