Journal of Life Sciences & Biomedicine, vol. 4(77), No 2, p. 50-63 (2022)

Soils of the Karabakh Economic Region of Azerbaijan and their ecological assessment

[*1]Mammadov Garib Shamil, [2] Mammadov Zaman Rashid, [2] Osmanova Sona Abkhaz

[1]Presidium of Azerbaijan National Academy of Sciences, 30 Istiglaliyyat Str., Baku AZ 1001, Azerbaijan
[3]Institute of Soil Science & Agrochemistry, Ministry of Science and Education of the Republic of Azerbaijan, 4 M.Rahim Str., Baku 1073, Azerbaijan

***For correspondence:** garibmammadov1@gmail.com*

Received: October 1, 2022; Received in revised form: October 17, 2022; Accepted: November 6, 2022

The article presents extensive information about climatic and soil indicators, as well as the soil composition of the newly created Karabakh Economic Region. The given data cover the pre-occupation period, except for some districts, modern total data are described. Investigated soils of the Karabakh Economic Region, the state of their use in the rural economy, the composition of the soil cover. On the basis of indicators of the internal diagnostics of soils, distributed over the economic district, the assessment of administrative districts was carried out, and the DEM and soil map were prepared based on modern technologies on the GIS platform. Also, the results of the soil and climatic conditions of the new economic district were analyzed, an ecological assessment was carried out and a map was compiled. The results of the conducted scientific research proved the essence of relying on scientific principles in increasing the flexibility of the rational use of agricultural lands for carrying out restoration and construction works on territories freed from occupation.

***Keywords**: Karabakh Economic Region, soil, fertility, assessment, ecological assessment, GIS, map*

INTRODUCTION

In order to ensure the sustainable development of cities and regions of our country, the President of the Republic of Azerbaijan signed a decree dated July 7, 2021. According to this decree, Azerbaijan is divided into 14 economic regions, one of which is the Karabakh Economic Region. This economic region includes the cities of Khankendi, Agjabadi, Agdam, Barda, Fuzuli, Khojali, Khojavend, Shushi and Tartar administrative regions. The mentioned regions and cities are the result of a very thoughtful policy for the restoration and rapid development of the ancient Karabakh region, which has its rich historical and cultural heritage and mysterious nature. The reintegration of the liberated regions into the economy of our country is a very important issue in terms of increasing the effectiveness of planned work on economic regions and ensuring flexibility in managing the economy.

It should be noted that since the middle of the 20th century, as in the whole world, in our republic, due to the rapid development of science and technology, the creation of various production areas, the rapid growth of the population, while at the same time, the aggressive policy of other countries and the violation of the legal regime surrounding lands had a negative impact on the ecological environment and natural resources of the country, especially on the use of soil resources (Mammadov, 2021).

In the modern period, the role and importance of the soil factor in human life have increased even more. The activity and development of the agricultural sector, functioning in a way to meet the natural needs of man and directly related to the soil, is associated primarily with the land factor, and then with the

https://doi.org/10.29228/jlsb.1
Available online 30 December 2022

state of its use. Even industrial production, which at first glance is not directly related to the land factor, is to some extent connected with soil and other resources associated with it. It should be noted that land relations have always been one of the main factors that decided the fate of the country.

MATERIALS AND METHODS

The Karabakh Economic Region differs from other regions of the republic in the complexity of natural conditions. The vegetation of the region, characterized by various climatic features, attracts attention to its biodiversity. Wormwood semi-deserts, dry deserts and semi-deserts on the foothill plains, xerophilic thickets, broad-leaved forests (beech, oak, etc.) are common on mountain slopes.

As a result of the interaction of the natural complexes of the region, a unique composition of the soil cover was formed. The existing vegetation cover of the formed and developing area mainly consists of herbaceous mountain-meadow, steppe mountain-meadow, brown mountain-forest, mountain-black, gray-brown, mountain-chestnut, gray, meadow-forest are widely distributed alluvial subtypes and types of meadow soils. In the mountain-mid-mountain zone, it is characterized mainly by a mild warm climate with dry winters, and in the high mountain zone - a cold climate with dry winters. As can be seen from the climatic data, the air temperature fluctuates between 1.90-3.30 (Fizuli and Tartar) in the mountainous part, and in the middle mountain zone it reaches -0.50 (Shusha). The same regularities are observed in the change of air temperature by seasons of the year.

Methods of approaches to the ecological assessment of soils for agricultural, fodder and forest crops have undergone a significant transformation from the 80s-90s of the last century to the beginning of the present century. When establishing special rating scales for the degree of manifestation of individual characteristics, the materials of G.Sh.Mammadov's own research, as well as the scales of a number of researchers on salinity, the structural-aggregate composition of soils, as well as climatic indicators of soils in Azerbaijan, were used (Mammadov, 2007).

However, at the beginning of the 2000s, a more advanced assessment system was put forward, which retained the scientific, theoretical and methodological foundations of the general approach of professors S.Z.Mammadova and G.Sh.Mammadov. In assessing the degree of manifestation of environmental symptoms in previous studies, he expressed the degree of manifestation of environmental symptoms by a score, and not from concepts expressing quality, that is, "high", "low", "bad", "good", and so on (Mammadova, 2006).

Also, characterizing the bioclimatic potential of the territories, A.J.Eyyubov divided them into 7 groups according to gradations (<0.8; 0.8-1.2; 1.2-1.6; 1.6-2.2; 2.2-2.8; 2.8-3.4; >3.4) and assessed these groups in terms of severity using both concepts and evaluation points.

Even in recent years, guidelines "Compilation of interactive soil maps based on GIS" and "Guidelines for the preparation of interactive electron soil maps and maps of ecological assessment of soils at a scale of 1:100000" have been developed, which are more innovative methods in this direction (Mammadov et al., 2020; Mammadov, 2022).

RESULTS AND DISCUSSION

To revive the agrarian economy, first of all, it is necessary to organize the effective use of soils, specifically determine the types of land ownership, create a mechanism for monitoring the use of land resources, and resolve such issues as their protection and conservation. Therefore, it is necessary to comprehensively introduce theoretical and practical knowledge on the restoration, improvement and protection of soil fertility, especially issues related to soil ecology. Undoubtedly, the growing demand of the population for agricultural products depends primarily on solving the problem of restoring, increasing and protecting the fertility of soils used for this purpose. The soil cover as an important component of the biosphere and an independent natural object is formed as a result of the influence of abiotic (relief, climate, parent rocks), biotic (vegetation and animals) and anthropogenic

factors that form the soil. It is from this point of view that the soils spread in the Karabakh Economic Region are distinguished by their diversity (Table 1).

Grassy mountain-meadow soils. These soils are typical soils, more common in the subalpine zone of the highlands of our republic. Grassy mountain-meadow soils are distributed at altitudes of 1800-2000 (2500) m, occupying a large area between mountain forests and alpine meadows. Grassy mountain-meadow soils form a single belt in the mountains of the Lesser Caucasus. Favorable relief conditions of the Karabakh volcanic highland, which has a relatively large area, created more favorable conditions for the development of these lands over a large area. Grassy mountain-meadow soils are rich in humus. Its amount in the upper layer is 16.6±2.9%. Grassy mountain-meadow soils are currently used mainly for summer pastures and mowing. However, intensive anthropogenic soil erosion is currently taking place in a number of areas, pasture paths, dirt roads, animal hooves destroy the grass layer of the soil, accelerate surface washout and create linear erosion (Mammadov, 2007).

Mountain meadow-steppe soils. Mountain-meadow-steppe soils stand out as an independent type of soil formation. These soils, characteristic of subalpine meadow steppes, are mainly distributed at altitudes of 1900-2100 m. However, in the southern regions of our republic, the upper boundary of the distribution areas of these soils rises to 2000-2200 m. Mountain-meadow-steppe soils are developed on the Karabakh plateau, Zangazur, Mikhtokan and Karabakh ranges in the Lesser Caucasus region.

Differences are observed in the sequence of genetic horizons and their thickness, depending on the relief conditions of the areas of soil development, the composition of parent rocks, and the age of soil formation. M.E.Salayev (1991) showed that the characteristic profile of mountain-meadow-steppe soils is characterized by the following morphological features: areas of distribution of mountain-meadow-steppe soils are used mainly as natural meadows. Only a small part of them is used for grain and potato crops.

Typical brown mountain-forest soils. In contrast to the subtype described above, typical brown mountain forest soils are distributed over relatively large forest areas in Azerbaijan. In the Lesser Caucasus, they are distributed above 1200 m. They can be found in all forests, especially on the eastern and western slopes, under oak and beech forests. The amount of humus in typical brown mountain forest soils is relatively high compared to other subtypes. In the upper layer, its amount ranges from 8.41-11.05%, and total nitrogen is within 0.54-0.9%. A sharp change in the amount of humus in the lower layers is characteristic. According to M.E.Salayev, the average amount of humus and nitrogen in the upper layer of these soils is 10.0±1.7% and 0.61±0.10%, respectively. Humus reserves of the upper meter layer of soil are 220-400 t/ha, nitrogen reserves are 20-40 t/ha (Mammadov, 2007).

Carbonate mountain black soils. Carbonate mountain black soils were formed as a result of the deep steppe formation of forests. Currently, these soils are being developed under forb steppes. In the described soils, the humus content belongs to the humus type, the amount of humic acids is higher than that of fulvic acids. If the Ch/Cf ratio is greater than one, a significant part of the humic acids combines with calcium, forming calcium humates. The fact that the C/N ratio in the upper horizons is low (3.7-7.7-9.6) indicates a deep decomposition of humus compounds in these soils. From the production point of view, carbonate mountain black soils are currently used mainly for grain, partly for tobacco and potatoes, without crop rotation.

Leached brown mountain-forest soils. Leached brown mountain-forest soils are not very large in the area; they occupy relatively small areas in the dry forest zone. These soils usually do not form an integral array, since they are formed mainly on the border with brown mountain forest soils on relatively well-moistened northern and northwestern forest slopes, in a relatively shaded forest zone. The amount of humus in the upper horizon of these soils ranges from 4.78-7.93%. Its average amount is 6.0±1.3%. The amount of humus gradually decreases in the lower horizons (Mammadov, 2007).

Typical brown mountain-forest soils. Typical brown mountain-forest soils are one of the soil subtypes widely distributed in the dry forests of

the region. Typical brown mountain-forest soils occupy a large area in a relatively weakly fragmented mid-mountain zone. The described soils differ in that the amount of humus is somewhat higher than in leached brown mountain-forest soils. In the upper horizons, its amount ranges from 5.6 to 10.8%. In southwestern Azerbaijan, it reaches 5.72-6.98% (Hasanov, 1978). Its average amount is 6.4±1.2%. The humus layer is extended down, in some cases even at a depth of 60-70 cm the amount of humus is not lower than 0.7-0.8%.

Carbonate brown mountain-forest soils. The belt in which these soils are distributed borders on typical and leached brown mountain forest soils from above and gray-brown soils of dry subtropical steppes in the system of altitudinal zonality. In the dry forests of the region, typical carbonate brown mountain forest soils are formed under sparse, significantly grayed oak-beech forests, as well as xerophilic shrub formations with well-developed herbaceous vegetation. The total amount of phytomass in this zone often does not exceed 100 t/ha. The amount of humus in carbonate brown mountain forest soils is somewhat lower than in other subtypes. Its average amount often does not exceed 4.0-8.0%.

Dark gray-brown (chestnut) soils. Dark gray-brown (chestnut) soils are distributed over a relatively limited area compared to other subtypes. These soils are bordered by grayish-brown soils at an altitude of 500-550 m in the upper part, and the lower boundary passes at an altitude of about 200-300 m. These soils often develop on rubble-garnet soil-calcareous loams, carbonate loess-like loams and clays. The humus profile of dark gray-brown (chestnut) soils almost repeats the profile of brown soils. The amount of humus varies between 3-5%. The distribution of humus in the soil profile towards the lower layers is gradual. At a depth of 80-90 cm, its amount is 0.5-0.7% (Mammadov, 2007).

Ordinary gray-brown (chestnut) soils. Ordinary gray-brown (chestnut) soils are one of the widespread subtypes of gray-brown soils. The soils included in this subtype are distributed between heights of 200-400 m in the Karabakh plain in the surrounding parts of the Kur-Araz plain. The amount of humus in ordinary gray-brown (chestnut) soils is less than in dark gray-brown soils. Its amount fluctuates between 2.0-3.0% in the upper horizons. The amount of humus in ordinary gray-brown (chestnut) soils in the southwest of the country reaches 3.09% (Hasanov, 1978).

Light gray-brown (chestnut) soils. Light gray-brown (chestnut) soils are a drier variant of gray-brown soils and are common in the drier parts of dry steppes, often below dark and normal gray-brown soils. The described soils are mainly formed under sagebrush-aggot, ephemeral-sagebrush, and in some cases under sagebrush-grass-ephemeral plants. The amount of humus does not exceed 2.1-2.3%. In some areas, its number is lower. The change of humus in the lower layers of the soil profile occurs gradually (Mammadov, 2007).

"Sod" gray-brown (chestnut) soils. "Sod" gray-brown (chestnut) soils are distributed over a limited area compared to other subtypes of gray-brown soils. These soils were formed on the crust of sulfate and carbonate erosion and spread in the form of a whole strip from Shamkir to Ganja, as well as in the Gazakh region, throughout Araz (Jabrail, partially Fizuli and Zangilan regions), in the form of separate spots on the Karabakh plain. The amount of humus in "sod" gray-brown (chestnut) soils usually does not exceed 2.2-2.8%. There are hardened, carbonate, saline, irrigated and underdeveloped types of gray-brown (chestnut) soils.

Meadow gray-brown (chestnut) soils. Soils included in this subtype are formed on relatively high and poorly drained river terraces, in areas where groundwater is located closer to the surface of the earth (2-3 m). Groundwater, located close to the surface, has a large influence on the process of soil compaction. In addition, a certain role in the moistening of these soils is played by surface waters flowing from the surrounding slopes, since they spread over relatively low-relief elements.

Gray soils. Gray soils of the region are poorly supplied with humus. Its quantity in the upper soil layer is 1.4±0.1%. In some species, the amount of humus varies between 1.5-2.0%, and in some cases, its absolute amount exceeds 2%. The main part of humus accumulates in the upper horizons (A and AB) and decreases with depth, amounting to 0.3-0.6% at a depth of 1 m. However, at the same depth, in some cases, the

amount of humus exceeds 1%. The absorption capacity of gray soils is characterized by average values. Absorbed sodium is 8-15% of the absorption capacity. Soils are usually alkaline.

Floodplain meadow-forest soils. The floodplain meadow-forest soils of our republic are mainly distributed in developed forests in the floodplains and low terraces of the main rivers of the Lesser Caucasus in the dry-steppe zone. In areas where floodplain meadow-forest soils are spread, groundwater is usually located close to the surface (1-3 m) and plays a major role in the soil treatment process. According to the profile, the amount of humus decreases sharply towards the lower layers. The amount of humus in the buried horizons of these soils is 2-3 times higher than in the horizons above and below it. Floodplain meadow-forest soils are sufficiently provided with organic matter. The average amount of humus in the upper horizon of the soil is 3.2±0.4%.

To prepare the soil map of the Karabakh economic region, a traditional map at a scale of 1:600000 was first scanned and reduced to coordinates in the ArcGIS program. Later, certain information was placed in the attribute database of contours after vectorization (Fig. 1).

To map a digital terrain model of this region, the boundary of the study area was first recognized in the Global mapper program and a DEM file was loaded (Fig. 2). The DEM file we received was loaded into the ArcGis program and set up for printing. Based on the DEM map, you can see the maximum and minimum heights of the terrain (Mammadov et al., 2020; Mammadov, 2022).

The Azerbaijani state, in accordance with the interests of the whole society, carries out state registration of rights to land plots, as well as control over the targeted use of landowners and tenants of these lands. Therefore, the study of land resources, not only from a legal but also from a natural and economic point of view, is considered one of the main tasks of the state land cadastre.

Table 1. The composition of the soil cover of the region

Types and subtypes	Area
	ha
Primitive and peaty mountain-meadow	67
Grassy mountain-meadow	14931
Steppe mountain-meadow	23522
Typical brown mountain-forest	7174
Typical brown mountain-forest	101124
Grass carbonate mountain-forest	2124
Leached brown mountain-forest	42325
Carbonate and steppe brown mountain-forest	49443
Carbonate mountain black	7033
Dark and ordinary mountain gray-brown	67981
Dark and ordinary mountain-chestnut	116903
Partially humus sulfate (limestone) and not fully developed mountain chestnut	28578
Dark and ordinary chestnut	84372
Partly residually solonetzic light chestnut	45196
Humus sulfate (limestone) chestnut	23416
Meadow-chestnut and chestnut	56978
Dark gray	22100
Typical gray	24102
Light and primitive gray	16461
Grassy gray	45089
Gray-grass with high humus	59251
Gray-meadow with medium and low humus	8003
Floodplain and carbonate (tugai) meadow-forest	13386
Floodplain alluvial meadow	83876
Grass swamp and swamp	3111
Bare rocks and exposed various rocks	12871

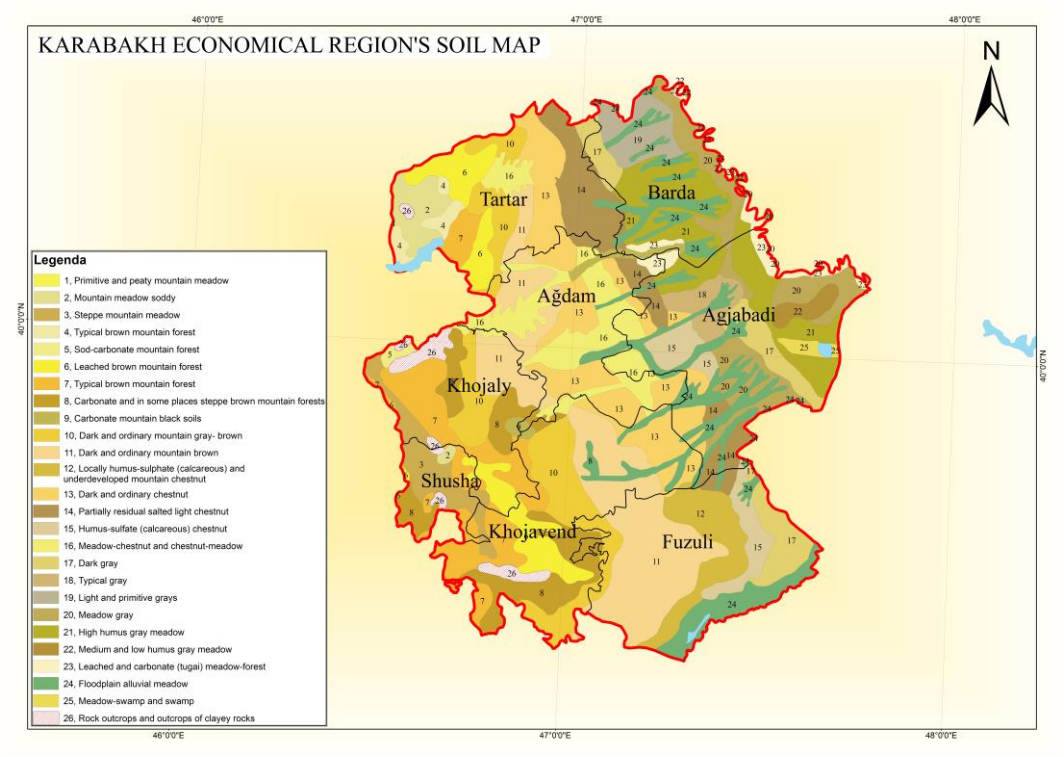

Fig. 1. Soil map of Karabakh Economic Region

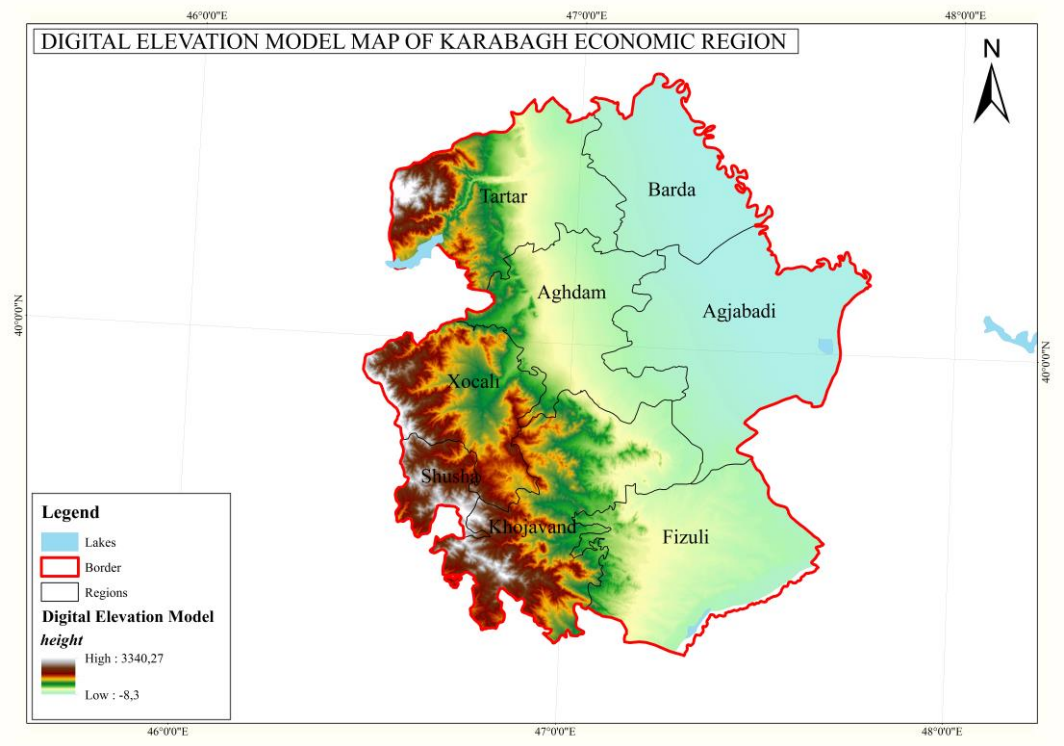

Fig. 2. DEM map of Karabakh Economic Region

Soil assessment has a dual meaning for the land registry. First, it is included in the land cadastre as an independent indicator; secondly, in the economic evaluation of soils, credit indicators ensure its objectivity, directly participating in the formation of the economic value of soils. Soils vary in fertility. Therefore, taking into account the diversity of soil fertility, their genetic and production classification and comparative assessment of their internal diagnostic indicators, i.e. their revision, are among the most important issues both in theoretical and practical terms. In table 2, the data of analyzes carried out for administrative regions in the bonitet scale of the lands of the Karabakh economic region are also reflected in the bonitet scores of the diversity of soils distributed in the region (Mammadov et al., 2022; Osmanova, 2022).

Table 2. Bonitet scale of soils of the Karabakh Economic Region (by administrative regions)

Soils	Area, ha	Bonitet scale
1	**2**	**3**
Aghdam		
Leached brown mountain-forest	42	84
Carbonate and steppe brown mountain-forest	867	93
Carbonate mountain black	2607	100
Dark and ordinary mountain gray-brown	1160	63
Dark and ordinary mountain-chestnut	17162	65
Dark and ordinary chestnut	37752	80
Partly residually solonetzic light chestnut	4982	77
Meadow-chestnut and chestnut-meadow	38919	56
High-humus gray-meadow	58	68
Floodplain and carbonate (tugai) meadow-forest	1703	88
Floodplain alluvial meadow	4459	63
Aghjabadi		
Meadow-marsh	3111	84
Meadow-gray	29041	80
Meadow-chestnut and chestnut-meadow	7818	67
Humus sulfate (limestone) chestnut	10734	100
Gray-meadow with medium and low humus content	6608	76
Partly humus sulfate (limestone) and unripe mountain chestnut	16	77
Partly residually solonetzic light chestnut	11298	95
Floodplain alluvial meadow	29544	75
Dark gray	12704	98
Dark and ordinary chestnut	9226	100
Floodplain and carbonate (tugai) meadow-forest	7121	99
High-humus gray-meadow	30598	93
Tartar		
Primitive and peaty mountain-meadow	67	20
Meadow mountain-meadow	13788	100
Typical brown mountain-forest	7114	98
Floodplain brown mountain-forest	21163	95
Typical brown mountain-forest	6947	96
Carbonate mountain black	409	100
Dark and ordinary mountain gray-brown	16560	77
Dark and ordinary mountain-chestnut	6124	73
Dark and ordinary chestnut	21102	89
Partly residually solonetzic light chestnut	25203	63
Meadow-chestnut and chestnut-meadow	7277	62
Dark gray	2436	92
Light and primitive gray	19	74
High-humus gray-meadow	285	76
Floodplain alluvial meadow	1009	71

Table 2 continued

1	2	3
Bare rocks and exposed various rocks	796	<10
Barda		
Light and primitive gray	16442	52
Meadow-gray	16048	100
Carbonate mountain-brown	1941	90
Partly residually solonetzic light chestnut	1395	95
Floodplain alluvial meadow	19851	75
Dark gray	5454	78
Floodplain and carbonate (tugai) meadow-forest	26088	89
High-humus gray-meadow	28309	86
Fizuli		
Carbonate and partly steppe brown mountain-forest	1877	100
Dark and ordinary mountain gray-brown	6420	75
Dark and ordinary mountain-chestnut	53322	77
Partly humus sulfate (limestone) and unripe mountain chestnut	28197	92
Dark and ordinary chestnut	279	95
Partly residually solonetzic light chestnut	1550	67
Humus sulfate (limestone) chestnut	12682	91
Dark gray	15491	97
Floodplain alluvial meadow	20214	75
Shusha		
Grassy mountain-meadow	1141	89
Steppe mountain-meadow	13321	96
Floodplain brown mountain-forest	1397	94
Typical brown mountain-forest	6408	96
Carbonate and partly steppe brown mountain-forest	6065	98
Bare rocks and exposed various rocks	1340	10
Khojaly		
Grassy mountain-meadow	3	89
Steppe mountain-meadow	7676	72
Grassy carbonate mountain-forest	2124	89
Floodplain brown mountain-forest	6244	84
Typical brown mountain-forest	26040	85
Carbonate and partly steppe brown mountain-forest	14604	69
Carbonate mountain black	1193	100
Dark and ordinary mountain gray-brown	12862	80
Dark and ordinary mountain-chestnut	15413	65
Dark and ordinary chestnut	57	80
Meadow-chestnut and chestnut-meadow	1307	56
Bare rocks and exposed various rocks	6877	<10
Khojavand		
Steppe mountain-meadow	2525	72
Floodplain brown mountain-forest	13478	99
Typical mountain-forest	22928	100
Carbonate and partly steppe brown mountain-forest	26029	100
Carbonate mountain black	679	99
Dark and ordinary mountain gray-brown	30980	81
Dark and ordinary chestnut	24882	76
Partly humus sulfate (limestone) and unripe mountain chestnut	366	76
Dark and ordinary chestnut	15956	76
Meadow-chestnut and chestnut-meadow	1658	65
Floodplain alluvial meadow	8799	74
Bare rocks and exposed various rocks	3858	<10

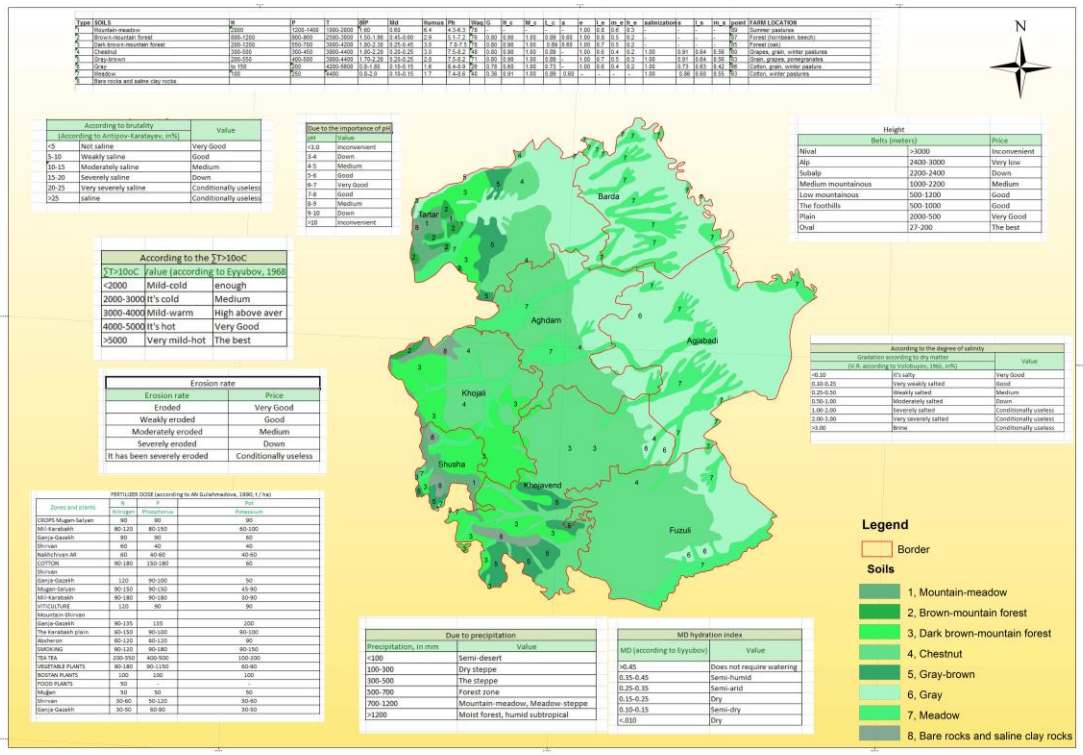

Fig. 3. Soil ecological assessment map of the Karabakh Economic Region

In the steppe zone, mountain-chestnut soils are common, occupying 29.6% of land resources. They are widely used in agriculture, horticulture, grain growing and animal husbandry. Brown mountain forest soils, which rank second in terms of the amount of soil resources in the region, occupy 25.1% of the total soil resources with partially steppe mountain forest soils. The main part of agricultural land, i.e. 48.9% are meadows and pastures. The areas of cultivated and rested lands, occupying the second place, are 38.3%. The area of land used for perennial crops reaches 9.1%. 34.% of the region's agricultural land is irrigated. The largest part of the irrigated areas suitable for agriculture, i.e. 67.8%, belongs to cultivated lands. 81.7% of perennial crops are cultivated on irrigated lands, which is 23.5% of irrigated areas in agriculture. The most irrigated areas in the region are registered in Aghdam and Fizuli regions (49.7-46.4 thousand ha). 25.4 thousand hectares of irrigated land in the Tartar region (Mammadov, 2007).

11.0% of the lands of agricultural turnover belong to the first quality group due to their high fertility. In terms of quality parameters, the main part of usable land is concentrated in 53.0% of the good quality group, which is somewhat less fertile, and the credit score ranges from 80-61. As a result of many years of careless use of land, fertility properties have deteriorated, so 31.4% of suitable land has been transferred to the group of the land of medium quality. Even 4.3% of the land used in the district was in poor quality land, as fertility indicators were seriously disturbed. The land that was once in circulation (0.3%) is not currently used, as it has been transferred to conditionally unsuitable land.

Drainage conditions of the area and salinization, waterlogging, erosion and other processes are among the factors that adversely affect the properties of natural soil fertility. At present, 39.7% of irrigated lands in the region are saline to some extent. 22.0% of saline soils are moderately saline and 11.6% are highly saline areas.

Table 3. Ecological assessment of soils of the Karabakh Economic Region (by administrative regions)

Soils	H	Y	T	BİP	Md	Humus	pH	Sag	Gr					E				S				point	Farm
									c	h.c	m.c	l.c	s	e	l.e	m.e	s.e	s	l.s.	m.s.	s.s.		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Aghdam																							
Brown mountain-forest	200-1200	550-700	3000-4200	1.80-2.30	0.25-0.45	3.0	7.0-7.5	78	0.80	0.90	1.00	0.89	0.60	1.00	0.7	0.5	0.2	-	-	-	-	85	Forest (oak)
Chestnut	300-500	300-450	3800-4400	1.80-2.20	0.20-0.25	3.0	7.5-8.2	48	0.80	0.90	1.00	0.89	-	1.00	0.6	0.4	0.2	1.00	0.91	0.64	0.56	60	Grapes, grain, winter pastures
Gray-brown	200-550	400-500	3800-4400	1.70-2.20	0.20-0.25	2.8	7.5-8.2	71	0.80	0.90	1.00	0.89	-	1.00	0.7	0.5	0.3	1.00	0.91	0.64	0.56	63	Grain, grapes, pomegranate, winter pastures
Gray	Up to 150	200	4200-5600	0.8-1.80	0.10-0.15	1.6	8.4-8.9	26	0.78	0.60	1.00	0.73	-	1.00	0.6	0.4	0.2	1.00	0.73	0.63	0.42	66	Cotton, grain, winter pastures
Meadow	100	250	4400	0.8-2.0	0.10-0.15	1.7	7.4-8.6	40	0.36	0.91	1.00	0.89	0.60	-	-	-	-	1.00	0.86	0.60	0.55	63	Cotton, winter pastures
Tartar																							
Mountain-meadow	2000	1200-1400	1000-2000	1.60	0.60	6.4	4.3-6.3	78	-	-	-	-	-	1.00	0.8	0.6	0.3	-	-	-	-	89	Summer pastures
Brown mountain-forest	800-900	2500-3000	1.50-1.90	0.45-0.60	2.9	5.1-7.2	76	0.80	0.90	1.00	0.89	0.60	1.00	0.8	0.5	0.2	-	-	-	-	-	87	Forest (beech)
Brown mountain-forest	200-1200	550-700	3000-4200	1.80-2.30	0.25-0.45	3.0	7.0-7.5	78	0.80	0.90	1.00	0.89	0.60	1.00	0.7	0.5	0.2	-	-	-	-	85	Forest (oak)
Chestnut	300-500	300-450	3800-4400	1.80-2.20	0.20-0.25	3.0	7.5-8.2	48	0.80	0.90	1.00	0.89	-	1.00	0.6	0.4	0.2	1.00	0.91	0.64	0.56	60	Grapes, grain, winter pastures
Gray-brown	200-550	400-500	3800-4400	1.70-2.20	0.20-0.25	2.8	7.5-8.2	71	0.80	0.90	1.00	0.89	-	1.00	0.7	0.5	0.3	1.00	0.91	0.64	0.56	63	Grain, grapes, pomegranate, winter pastures
Gray	Up to 150	200	4200-5600	0.8-1.80	0.10-0.15	1.6	8.4-8.9	26	0.78	0.60	1.00	0.73	-	1.00	0.6	0.4	0.2	1.00	0.73	0.63	0.42	66	Cotton, grain, winter pastures
Meadow	100	250	4400	0.8-2.0	0.10-0.15	1.7	7.4-8.6	40	0.36	0.91	1.00	0.89	0.60	-	-	-	-	1.00	0.86	0.60	0.55	63	Cotton, winter pastures
Fizuli																							
Chestnut	300-500	300-450	3800-4400	1.80-2.20	0.20-0.25	3.0	7.5-8.2	48	0.80	0.90	1.00	0.89	-	1.00	0.6	0.4	0.2	1.00	0.91	0.64	0.56	60	Grapes, grain, winter pastures
Gray-brown	200-550	400-500	3800-4400	1.70-2.20	0.20-0.25	2.8	7.5-8.2	71	0.80	0.90	1.00	0.89	-	1.00	0.7	0.5	0.3	1.00	0.91	0.64	0.56	63	Grain, grapes, pomegranate, winter pastures
Gray	Up to 150	200	4200-5600	0.8-1.80	0.10-0.15	1.6	8.4-8.9	26	0.78	0.60	1.00	0.73	-	1.00	0.6	0.4	0.2	1.00	0.73	0.63	0.42	66	Cotton, grain, winter pastures
Meadow	100	250	4400	0.8-2.0	0.10-0.15	1.7	7.4-8.6	40	0.36	0.91	1.00	0.89	0.60	-	-	-	-	1.00	0.86	0.60	0.55	63	Cotton, winter pastures

Table 3 continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Shusha																							
Mountain-meadow	2000	1200-1400	1000-2000	1.60	0.60	6.4	4.3-6.3	78	-	-	-	-	-	1.00	0.8	0.6	0.3	-	-	-	-	89	Summer pastures
Brown mountain-forest	200-1200	550-700	3000-4200	1.80-2.30	0.25-0.45	3.0	7.0-7.5	78	0.80	0.90	1.00	0.89	0.60	1.00	0.7	0.5	0.2	-	-	-	-	85	Forest (oak)
Chestnut	300-500	300-450	3800-4400	1.80-2.20	0.20-0.25	3.0	7.5-8.2	48	0.80	0.90	1.00	0.89	-	1.00	0.6	0.4	0.2	1.00	0.91	0.64	0.56	60	Grapes, grain, winter pastures
Gray-brown	200-550	400-500	3800-4400	1.70-2.20	0.20-0.25	2.8	7.5-8.2	71	0.80	0.90	1.00	0.89	-	1.00	0.7	0.5	0.3	1.00	0.91	0.64	0.56	63	Grain, grapes, pomegranate, winter pastures
Meadow	100	250	4400	0.8-2.0	0.10-0.15	1.7	7.4-8.6	40	0.36	0.91	1.00	0.89	0.60	-	-	-	-	1.00	0.86	0.60	0.55	63	Cotton, winter pastures
Khojaly																							
Mountain-meadow	2000	1200-1400	1000-2000	1.60	0.60	6.4	4.3-6.3	78	-	-	-	-	-	1.00	0.8	0.6	0.3	-	-	-	-	89	Summer pastures
Brown mountain-forest	800-1200	800-900	2500-3000	1.50-1.90	0.45-0.60	2.9	5.1-7.2	76	0.80	0.90	1.00	0.89	0.60	1.00	0.8	0.5	0.2	-	-	-	-	87	Forest (beech)
Brown mountain-forest	200-1200	550-700	3000-4200	1.80-2.30	0.25-0.45	3.0	7.0-7.5	78	0.80	0.90	1.00	0.89	0.60	1.00	0.7	0.5	0.2	-	-	-	-	85	Forest (oak)
Chestnut	300-500	300-450	3800-4400	1.80-2.20	0.20-0.25	3.0	7.5-8.2	48	0.80	0.90	1.00	0.89	-	1.00	0.6	0.4	0.2	1.00	0.91	0.64	0.56	60	Grapes, grain, winter pastures
Meadow	100	250	4400	0.8-2.0	0.10-0.15	1.7	7.4-8.6	40	0.36	0.91	1.00	0.89	0.60	-	-	-	-	1.00	0.86	0.60	0.55	63	Cotton, winter pastures
Khojavand																							
Mountain-meadow	2000	1200-1400	1000-2000	1.60	0.60	6.4	4.3-6.3	78	-	-	-	-	-	1.00	0.8	0.6	0.3	-	-	-	-	89	Summer pastures
Brown mountain-forest	200-1200	550-700	3000-4200	1.80-2.30	0.25-0.45	3.0	7.0-7.5	78	0.80	0.90	1.00	0.89	0.60	1.00	0.7	0.5	0.2	-	-	-	-	85	Forest (oak)
Chestnut	300-500	300-450	3800-4400	1.80-2.20	0.20-0.25	3.0	7.5-8.2	48	0.80	0.90	1.00	0.89	-	1.00	0.6	0.4	0.2	1.00	0.91	0.64	0.56	60	Grapes, grain, winter pastures
Gray-brown	200-550	400-500	3800-4400	1.70-2.20	0.20-0.25	2.8	7.5-8.2	71	0.80	0.90	1.00	0.89	-	1.00	0.7	0.5	0.3	1.00	0.91	0.64	0.56	63	Grain, grapes, pomegranate, winter pastures
Gray	Up to 150	200	4200-5600	0.8-1.80	0.10-0.15	1.6	8.4-8.9	26	0.78	0.60	1.00	0.73	-	1.00	0.6	0.4	0.2	1.00	0.73	0.63	0.42	66	Cotton, grain, winter pastures
Meadow	100	250	4400	0.8-2.0	0.10-0.15	1.7	7.4-8.6	40	0.36	0.91	1.00	0.89	0.60	-	-	-	-	1.00	0.86	0.60	0.55	63	Cotton, winter pastures

Slightly saline soils make up 66.4% of irrigated soils. The area of irrigated soils is 42.4 thousand hectares, which is equal to 26.6% of irrigated. 24.0% of them belong to medium and severely damaged areas. 45.9% of the region's soil resources are areas that are more or less subject to erosion. 23.4% of the eroded territories are classified as highly eroded, 28.5% moderately eroded and 48.1% slightly eroded soils. 43.3-49.1% of the territory of the Fizuli and Tartar regions is surrounded by erosion processes (Mammadov, 2007).

Fluctuations in a number of the listed soil factors testify to the importance of the ecological assessment of soils (Fig. 3, table 3). The ecological assessment of soils plays an important role in solving a number of problems in soil research. The ecological assessment of soils characterizes the conditions of their formation and the suitability of the soil cover for certain purposes. It is also possible to determine the correct place to classify soils using ecological assessment (Mammadov and Samadov, 2022).

Soil environmental assessment mapping should summarize the information obtained at all stages associated with soil assessment and should be reflected here. It should be noted that in the early 1990s, as a result of research by G.Sh.Mammadov. The author associated research in this direction primarily with the compilation of ecological evaluation maps of soils. Thus, an ecological map differs very significantly from a traditional soil map in that it includes the ecological characteristics of soils (Mammadov, 1998, 2004).

In general, since most of the region's land is located in mountainous and foothill areas, the erosion process is widespread here. Surface, linear, wind and irrigation erosion are widespread in these territories. In the foothill zone, there are many areas of development of gobu and ravine erosional types (Mammadov, 2014).

CONCLUSIONS

From the results of studies carried out according to the above methods, it can be seen that the soils common in the territory of the Karabakh economic region, according to their internal diagnostic indicators, are included in the group of soils of good quality. Thus, the assessment of soils in the general area corresponds to VIII and II quality groups.

The results obtained during the ecological assessment of the soil and climatic conditions of the region were of great interest. There are certain differences between the quality scores and ecological scores of soils. This is due to the diversity of soil and climatic conditions of the Karabakh region. In the ecological assessment, the highest score was 89 and the lowest score was 60.

In general, since most of the region's land is located in mountainous and foothill areas, the erosion process is widespread here. Surface, linear, wind and irrigation erosion are widespread in these territories. In the foothill zone, there are many areas of development of gobu and ravine erosional types.

Thus, in order to preserve the properties of natural fertility present in the soil cover and restore the lost fertility, complex anti-erosion measures are required.

REFERENCES

Babayev M.P., Hasanov V.H., et al. (2011) Morphogenetic diagnostics, nomenclature and classification of Azerbaijani soils. Baku: Elm, p.452 (in Azerbaijani).

Mammadov G.S. (1998) Ecological evaluation of Azerbaijani soils. Baku: Elm, p.282 (in Azerbaijani).

Mammadov G.S. (2004) Ecoethical problems of Azerbaijan: scientific, legal, moral aspects. Baku: Elm, p.380 (in Azerbaijani).

Mammadova S.Z. (2006) Ecological evaluation of the Lankaran region lands of Azerbaijan. Baku: Elm, p.372 (in Azerbaijani).

Mammadov G.S. (2007) Basics of soil science and soil geography. Baku: Elm, p.644 (in Azerbaijani).

Mammadov G.S. (2007) Socio-economic and ecological bases of effective use of Azerbaijan's land resources. Baku: Elm, p.856 (in Azerbaijani).

Mammadov Z.R. (2014) Ecological assessment of the soils of the Lesser Caucasus north-eastern

slope. Baku: Elm, p.216 (in Azerbaijani).

Mammadov G.Sh., et al. (2020) Methodical instruction on the compilation of interactive electronic land and ecological cost maps of land on a scale of 100,000. Baku: Elm, p.95 (in Azerbaijani).

Mammadov G.Sh. (2021) Lands of Azerbaijan freed from occupation: problems, restoration, effective use and mapping based on GIS. *"Materials of the republican scientific conference on "Biodiversity, land and water resources of Karabakh: past, present and future"*. Baku, Elm, p. 116 (in Azerbaijani).

Osmanova S.A. (2022) Soil cover of the Karabakh plain. Scientific journal "Bulletin of Science and Practice", No 7: 82-96 (in Russian).

Salayev M.E. (1991) Diagnostics and classification of Azerbaijani soils. Baku: Elm, p.240 (in Russian).

Eyubov A.A. (1975) Assessment of the climate of the Azerbaijan SSR. Baku, Elm p.148 (in Russian).

Mammadov G.Sh. (2022) Fundamentals for the establishment of interactive electronic maps and maps of environmental assessment of soils on the basis of GIS. *Sciences of Europe* (*Praha, Czech Republic)*, **103:** 14-26.

Mammadov G.Sh., Samadov P.A. (2022) System analysis, an important method for studying the transformation of solar energy for individual ecosystem blocks. *In proc. of IV International Scientific and Practical Conference International Scientific Discussion: problems, tasks and prospects*, Great Britain: Brighton, p. 636-640.

Mammadov G.Sh., Samadov P.A., Osmanova S.A. (2022) To the study of the biogeocenotic state of the gray-brown (chestnut) soils of the Karabakh steppe during the post-war time. *German International Journal of Modern Science (Satteldorf, Germany)*, **31:** 13-16.

Azərbaycanın Qarabağ iqtisadi rayonunun torpaqları və onların ekoloji qiymətləndirilməsi

[1] Məmmədov Qərib Şamil oğlu, [2] Məmmədov Zaman Rəşid oğlu, [2] Osmanova Sona Abxaz qızı

[1]Azərbaycan Milli Elmlər Akademiyasının Rəyasət Heyəti, Bakı, Azərbaycan
[2]Azərbaycan Respublikası Elm və Təhsil Nazirliyinin Torpaqşünaslıq və Aqrokimya İnstitutu, Bakı, Azərbaycan

Məqalədə Qarabağ iqtisadi rayonunun iqlim və torpaq göstəriciləri, həmçinin torpaq tərkibi haqqında geniş məlumat verilmişdir. Bu məlumatlar işğalaqədərki dövrü (bəzi ərazilər istisna olmaqla) əhatə etmiş və hazırkı ümumi vəziyyətlə bağlı informasiya da təsvir edilmişdir. Qarabağ iqtisadi rayonunun torpaqları, onların kənd təsərrüfatında istifadəsinin vəziyyəti, torpaq örtüyünün tərkibi araşdırılmışdır. İqtisadi rayon üzrə yayılmış torpaqların daxili diaqnostik göstəriciləri əsasında inzibati rayonlar üzrə bonitirovkası aparılmış, müasir texnologiyalara əsaslanan DEM və torpaq xəritəsi CİS platforması üzərində hazırlanmışdır. Eləcə də yeni iqtisadi rayon üzrə torpaq-iqlim şəraitinin nəticələri təhlil edilərək ekoloji qiymətləndirmə aparılmış və xəritəsi tərtib edilmişdir. Hazırkı məqalədə verilmiş tədqiqat nəticələri işğaldan azad olunmuş ərazilərdə bərpa və quruculuq işlərinin aparılması zamanı kənd təsərrüfatı təyinatlı torpaqlardan səmərəli istifadənin çevikliyinin artırılmasında elmi əsaslara söykənmənin vacibliyini sübut etmişdir.

Açar sözlər: *Qarabağ iqtisadi rayonu, torpaq, münbitlik, bonitirovka, ekoloji qiymətləndirmə, CİS, xəritə*

Почвы Карабахского экономического района Азербайджана и их экологическая оценка

[1] Мамедов Гариб Шамиль оглу, [2] Мамедов Заман Рашид оглу, [3] Османова Сона Абхаз гызы

[1]Президиум Национальной Академии наук Азербайджана, Баку, Азербайджан
[2] Институт почвоведения и агрохимии Министерства науки и образования Азербайджанской Республики, Баку, Азербайджан

В статье представлена информация о климатических и почвенных показателях, а также о почвенном составе вновь созданного Карабахского экономического района. Приведенные данные охватывают дооккупационный период (кроме некоторых районов), описаны современные итоговые данные. Исследованы почвы Карабахского экономического района, состояние их использования в сельском хозяйстве, состав почвенного покрова. На основе показателей внутренней диагностики почв, расспространенных по экономическому району, проведена оценка административных районов, подготовлены DEM и карта почв на основе современных технологий на платформе ГИС. Также были проанализированы результаты почвенно-климатических условий нового экономического района, проведена экологическая оценка и составлена карта. Результаты проведенных научно-исследовательских работ подтвердили необходимость опоры на научные принципы в повышении гибкости рационального использования земель сельскохозяйственного назначения при проведении восстановительно-строительных работ на освобожденных от оккупации территориях.

Ключевые слова: *Карабахский экономический район, почва, плодородие, бонитировка, экологическая оценка, ГИС, карта*