International Journal of Natural and Engineering Sciences
E-ISSN: 2146-0086 12 (1): 49-56, 2018

Analysis and Evaluation of Soil Degradation Based on Application of Modern Cartographic Technologies.

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Received: January 27, 2018
Accepted: March 30, 2018

Abstract

In the article, the author investigated the current condition of gray-brown agricultural soils spread in the area of 1097 hectares of Mamirli municipality of Tartar region, 20% of which was found to be vulnerable to salting and preventive measures were recommended to prevent the salinization. Moreover, electronic land cadastral maps have been drafted on the basis of ArcGIS software.

Keywords: *soil degradation, geoinformational technologies, erosion of soils, salinity, salination, etc.*

INTRODUCTION

In modern times protection of soil cover and fertility is one of the most important issues. 48% land reserves of the Republic are suitable for agriculture, with more than 50% of these lands being subjected to degradation as a result of erosion, resalting and salinization, as well as mining operations. This led to a decrease in fertility in the soil, degradation of the vegetation and a sharp fall in productivity and the removal of agricultural turnover. The mentioned problems have created economic and social difficulties in meeting the population's nutritional needs in general [1, 4].

As a result of the joint influence of the anthropogenic factors on the Mil-Garabagh plain, the degraded lands here cover a large area. Thus, uncontrolled grazing of cattle on the municipal property areas and winter pastures caused the fall of these areas and increase in floods [4].

MATERIALS AND METHODS

Soil types and semi-types that have been spreaded over Mil-Kharabakh plain reached a wider range in degree of degradation. Learning and evaluation of this geographical area based on modern methods have both scientific-theoretical and practical significance. In recent years, most developed countries have been widely used satellite imagery of the Earth while mapping of agriculture and other land plots. Based on the processing of these imagery, it is possible to map agricultural areas and other objects in the areas with 100 thousands hectares in a short period of time, as well as define land degradation in those territories. This is considered to be more efficient in terms of both time and proper conduct of works [2].

While doing research we have concidered using GPS and other modern measuring systems, compiling electronic maps and cartograms based on GIS technology, and creating databases.

RESULTS AND DISCUSSION

On the basis of numerical drawings of satellite images, there were prepared map of 1: 10000 magnitudinal natural farming areas of the Mamirli municipality of Tartar region, land map, and salination map.

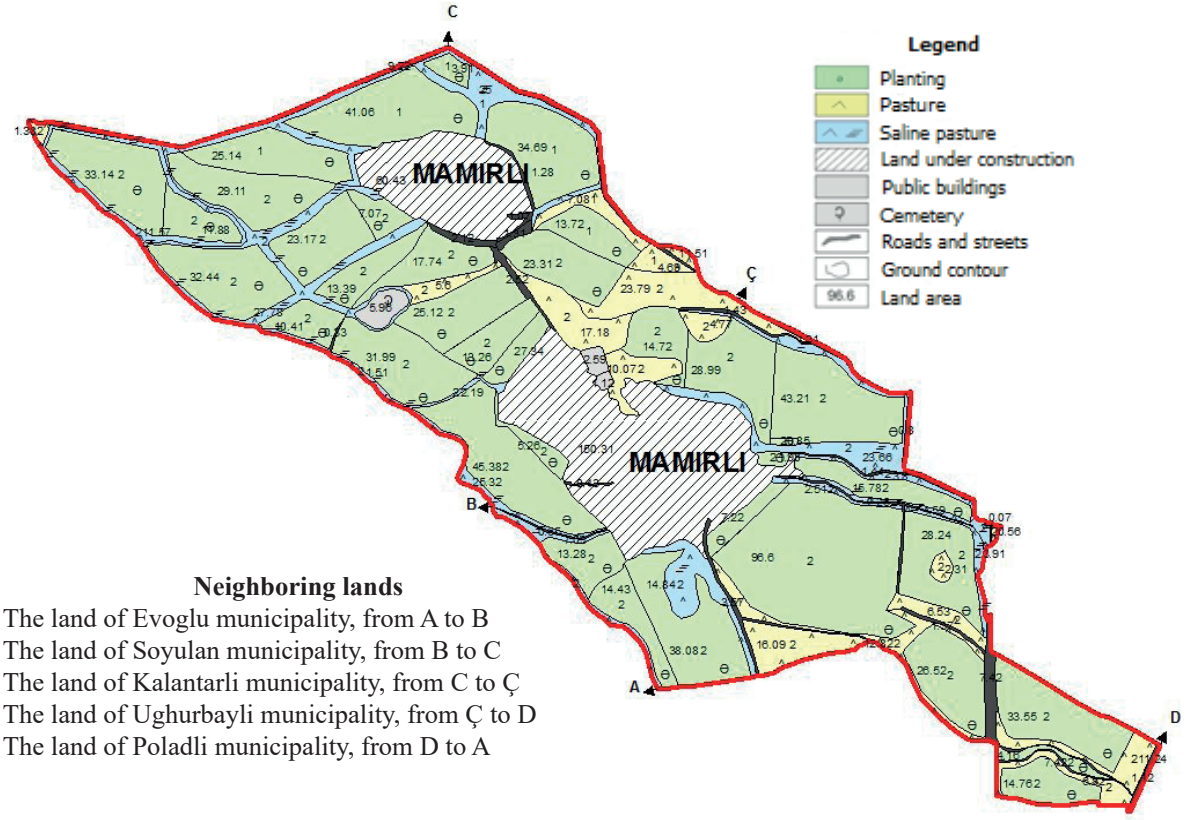


Figure 1. Map of natural farming areas of Mamirli municipality of Tartar region

On the basis of the processing of cosmic images, the map of the natural farming areas of the Mamirli municipality has been shown, including planting areas, saline grasslands, land under construction (villages, etc.) and public buildings (school, etc.), cemeteries (Figure 1).

According to the results of field-soil surveys and laboratory analyzes carried out in the territory of the research object, it was defined that gray-brown soil type is common for this area. These lands are 1097 hectares of the total area that fully cover the study area and divided into heavy loamy, thick and medium loamy, thick diverse of granulometric composition (Figure 2).

Depending on the morphological indications of the cut, the color of the soil is brown in the upper layer, light brown in the middle layer, and the pale yellow in the last layer. Structure is cloggy in th upper layer, small cloggy in the middle layer, and unstructured in the last layer. Granulometric composition is heavy loamy along the profile. From newborns and grasses, roots and rhizomes, there are paths of insects, rust spots and cracks. It is solid or slightly solid on the upper layers and soft on the lower layers. This soil is affected by the effect of 10% HCl. The humidity is moist and less moist, transition to genetic layers is clear and gradual.

From the laboratory analysis it is clear that granulometric composition of the gray-brown soil that is spreade there is heavy or medium loamy. Thus, the amount of physical clay varies between 35.74-43.90% in the upper layers and 35.74-46.58% along the profile (Table 1).

№ of cut	Depth, sm	Particle size in mm, quantity in %						Physical clay in % <0,01mm
		1-0,25	0,25-0,05	0,05-0,01	0,01-0,005	0,005-0,001	<0,001	
1. Heavy loamy, thick gray-brown								
13	0-22	1.35	28.41	26.34	19.82	14.16	9.92	43.90
	22-45	0.90	26.40	37.30	9.56	15.44	20.40	45.40
	45-89	1.16	35.75	18.85	13.90	14.46	15.88	44.24
	89-138	0.88	32.06	20.48	13.38	15.56	17.64	46.58
	138-169	1.20	32.28	22.76	19.20	14.08	10.48	43.76
2. Medium loamy, thick gray-brown								
46	0-21	1.90	38.98	23.38	14.24	11.40	10.10	35.74
	21-40	1.58	40.38	20.38	14.72	12.44	10.50	37.66
	40-86	1.86	37.46	20.76	17.20	14.64	9.08	39.92
	86-140	1.54	41.70	18.64	15.30	13.22	9.60	38.12
	140-175	1.44	40.74	17.66	14.80	13.26	12.10	40.16

Table 1. Granulometric composition of the gray-brown soil (2017).
(in absolute dry land, in %)

The main ingredient is hygroscopic moisture that varies between from 3.6-4.7% along the profile. The total amount of humus is 1.77-2.33% on the upper layers and 0.80-2.33% in one meter depth. The total amount of nitrogen in the aggregate humus was 0.07-0.18% in one meter layer. The amount of pH in the water suspension is 7.6-8.1 units, which shows that gray brown soils have alkaline and weak alkaline environments. The amount of carbonates has varied between 9.48 and 13.27% along the profile (Table 2).

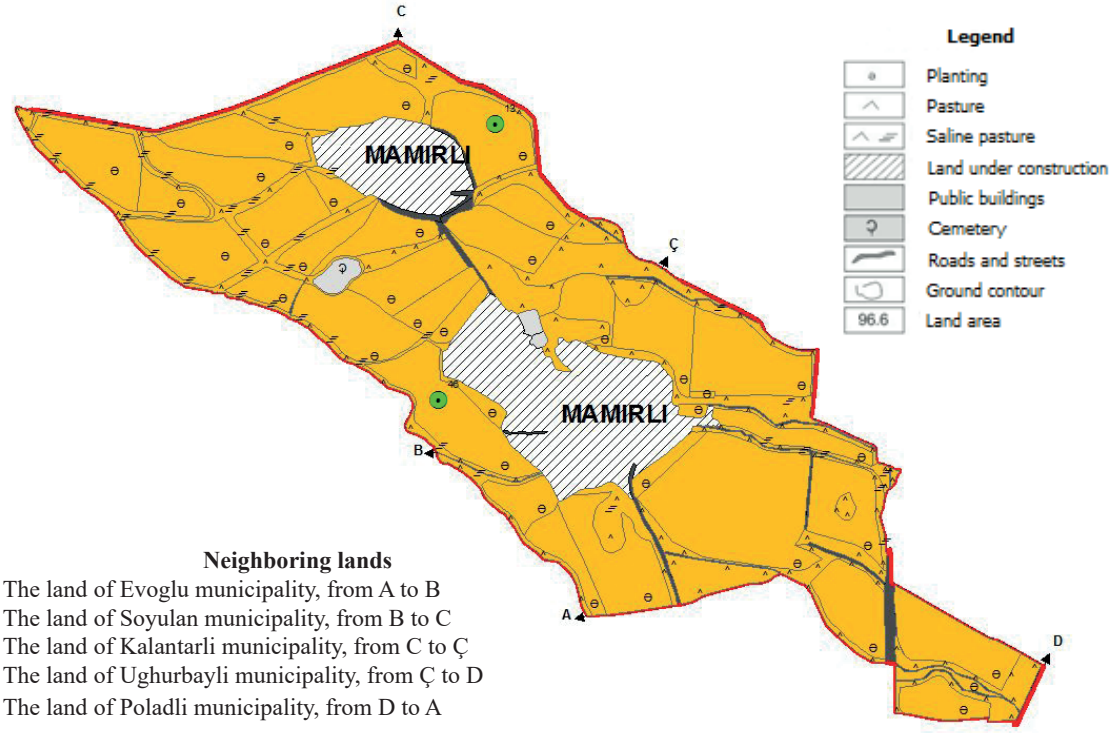
№ of cut	Depth, Sm	Hysteroscopic moisture in %	General humus in %	General nitrogen in %	CaCO3 according to CO2	pH
1. ***Heavy loamy, thick gray-brown***						
13	0-22	4.4	2.33	0.18	10.34	7.6
	22-45	4.7	1.42	0.12	11.20	7.8
	45-89	4.5	0.80	0.09	9.48	8.1
	89-138	4.7	-	-	12.00	8.0
	138-169	4.4	-	-	13.27	7.9
2. Medium loamy, thick gray-brown						
46	0-21	3.6	1.77	0.15	10.77	7.6
	21-40	3.8	1.20	0.11	12.43	7.7
	40-86	4.1	0.83	0.07	13.27	7.9
	86-140	4.0	-	-	12.86	8.1
	140-175	4.1	-	-	12.00	8.0

Table 2. Physical and chemical characteristics of gray-brown soil (2017).
(in absolute dry land, in %)

№ of cut	Depth, Sm	Total of absorbed bases, mg.ekv	Ca in % of total absorbed bases	Mg in % of total absorbed bases	Na in % of total absorbed bases
1. Heavy loamy, thick gray-brown					
13	0-22	31.12	63.05	34.54	2.41
	22-45	31.05	65.22	32.21	2.58
	45-89	-	-	-	-
	89-138	-	-	-	-
	138-169	-	-	-	-
2. Medium loamy, thick gray-brown					
46	0-21	23.65	65.54	31.71	2.75
	21-40	26.32	64.10	33.24	2.66
	40-86	-	-	-	-
	86-140	-	-	-	-
	140-175	-	-	-	-
mg.ekv equals to 20,04 mg of Ca ++ and 12,15 mg Mg ++					

Table 3. Quantity of bases absorbed in gray-brown soils (2017).
(in absolute dry land, in %)

Total of absorbed bases is 23.65-31.12 mg.ekv in this soils. Ca cation has the most priveldge among other cations which is 63.05-65.54% of total amount of absorbed bases. Mg cation is in the second place with amount equal to 31.71-34.54%. Na cation has the last place with 2.41-2.75% of total amount of absorbed bases (Table 3).

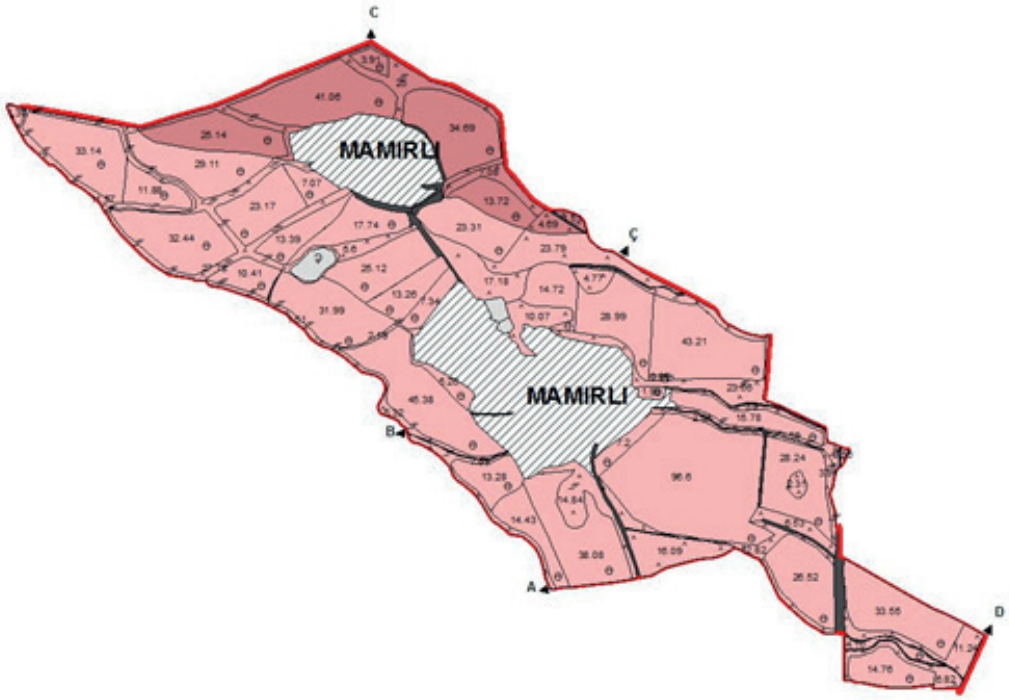


Neighboring lands

The land of Evoglu municipality, from A to B
The land of Soyulan municipality, from B to C
The land of Kalantarli municipality, from C to Ç
The land of Ughurbayli municipality, from Ç to D
The land of Poladli municipality, from D to A

LEGENDA

Sıra sayı	Rəng işarəsi	Torpaqların adı	Qranulometrik tərkibi, sm-lə	Relyefi	Torpaq əmələ-gətirən süxurlar	Təbii təsərrüfat yerləri			Sahə	
						əkin	örüş	şoran örüş	ha-la	%-lə
I. Boz-qəhvəyi torpaqlar						**830.87**	**132.45**	**133.74**	**1097.06**	**80.83**
1		Ağır gilliceli, qalın boz-qəhvəyi	ağır gilliceli	meyilli düzənlik	prolüvial	118.52	13.28	25.00	156.80	**11.55**
2		Orta gilliceli, qalın boz-qəhvəyi	orta gilliceli	meyilli düzənlik	prolüvial	712.35	119.17	108.74	940.26	69.28
Sair torpaqlar									260.12	19.17
Ümumi sahə						**830.87**	**132.45**	**133.74**	**1357.18**	**100**



Qranulometrik tərkibə aid şərti işarələr							
Sıra sayı	Rəng işarəsi	Qranulometrik tərkib	Təbii təsərrüfat yerləri			Sahə	
			əkin	örüş	şoran örüş	ha-la	%-lə
1		Ağır gilliçəli	118.52	13.28	25.00	156.80	11.55
2		Orta gilliçəli	712.35	119.17	108.74	940.26	69.28
Sair torpaqlar						260.12	19.17
Ümumi sahə			**830.87**	**132.45**	**133.74**	**1357.18**	**100**

Figure 2. Map of land and granulometric composition of Mamirli municipality of Tartar region.

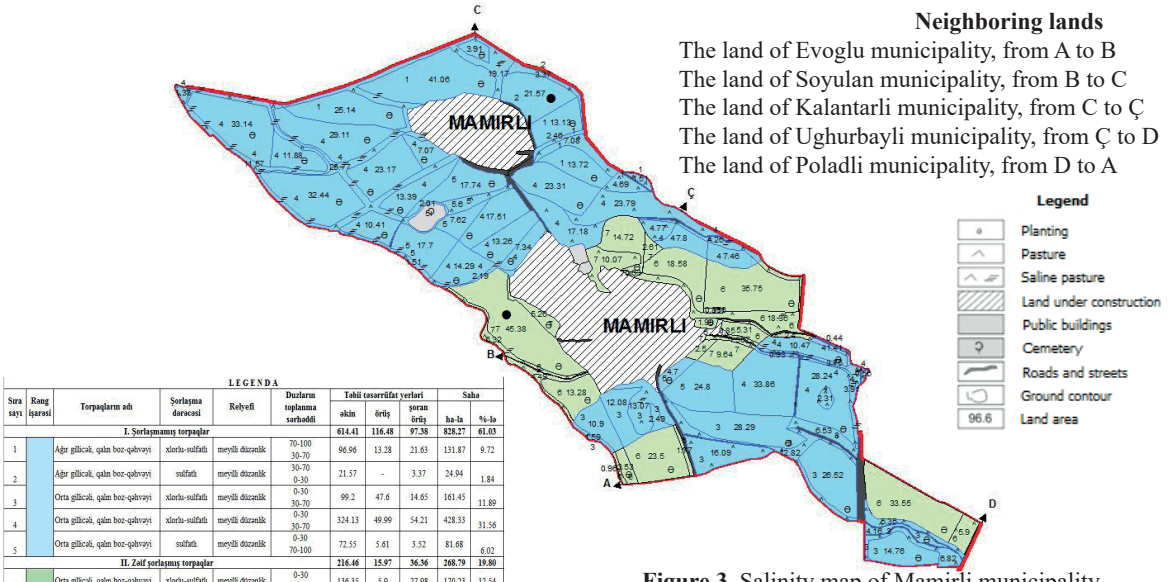
The salinization type of saline soil in the study area is sulfate and chlorinated-sulphate. The amount of dry precipitate in slightly saline soils varies from 0.633 to 0.815% in the profile. As it is shown, the amount of salt in 0-30 cm layer in complete water withdrawal is 0.67%, 0.75% in 30-100 cm layer, 0.73% in 100-150 cm layer and 0.75% in 150-200 cm layer (Table 4).

№ of cut	Depth, sm	Anions				Cations			Dry precipitate in %
		CO_3	HCO_3	Cl	SO_4	Ca	Mg	Na+	
1. Saline, heavy loamy, thick gray-brown									
13	0-22	yox	0.052 0.85	0.009 0.25	0.072 1.50	0.028 1.38	0.009 0.75	0.011 0.47	0.185
	22-45	-	0.046 0.75	0.009 0.25	0.094 1.96	0.035 1.75	0.012 1.00	0.005 0.21	0.208
	45-89	-	0.037 0.60	0.013 0.38	0.067 1.39	0.025 1.25	0.011 0.88	0.006 0.24	0.163
	89-138	-	0.040 0.65	0.009 0.25	0.122 2.54	0.040 2.00	0.015 1.25	0.004 0.19	0.235
	138-169	-	0.043 0.70	0.013 0.38	0.145 3.02	0.048 2.38	0.018 1.50	0.005 0.22	0.278
2. Slightly saline, medium loamy, thick gray-brown									
46	0-21	Yox	0.043 0.70	0.084 2.38	0.312 6.50	0.080 4.00	0.030 2.50	0.071 3.08	0.633
	21-40	-	0.040 0.65	0.040 1.13	0.445 9.26	0.093 4.63	0.033 2.75	0.094 3.66	0.750
	40-86	-	0.046 0.75	0.062 1.75	0.463 9.64	0.105 5.25	0.040 3.25	0.094 3.64	0.815
	86-140	-	0.049 0.80	0.093 2.63	0.358 7.45	0.088 4.38	0.035 2.87	0.083 3.63	0.723
	140-175	-	0.052 0.85	0.071 2.00	0.400 8.33	0.098 4.88	0.036 3.00	0.076 3.30	0.748

Table 4. The results of analysis of gray-brown soils in complete water withdraw (2017). (in absolute dry land, in %/mg.ekv)

Salination map of research area is shown in figure 3. It turns out that about 828.27 hectares (61.03%) of the lands formed from saline soils and 268.79 hectares (19.80%) from slightly saline soils. From conducted experiments it was found that the main reason for the salinization of irrigated soils is the rise of salty ground waters to the top of the earth. Thus, one of the main ways of soil salinization is to concede water loss by evaporation in agricultural and sowing areas.

The amount of salts in irrigation water has a negative impact on the development of plants as well as on the quality of products. The effect of salts on plants start when the seeds begin to swell, when density of salts is too high in the soil product, swelling of the seeds becomes weaker and its normal development is delayed. Seeds that are sprinkled on saline soils germinate slower in comparison with clean soil. In these soils the water regime of plants is also not normal, which in turn causes decline in product [3].



LEGENDA

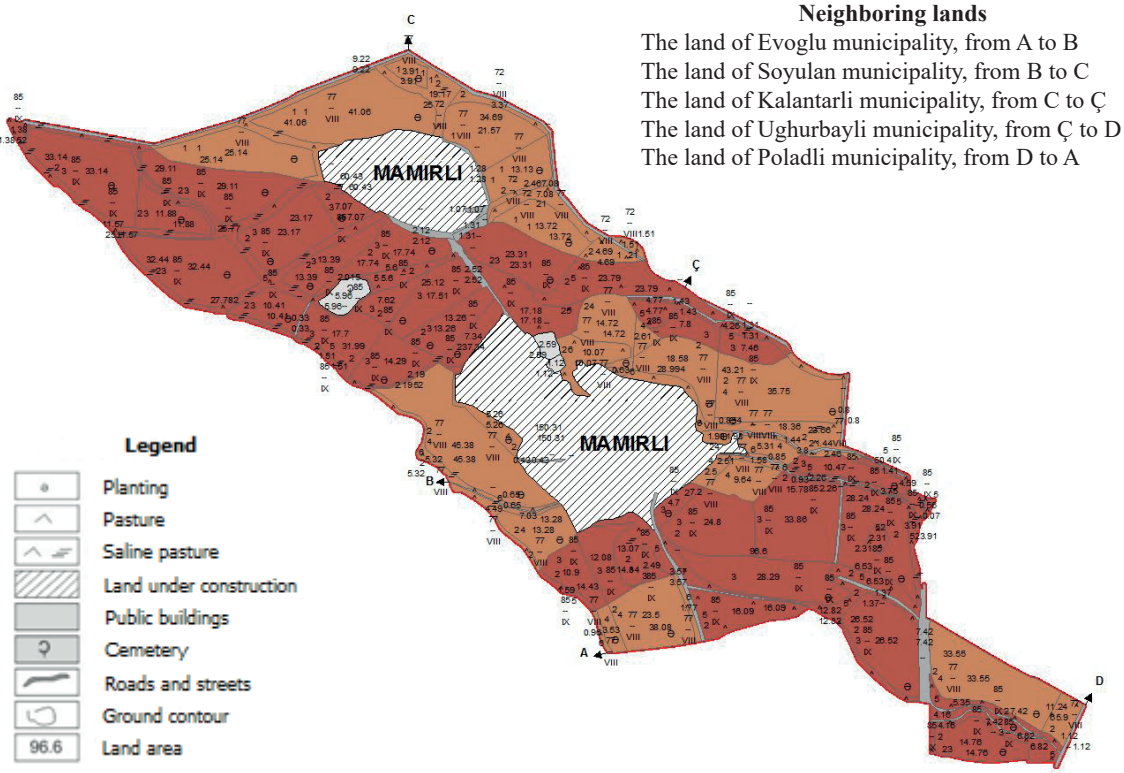
Sıra sayı	Rəng işarəsi	Torpaqların adı	Şorlaşma dərəcəsi	Relyefi	Duzların toplanma sərhədd	Təbii təsərrüfat yerləri əkin	örtü	şoran örtü	Sahə ha-la	%-lə
I. Şorlaşmamış torpaqlar						614.41	116.48	97.38	828.27	61.03
1		Ağır gilicalı, qalın boz-qəhvəyi	xlorlu-sulfatlı	meyilli düzənlik	70-100 30-70	96.96	13.28	21.63	131.87	9.72
2		Ağır gilicalı, qalın boz-qəhvəyi	sulfatlı	meyilli düzənlik	30-70 0-30	21.57	-	3.37	24.94	1.84
3		Orta gilicalı, qalın boz-qəhvəyi	xlorlu-sulfatlı	meyilli düzənlik	0-30 30-70	99.2	47.6	14.65	161.45	11.89
4		Orta gilicalı, qalın boz-qəhvəyi	xlorlu-sulfatlı	meyilli düzənlik	0-30 30-70	324.13	49.99	54.21	428.33	31.56
5		Orta gilicalı, qalın boz-qəhvəyi	sulfatlı	meyilli düzənlik	0-30 70-100	72.55	5.61	3.52	81.68	6.02
II. Zəif şorlaşmış torpaqlar						216.46	15.97	36.36	268.79	19.80
6		Orta gilicalı, qalın boz-qəhvəyi	xlorlu-sulfatlı	meyilli düzənlik	0-30 30-70	136.35	5.9	27.98	170.23	12.54
7		Orta gilicalı, qalın boz-qəhvəyi	xlorlu-sulfatlı	meyilli düzənlik	30-10 30-100	80.11	10.07	8.38	98.56	7.26
Sair torpaqlar									260.12	19.17
Ümumi sahə						830.87	132.45	133.74	1357.18	100

Figure 3. Salinity map of Mamirli municipality of Tartar region.

First of all it is important to improve the operational conditions of collector-drainage system in order to carry out land reclamation measures in salty and saline soils. It is advisable to use drainage wells to reduce the level of groundwater that is close to the surface. Drilling of these wells will allow the ground water to run down at any depth depending on the purpose. Then it is possible to remove the saline water from areas through pumping it from the wells by pumps [1].

As land reclamation is a long-term process, measures against soil salinity should be carried out for several seasons. In order to improve the condition of these soils, along with removing salinity it is also advisable to provide organic and mineral fertilizers to the soil, to cultivate salt-tolerant plants in the fields and improve land reclamation through introduction of modern agrotechnical measures.

As a result of the systematization of the data acquired during previous years of the research, an assessment of the lands scattered throughout the research object was carried out. Thus, the territories of the Mamirli municipality of Tartar region are included in the Mil-Karabakh Cadastral District. According to quality groups the lands there are classified as I (85 points) and II (77 points). The total area of land on the I quality group is 671.47 hectares, and 425.59 hectares in the II one (Figure 4).



Rəng işarəsi	Bonitet şkalası	Bonitet sinfi	Keyfiyyət qrupu	Torpaq xəritəsində kontur N-si	Bonitet kartoqramında kontur N-si	Torpaq növmüxtəlifliklərinin adı	Bonitet balı	Sahə			
								əkin	Örüş	Digər torpaqlar	ha-la	%-lə
						Mil-Qarabağ qiymət (kadastr) rayonu						
	90-81	IX	I-Yüksək	2	3	Orta gilliciəli,qalın boz-qəhvəyi	85	495.89			495.89	
				2	5	Orta gilliciəli,qalın boz-qəhvəyi	85		175.58		175.58	
						IX sinfin yekunu		495.89	175.58		671.47	
						I keyfiyyət qrupunun yekunu		495.89	175.58		671.47	49.47
	80-71	VIII	II-Yaxşı	1	1	Ağır gilliciəli,qalın boz-qəhvəyi	77	118.52			118.52	
				2	4	Orta gilliciəli,qalın,zəif şorlaşmış boz-qəhvəyi	77	216.46			216.46	
				2	6	Orta gilliciəli,qalın,zəif şorlaşmış boz-qəhvəyi	77		52.33		52.33	
				1	2	Ağır gilliciəli,qalın boz-qəhvəyi	72		38.27		38.27	
						VIII sinfin yekunu		334.98	90.6		425.58	
						II keyfiyyət qrupunun yekunu		334.98	90.6		425.58	31.36
						Digər topaqlar(yollar,qəbristanlıq,yararsız,kənd altında,göllər)					260.13	19.17
						Cəmi sərhəd daxilində		830.87	266.18	260.13	1357.18	100

Qeyd: $\frac{77}{VIII}$ Kartoqramda konturların daxilində yazılmış tamlı kəsrin tamı bonitet konturunun nömrəsini surəti torpaqların bonitet balını məxrəci isə bonitet sinfini göstərir.

Figure 4. Appraisal map of soils in Mamirli municipality of Tartar region.

CONCLUSION

Finally, we got the following results from the research:

1. In the slightly saline agricultural areas, collector-drainage network flows should be monitored and the irrigation norms should be properly regulated in order to avoid the increase in groundwater level.

2. At the time of land use, agrotechnical and agromeliorative regulations should be followed, agrochemical measures should be taken against them when hazardous areas occur.

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