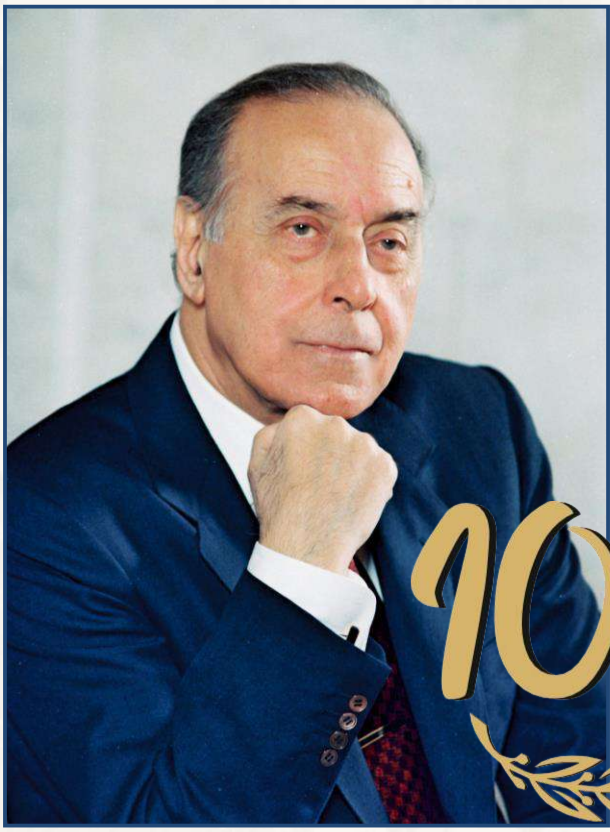

CLIMATE CHANGE AND SUSTAINABLE SOIL MANAGEMENT

INTERNATIONAL CONGRESS

21-23 june 2023
Baku, Azerbaijan

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INTERNATIONAL SOIL SCIENCE CONGRESS ON “CLIMATE CHANGE AND SUSTAINABLE SOIL MANAGEMENT”

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HEYDAR ALIYEV'S POLICY OF AGRARIAN AND LAND REFORMS

As the president of the Azerbaijan Soil Science Society, I want to tell you about the history and activities of this society. The Society of Soil Scientists of Azerbaijan was founded in 1946. From 1946 to 1975, the society was headed by academician Jabrayil Huseynov, from 1975 to 1993 - academician Hasan Aliyev, and from 1995 to the present - me. During this period, the anniversaries of Academician Volobuyev, Academician Hasan Aliyev, Academician Jabrayil Huseynov and other scientists were celebrated. The role of society in training young scientists is undeniable. All members of this society were directly involved in the land reform carried out by the great leader Heydar Aliyev.

In 2012, 4 countries (Turkey, Russia, Kazakhstan and Azerbaijan) jointly established the International Society of Eurasian Soil Scientists under our personal signature.

The 1st Eurasian Congress was held in Antalya, Turkey in October 2014.

The II Eurasian Congress was held on October 19-23, 2015 in Sochi, Russia.

The III Eurasian Congress was held on October 17-19, 2018 in Almaty, Kazakhstan.

The IV Eurasian Congress will be held on June 21-23, 2023 in Baku, Azerbaijan. It is a very

pleasant coincidence that our International Congress coincides with the 100th anniversary of the birth of great leader Heydar Aliyev. Great leader Heydar Aliyev was appointed First Secretary of the Central Committee of Azerbaijan in 1969. Before the reign of Heydar Aliyev, the situation in Azerbaijan was not encouraging. The industry and agriculture of Azerbaijan were very backward. Without taking up much of your time, I want to express my opinion in one sentence: Azerbaijan ranked 14th among the 15 union republics that were part of the former USSR at that time. In 1970, he held a general meeting. This meeting was connected with the development of agriculture in Azerbaijan. It is clear that there were not enough specialists in many areas, especially in agriculture. To overcome this problem, starting this year, he annually sent our young compatriots to the leading institutes and universities of the former USSR to study abroad. Soon, thanks to the efforts of the Great Leader, the problem is solved.

In 1975, the great leader Heydar Aliyev convened another council. This council was a further development of agriculture. The main goal here was the issue of regionalization of agriculture. Animal farming, cocoon farming, fruit growing, vegetable growing, viticulture, cotton growing and other industries were to be determined and developed by zoning which region is suitable for each industry. The presence in Azerbaijan of 9 out of 11 types of climate allows the development of more areas of agriculture.

In 1976, under the leadership of the great leader, the Reclamation and Irrigation Network was built - deep channels, a collector-drainage network, etc. Due to the difficult terrain of Azerbaijan, the construction of these networks was necessary and important.

In 1979, Heydar Aliyev further expanded the development of viticulture and winemaking. I should note that at that time Azerbaijan produced more grapes than Moldova, Ukraine, the North Caucasus, the republics of Central Asia, Armenia and Georgia combined. Because Azerbaijan has favourable climatic conditions for the development of viticulture and winemaking. At that time, grape production in Azerbaijan was 2 million tons. However, the goal was to get 3 million tons of grapes. In 1985, as a result of Mikhail Gorbachev's unsuccessful policy called "Fight against alcoholism", vineyards in Azerbaijan were destroyed. It is good that as a result of the efforts of our esteemed President Ilham Aliyev, a law on viticulture was adopted and modern vineyards were established.

The fourth meeting was not accidental. This was the result of the far-sighted policy of Heydar Aliyev. At that time, the Great Leader prepared the future platform for the development of Azerbaijan for the development and prosperity of the country.

After the appointment of the great leader Heydar Aliyev to a leading position in Moscow, who in 1982 was appointed the first deputy of the Council of Ministers of the USSR, many people led Azerbaijan. Thanks to their leadership, Azerbaijan again began to decline in all respects. As a result of the efforts of internal and external enemies, the situation in Azerbaijan has escalated. On June 13, 1993, Heydar Aliyev was invited from Nakhchivan to Baku at the insistence then-President Abulfaz

Elchibey. From there he went to Ganja and stopped the Ganja uprising. The Great Leader knew perfectly well that without stability there can be no development. These processes caused excitement among the Azerbaijani people. At that time, Azerbaijan cooperated with the United States of America, Italy, Germany, France and other countries.

Then Heydar Aliyev started the reforms. In 1995, a law on collective farms and state farms was adopted. In 1996, laws were adopted on land reform, the land code, the land market, land tax, cadastral control and land management, and municipalities. More than 52 laws, codes and legal acts have been adopted. Accordingly, orders and decrees of the President, as well as orders and decisions of the Cabinet of Ministers. It was a collection of more than 150 laws, regulations and decrees. The basic legal framework for the reform has been created. I note that the total land fund of Azerbaijan is 8.6 million hectares (86.6 thousand km2). At that time there were 2041 collective farms and state farms in Azerbaijan. Partial reforms were carried out in 41 of them. The goal was to ensure that the experience gained over 70 years under the USSR was not lost. In the base of the Land Fund of Azerbaijan, state lands make up 56.9% (summer and winter pastures, forest fund lands, specially protected lands, special cisterns, highways and other objects of state importance). 23.5% are municipal lands (suburban pastures, marginal and conditionally unused lands). 19.6% is given to private property and citizens. It is received by 845 thousand families or 3.5 million subjects.

The principles of the economic policy of the great leader were:

1) By order of Heydar Aliyev, 3.5 million people received free land. The goal is to provide jobs for 3.5 million people;

2) improve the financial situation by transferring fertile lands of former collective farms and state farms to the population;

3) there are such categories of people that, for example, teachers, doctors and other specialists should not stay away from land relations;

4) ownership of land is not granted to citizens of foreign states. This has not only economic but also political significance.

Summing up all this, we can say that Heydar Aliyev created a platform for the future development of Azerbaijan.

President Ilham Aliyev continues this policy very successfully. As soon as Ilham Aliyev was elected president in 2003, he ensured the socio-economic development of the regions. Hospitals, sports complexes and other measures aimed at improving people's well-being have found their solution. Ilham Aliyev noted that Azerbaijan is not only Baku and Absheron, all regions should develop. President Ilham Aliyev has been paying special attention to the army since he took over the leadership of Azerbaijan.

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EFFECT OF MINERAL FERTILIZERS ON SUNFLOWER OIL YIELD IN GRAY-BROWN SOILS

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The article deals with the effect of mineral fertilizers on sunflower oil yield in gray-brown soils. The nutritional conditions of sunflower in our republic haven't been almost studied. Increasing the productivity and quality of sunflower is possible by using new cultivation technologies, and most importantly, mineral fertilizers. Mineral fertilizers affect the physiological and biological processes in the plant, the formation of valuable economic indicators and productivity directly. Therefore, taking into account its importance as a valuable food plant, optimization of nutritional conditions affecting the improvement of the productivity and quality of sunflower in the region is one of the urgent problems. It has been determined that besides the productivity, mineral fertilizers increase the oil yield of sunflower seeds. Due to the effect of mineral fertilizers, oil yield increased between 148.8-617.1 kg/ha, or 17.2-75.7%, seed yield per 1 kg of NPK between 5.62-12.22 kg, and oilseed crop between 0.83 -1.71 kg compared to the control option (no fertilizer). The highest oil yield was 1349.0-1484.7 kg/ha, growth was 581.0-617.1 kg/ha or 71.1-75.7%, seed yield per 1 kg of NPK was 7,70-8,42 kg, oilseed crop was 1,61-1,71 kg by observing in $N_{120}P_{120}K_{120}$ option.

Key words: *sunflower, gray-brown, soil, mineral fertilizers, seed yield, oil yield*

INTRODUCTION

Sunflowers were planted in area of 11,095 ha in our republic, 4,746 ha in Ganja-Dashkasan economic region, and 1,851 ha in Samukh region in 2021, sunflower production for grain was accordingly 25216, 11785 and 4513 tons, and the average yield was 22.3, 24.0 and 22.1 c/ha [10].

Sunflower is mainly cultivated as oleaginous plants. Modern seed varieties and hybrid seeds contain 16% protein and 50-56% light yellow edible oil with good taste quality. The oil contains 62% biologically active linoleic acid, which improves its food quality, as well as phosphatides, vitamins A, D, E, K. Sunflower oil is widely used in the food industry as cooking oil, in the preparation of bread and confectionery products, canned fish and vegetable, margarine and mayonnaise. At the same time, it is also used in the industries of varnish and paint, soap making, tanning of leather, perfumery, textile, etc. The food and technical importance of vegetable oils is great. The shell of sunflower seeds is used as a raw material in the industry to obtain hexose and pentose sugars. Alcohol is made from hexose sugars, and furfurol from pentose sugars, from which artificial fibers, plastics, unbreakable glasses, etc. are made. At the same time, linoleum, tarpaulin, waterproof fabrics, etc. are made in the industry. Oleaginous plants are also a source of plant protein. 35-40% protein is extracted from the remaining press cake during processing the oil of the seeds. One centner of the remaining press cake is equal to 102 feed units or 3.6 kg of protein. The green mass of the sunflower is used for making fodder and high-quality silos for cattle. After the grains are harvested, the dried receptacles are used as an additional feed source in cattle-breeding. Dry receptacle yield is 55-60% of grain. The feed unit of 1 centner of flour, which is made from the receptacle, is 80, and easily digestible protein is equal to 3.8-4.3 kg. As an inter-row crop, sunflower is a good predecessor for many agricultural crops [2, pp. 236-237].

The main importance of sunflower is to get oil from it. The oil yield in seeds varies between 10-50% based on dry matter. However, it is up to 58% in new hybrids. Sunflower oil is more expensive than soybean, rapeseed, cotton and groundnut oils in the world market. Sunflower seeds are used in the preparation of confectionery and bakery products, and in the production of fodder [5, pp.120-124, 7, pp.42-46, 10, pp.54-59].

The effect of different plant densities of 47, 52, 65, 74 thousand/ha on productivity and oil content was studied in the background of mineral fertilizers $N_{90}P_{60}K_{90}$ in other studies conducted by V.P. Vladimirov and E.M. Chugunov in the forest-steppe conditions of Middle Povolje. The highest indicators were obtained at a plant density of 74 thousand/ha. The yield without fertilizer was 1,912 t/ha, oil content was 50.97%, and oil yield was 976.6 kg/ha at a plant density of 74,000/ha, and it was accordingly 2,839 t/ha, 50.97% and 1463.9 kg/ha in the $N_{90}P_{60}K_{90}$ option [6, pp. 16-20].

The effectiveness of mineral fertilizers in sunflower cultivation was studied in the research conducted by R.M.Nizamov in the forest-steppe zone of Middle Povolje. It was determined that while sunflower seed oil was 42.1%, oil yield was 555.7 kg/ha, productivity was 1.32 t/ha, nitrogen extracted from the soil was 54.0 kg/ha, phosphorus 22.0 kg/ha and potassium 68.0 kg/ha in the control option at a plant density of 70 thousand/ha, it was accordingly 44.9%, 1082.1 kg/ha, 2.41 t/ha, 100.0 kg/ha, 28.0 kg/ha and 128.0 kg/ha in the rate of mineral fertilizers calculated for the yield of 3.0 t/ha in the $N_{73}P_{21}K_{90}$ version [9, pp. 33-35].

The effectiveness of poultry manure as organic fertilizer and mineral fertilizers in sunflower crop was studied by plowing with a 10-12 cm disc harrow and at a depth of 25-27 cm on two backgrounds in the Rostov region in the researches. The productivity in the control option was 1.15 t/ha, 1.76 t/ha in the 15 t/ha poultry manure option, the growth was 0.61 t/ha or 53.3% compared to the control option at a depth of 10-12 cm in the background of plowing with a disc trowel, the productivity was accordingly 1.56 t/ha, 0.41 t/ha and 36.0%, oiliness was 36.9%, 37.6% and 36.8%, oil yield was 387 kg/ha, 612 kg/ha, growth was 225 kg/ha or 58.1% and 525 kg/ha compared to control option, growth was 138 kg/ha or 35.% in $(NPK)_{50}$ option, the productivity was 1.34 t/ha in control option on background of 25-27 cm plowing, 2.04 t/ha in the option of 15 t/ha poultry manure, growth was 0.70 t/ha or 52.0% compared to control option, the productivity was accordingly was 1.62 t/ha, 0.28 t/ha and 31.0%, oil content was 37.0%, 40.8% and 38.1%, oil yield was 450 kg/ha, 760 kg/ha, growth was 310.0 kg/ha or 68.9% and 561 kg/ha, growth was 111, 0 kg/ha or 24.7% in $(NPK)_{50}$ option [3, pp.25-26, 4, pp.31-33, 8, pp.142-143].

The nutritional conditions of sunflower in our republic haven't been almost studied. Increasing the productivity and quality of sunflower is possible by using new cultivation technologies, and especially, mineral fertilizers. Mineral fertilizers affect the physiological and biological processes in the plant, the formation of valuable economic indicators and productivity directly. Therefore, taking into account its importance as a valuable food plant, optimization of nutritional conditions affecting the improvement of the productivity and quality of sunflower in the region is one of the urgent problems.

MATERIALS AND METHODS

The main purpose of the research is to study the effective nutrition conditions affecting the growth, development, productivity, quality, biological and economic indicators of sunflower in irrigated gray-brown (chestnut) soils in the Ganja-Gazakh region.

Field experiments were carried out with the fast-growing large-grain Lakomka variety of sunflower, which was purchased from the All-Union Scientific-Research Institute of Oil Plants located in Krasnodar, Russian Federation, in irrigated gray-brown (chestnut) soils of the Ganja Regional Agrarian Science and Innovation Center of the Ministry of Agriculture in 2018-2021 and were presented in the following scheme: 1. Control (no fertilizer); 2. $(NPK)_{60}$; 3. $(NPK)_{90}$; 4. $(NPK)_{120}$; 5. $(NPK)_{150}$.

Field experiments were carried out 3 times with a total area of 100 m^2 (40x2.5 m) by sowing in rows (50x35 cm, 15 kg of seeds per hectare). Nitrogen-ammonium nitrate with 34.7%, phosphorus-single superphosphate with 18.7% and potassium-potassium sulfate with 46% were used as mineral fertilizers in the experimental field. Phosphorus, 80% of potassium were used in fall plowing, the remaining 20% in feeding and nitrogen was used in feeding 2 times. Phenological observations were repeated 2 times on 25 plants, and agrotechnical measures were carried out as a rule adopted for the region. Oil in sunflower seeds was determined in a Soxhlet method [1, p. 264].

The effect of mineral fertilizer norms on oil yield of sunflower seeds, seed and oil yield per 1 kg of NPK in irrigated gray-brown (chestnut) soils was also studied in our research during 2018-2020. The results of the study are shown in the table. As shown, the oil yield of sunflower seeds in the control (no fertilizer) option was 768.0-867.6 kg/ha. As a result of the use of different rates of mineral fertilizers, oil yield increased compared to the control option (no fertilizer). So, the oil yield is 949.5-1062.6 kg/ha, the growth is 148.8-246.6 kg/ha or 17.2-30% compared to the control-no fertilizer option, seed yield per 1 kg of NPK was 10.94-12.22 kg, oil crop was 0.83-1.37 kg in the $(NPK)_{60}$ option, accordingly 1079.3-1215.0 kg/ha, 311.3-382.0 kg/ha or 40.0-47.5%, seed yield per 1 kg of NPK was 8.26-9.26 kg, oil crop was 1.15-1.41 kg in the $(NPK)_{90}$ option, the highest oil yield was in the $(NPK)_{120}$ option as in the productivity, so it was 1349.0-1484.7 kg/ha, the growth was 581.0-617.4 kg/ha or 71.1-75.7% compared to the control option, seed yield per 1 kg of NPK was 7.70-8.42 kg, oil crop was 1.6-1.71 kg. As mineral fertilizer rates increased, oil yield in sunflower seeds decreased in $(NPK)_{150}$ option compared to $(NPK)_{120}$ and varied between 1229.6-1347.0 kg/ha, growth was 447.6-479.4 kg/ha or 55.0-60.1%, seed yield per 1 kg of NPK was 5.62-6.13 kg, and oil crop was 1.00-1.07 kg.

Effect of mineral fertilizers on sunflower oil yield in gray-brown soils

No.	Options of practice	Productivity, c/ha	Oil content, %	Oil yield, kg/ha	Growth		Crop per 1 kq of NPK	
					kg/ha	%	Seed, kg	Oil, kg
2018								
1	Control (no fertilizer)	18,0	48,2	867,6	-	-	-	-
2	$N_{60}P_{60}K_{60}$	21,0	48,4	1016,4	148,8	17,2	11,67	0,83
3	$N_{90}P_{90}K_{9}$	25,0	48,6	1215,0	347,4	40,0	9,26	1,30
4	$N_{120}P_{120}K_{120}$	30,3	49,0	1484,7	617,1	71,1	8,42	1,71
5	$N_{150}P_{150}K_{150}$	27,6	48,8	1347,0	479,4	55,3	6,13	1,07
2019								
1	Control (no fertilizer)	16,0	48,0	768,0	-	-	-	-
2	$N_{60}P_{60}K_{60}$	19,7	48,2	949,5	181,5	23,6	10,94	1,01
3	$N_{90}P_{90}K_{9}$	22,3	48,4	1079,3	311,3	40,5	8,26	1,15
4	$N_{120}P_{120}K_{120}$	27,7	48,7	1349,0	581,0	75,7	7,70	1,61
5	$N_{150}P_{150}K_{150}$	25,3	48,6	1229,6	461,6	60,1	5,62	1,03
2020								
1	Control (no fertilizer)	17,0	48,0	816,0	-	-	-	-
2	$N_{60}P_{60}K_{60}$	22,0	48,3	1062,6	246,6	30,0	12,22	1,37
3	$N_{90}P_{90}K_{9}$	24,7	48,5	1198,0	382,0	47,0	9,15	1,41
4	$N_{120}P_{120}K_{120}$	29,3	48,8	1430,0	614,0	75,0	8,14	1,71
5	$N_{150}P_{150}K_{150}$	26,0	48,6	1263,6	447,6	55,0	5,78	1,00

So, mineral fertilizers increase oil yield of sunflower seeds besides productivity. Due to the influence of mineral fertilizers, oil yield increased by 148.8-617.1 kg/ha, or 17.2-75.7%, the seed yield per 1 kg of NPK by 5.62-12.22 kg, and the oil yield by 0.83-1.71 kg compared to the control (no fertilizer) option. The highest oil yield was observed in $N_{120}P_{120}K_{120}$ option and was 1349.0-1484.7 kg/ha, growth was 581.0-617.1 kg/ha or 71.1-75.7%, seed yield per 1 kg of NPK was 7.70-8.42 kg, oil yield was 1.61-1.71 kg.

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INFLUENCE OF HIGH DOSES OF NITROGEN FERTILIZERS ON THE ACCUMULATION OF HEAVY METALS IN THE VEGETATIVE ORGANS AND FRUITS OF TOMATOES

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Recently, various studies have been conducted on the absorption of heavy metals from the soil by the tomato plant through its root system. During the research, we have learned the changes in the uptake of heavy metals from the soil by the tomato plant as a result of the application of high doses of nitrogen fertilizer. For this purpose, we are studied the total amount of heavy metals in the roots, stems, leaves and fruits of tomatoes in two variants: control and 10 t/ha manure + $N_{180}P_{90}K_{90}$. The field research was conducted on an open ground on the Absheron. The experiments were carried out with the sort of tomato "Ilkin".

The amount of heavy metals in the root, stem, leaves and fruits of the tomato plant in samples taken from the variant 10 t/ha manure + $N_{180}P_{90}K_{90}$ is higher than in the control variant. However, in both cases, the amount of heavy metals is the least in tomato fruits, and most of all in the roots.

Keywords: *tomato, ammonium nitrate, heavy metals*

INTRODUCTION

Environmental pollution has become one of the most discussed issues in the current century. The scientists analyzed toxic heavy metals from irrigation water, soil and vegetative parts of tomato plants. As a result, such elements as Cu, Pb, Cr, Fe, Mn, Na, K, Ca and Mg, Zn were found in irrigation water and soil. The results of the analysis showed that toxic metals Fe, Pb, Co, Cr, Mn, Zn and Cu accumulate in the roots of tomato plants. The most toxic metal, Pb, was found in the roots and stems of tomatoes. Fe accumulated in all vegetative parts of the tomato plant, while Zn, Mn, Cr, Pb, and Cu were found in tomato fruits. It should also be noted that tomato (Solanum lycopersicum) seeds were planted and grown in pots in a greenhouse under optimal conditions [7].

In the human diet, tomato is an important source of micronutrients, anti-oxidants and secondary metabolites such as vitamins C and E, b-carotene, lycopene, flavonoids, organic acids, phenolics and chlorophyll. Tomato consumption has been found to reduce the risks of cardiovascular disease and certain types of cancer, such as prostrate, lung and stomach. The quality of tomato depends on factors such as, choice of cultivar, cultural practices, harvest time and method, storage, and handling procedures. Tomatoes grown on contaminated soils may lead to the uptake of elevated heavy concentration of metals producing adverse effect. The presence of heavy metals reduces the nutritional value of the tomato [2-4].

Heavy metals in contaminated soils have benefited from a considerable attention due to the possible risks for the human body. The current study has investigated the accumulation and transfer coefficient for three heavy metals (Cu, Pb, Zn) found in the contaminated soil with three concentrations (1.5%, 3.0%, 4.5%, 6.0%), obtained by mixing the three metals, in the tomato fruit. The highest accumulation in the tomato fruits was recorded for zinc, then copper and the smallest for lead, for all four concentrations used. The transfer coefficient decreases as the concentration of heavy metals increases in soil, so that for high heavy metals concentrations, the values of the transfer coefficient are very low, and for small heavy metals concentrations in the soil, the values for the transfer coefficient are higher [5].

Serbian scientist Zoran Sergeyevich Ilyich has repeatedly studied the amount of heavy metals and nitrates in tomatoes grown under the influence of organic fertilizers. He found that organically grown tomatoes contain fewer heavy metals and nitrates than fertilized tomatoes. He also concluded that the accumulation of heavy metals and nitrates also depends on the variety of tomato. It is better to identify and select varieties of tomatoes that absorb less harmful substances and are healthier [8].

MATERIAL AND METHODS

Gray-brown irrigated soils are especially developed in Absheron. These soils have changed due to long-term anthropogenic impact and differ significantly in structure and physico-chemical properties from gray-brown soils. Cultivated variants of irrigated gray-brown soils are characterized by heavy loamy and light clayey granulometric composition. The humus content is low (1.5-1.9%), but higher than in virgin varieties. The exchange capacity is quite high - 20-25 meq/100 g of soil. In the process of development under irrigation conditions, the pH of the aqueous suspension also increases - up to 8.5-9.2. Irrigated gray-brown soils develop under the conditions of a leaching irrigation-semi-automorphic moisture regime [9].

The basis of agriculture in Absheron is vegetable growing, melon growing, viticulture and dry subtropical fruit growing, which are included in the suburban economic complex. Olives, almonds, pistachios, figs, white and black grapes are important agricultural products grown here. There are also summer and winter pastures in Absheron. Some sorts of tomatoes with different purposes have been created and regionalized in the conditions of the Absheron Peninsula, which ensure a high yield.

Our experiments were carried out with the sort of tomato "Ilkin". This variety was obtained by crossing varieties 294-VD1-D1-DVK-DVK and Brigantina. "Ilkin" - is the first typical sort of tomato for canning purposes, for growing in open ground. Leaves of ordinary type, large (28-37 cm), green. The inflorescence is simple, compact (13-16 cm). By the duration of the growing season, "Ilkin" belongs to the group of medium-growing varieties. The duration of the growing season is 110 days [1].

One hundred grams of tomato contains the recommended daily intake of vitamin C 24-48 %, vitamin E 0.5-0.8 % and beta-carotene 2.7-4.0 %. Tomato fruits are considered the main source of lycopene. The mineral content is typically between 0.60 and 1.80 %; the main elements are K, Na, Ca, Mg, P, Fe, and Mn [6].

From the above, it is clear that heavy metals and nitrates reduce the nutritional value of tomatoes. Therefore, we set a goal to study the total amount of heavy metals in the roots, stems, leaves and fruits of tomatoes. Heavy metals were determined by the iCAP™ 7000 ICP-OES device.

DISCUSSION, RESULTS AND CONCLUSION

In our research, field studies were carried out on the experimental plot of the Research Institute of Vegetable Growing of the Ministry of Agriculture of Azerbaijan in the territory of the Absheron region (Pirshagi settlement). The photo shows the "Ilkin" tomato sort taken in the research area. As can be seen from the picture, the high dose of nitrogen fertilizer had an effect on the vegetative organs of the tomato plant, especially on the size and color of its leaves. So, the size of the leaves has increased and the color has darkened.

Pict. The sort of tomato “Ilkin”

The main goal of our research was to study the effect of high doses of nitrogen fertilizers on the quality indicators of tomato plants. Therefore, it is very important to study the amount of heavy metals. During the study for the research purposes tomato samples were taken from two variants. One of the variants is the control one, in which fertilizers are not used, and the other one is the variant of 10 t/ha manure + $N_{180}P_{90}K_{90}$, where the highest amount of nitrates is contained in tomato fruits.

The amount of heavy metals in the root, stem, leaves and fruits of the tomato plant in samples taken from the variant 10 t/ha manure + $N_{180}P_{90}K_{90}$ is higher than in the control variant. However, in both cases, the amount of heavy metals is the least in tomato fruits, and most of all in the roots. Although the leaves, stems and roots of the tomato contain large amounts of iron, copper, chromium, cobalt and silver from heavy metals, the fruits did not exceed this limit in both cases. So, if the amount of iron in the fruits of tomatoes in the control variant is 110 ppm, then in the variant 10 t/ha manure + $N_{180}P_{90}K_{90}$ is 140 ppm. The amount of iron in tomato leaves is the same in both variants and is 300 ppm, 480 and 520 ppm in the stem and 610 and 650 ppm in the root, respectively. Also, in the control variant and in the variant 10 t/ha manure + $N_{180}P_{90}K_{90}$, tomato fruits contain copper - 4 and 9 ppm, chromium – 0.9 and 1.3 ppm, cobalt - 0.2 and 0.3 ppm, silver - 0.19 and 0.24 ppm, respectively, and does not exceed the allowable limit. The amount of zinc, lead and cadmium did not exceed the norm in all vegetative organs of the tomato plant.

As a result of our research it can be concluded that an increase in the doses of nitrogen fertilizers can lead to an increase in nitrates in tomato fruits, as well as to the accumulation of heavy metals in tomato plants that disrupt biochemical processes. As a result, the accumulation of heavy metals in the vegetative organs and fruits of the tomato plant was observed, although in the fertilized variant it was slightly higher than in the control.

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SPECIES DIVERSITY OF PESTS IN HAZELNUT ORCHARDS IN SHEKI-ZAGATALA REGION

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The aim of research was establishing of pests diversity the hazel trees in Shaki-Zagatala region in Azerbaijan, for studying of their bioecological abilities. The paper was prepared on the basis of results of researches carried out in Shaki, Qakh, Zagatala, Balakan districts in 2023 during 6 month. Research was carried out on hazelnut trees growing in orchards of this region. Field works were carried out twice in a month along the route and each week in the stationary orchard. The stationary orchard located in Zagatala district village Ashagi Tala. Based on our research, it was found that the biological diversity in the hazelnut orchards of Sheki-Zagatala region is high. Diversity pests of hazelnut orchards like Big bud galls, Hazelnut aphids, Nut weevil, Wood boring, Gypsy moth, Brown Marmorated Stink Bug and etc. Brown marmorated stink bug is more dangereous pets and it is spread in the village of Aliaabad in Zagatala district.

Keywords: *aphids, bug, diversity, pests, hazelnut, orchards.*

INTRODUCTION

The aim of research was establishing of aphids damaging the hazel trees in Azerbaijan, their entomophaghs, studying of thei bioecological abilities. The paper was prepared on the basis of results of researhces carried out in Ismayilli, Gabala and Zagatala districts in 2017-2018. Research was carried out on single hazelnut bushes growing in parks and orchards of Baku and Absheron, and in hazelnut orchards and forests of Ismayilli, Gabala and Zagatala districts in 2017-2018. Field works were carried out twice in a month along the route and each week in the stationaries.

Hazelnut occupy a special place in fruit growing due to their national economic importance. Azerbaijan is considered to be one of the centers of initial natural distribution, formation (diversity) and domestication (N. I. Vavilov, 1932) of hazelnut.

Walnuts, hazelnuts, chestnuts, almonds, and pistachios are fruit crops that have been cultivated in Azerbaijan since ancient times. Cultivation of fruit plants in Azerbaijan has a history of 1000 years. This is confirmed by the material evidence found during the archaeological excavations in Nakhchivan.

The hazelnut plant ranks first in the republic in terms of distribution area, cultivated area and yield among the fruit plants. In addition to using hazelnut kernels fresh, various confectionery products are made from it, obtained is oil, and produced flour that does not lose its quality for a long time (10). Hazelnut oil is used in perfumery, painting, soap and candle making.

Today, Azerbaijan ranks fourth in the world in terms of hazelnut production, and third in terms of import. 35,000-40,000 tons of hazelnuts are produced annually, and the area of hazelnut orchards has reached 55,000 hectares. It is planned to increase this indicator to 80 thousand hectares in the near future.

Hazelnuts contain 59-70% fat, 11-18% protein, 3-8 carbohydrates, 2-3% mineral salts, 12-31% cellulose, 13-17% nitrogenous substances, carotene, vitamins and a number of macro and micro elements. As a result of long-term selection, the varieties Ata-baba, Oil hazelnut, Ganja hazelnut, Ashrafi, and also the imported Kudryavchik variety, which are the product of folk selection, are widely cultivated in our republic. The ancestral variety is the oldest in the Sheki-Zagatala region. Being a folk selection variety cultivated since ancient times, it makes up 93% of hazelnut orchards in our republic.

MATERIAL AND METHODOLOGY OF RESEARCH

Like all fruit plants, there are many diseases and pests in hazelnut plants. In addition to agrotechnical measures, disease and pest control also plays a key role in order to obtain a high and quality product from the hazelnut plant. Our research was carried out on hazelnut trees growing in orchards of Shaki-Zagatala region. Field works were carried out twice in a month along the route and each week in the stationar orchard located on village Ashagi Tala. This is the first year of researching work. Various pests have been studied in this study. There are different pests of hazelnut orchards like big bud galls, hazelnut aphids, nut weevil, wood boring, Gypsy moth, Brown Marmorated Stink Bug and etc. The study is ongoing.

DISCUSSION

The **big bud galls** (Phytoptus avellanae) is common in some countries in Europe. It is also widely found in the hazelnut growing regions in Azerbaijan. Bud galls adults are white in color and 0.3 mm long. There are two forms of this pest; tumor-forming - they mainly feed on the generative shoot and cause its swelling. Swollen shoots are green at first and gradually turn brown. Thus, the shoots affected by the pest cannot develop. The other form does not form a tumor in the bud, it feeds on stamens and young fruit clusters. When the pest spreads widely, it can have a great effect on the reduction of the productivity of the plant. As a measure against the egg mite, it is necessary to manually tear off the damaged shoots at the end of winter and at the beginning of spring. Pruned parts should be removed from the garden and burned. Bud mite adults are white in color, 03 mm long. When the pest is widespread, it can greatly affect the reduction of plant productivity.

Oberea linearis L. (Coleoptera Cerambycidae) is a wood boring insect that infests hazelnut (Corylus avellana L.) young shoots and two-to three-year-old twigs (3). These insects are black in color, oblongated in shape. O. linearis measures between 11 and 14 mm. The female individuals of the pest lay their eggs under the bark of one-year branches. The larvae that emerge from the eggs move upwards and downwards in the wood tissue and throw sewers. The length of these sewers can be up to 40-60 cm. As a pest control, spraying should be done on time and correctly, so that if the larvae have already entered the wood tissue, then pesticid will have not an effect.

Hazelnut aphids (Myzocallis corly) – The color of this pest is yellow-green, the body is thin. Its size is 1.3-2.2 mm. It lives and develops mainly in the lower part of the leaf. The eggs are oblong-oval in shape. At first, it is light yellow and gradually turns into a bright black color (5). After 2-3 weeks, the larvae that emerge from the eggs turn into adult winged individuals. Individuals give birth to live young. Moths feed by sucking leaf juice. Although it is a pest of the hazelnut plant, it is not considered dangerous. So, there are many natural entomophagus of this pest (4). Lady-birds and hazelnut woodlice are wide spread, these insects feed on hazelnuts aphids and prevent their number from increasing.

Nut weevil (Curculio nucum L.) is the main pest of hazelnut orchards (3). The head is stretched forward in the form of a proboscis. This proboscis is longer than the body in female individuals. The body is black, the trunk and legs are brown. The whiskers are located in the middle of the trunk. The egg is elliptical, when it is freshly laid, it has a bright white color and gradually turns brown. The larva is legless and yellowish. At the last age, its length is 10-16 mm. The pupa is white in color, its length is 9 mm. Adult insects feed on leaves, shoots and delicate fruits. To lay eggs, they pierce the skin of delicate fruits with their proboscis and lay their eggs in those holes. The hatched larva feeds on the inside of the fruit, then pierces the skin and emerges from there. Falling into the ground, it builds a nest and hibernates in it. It pupates in mid-April. Within two weeks, insects begin to fly from the pupae. It gives 1 generation during the year. As a result of the harmful activity of this pest, the damaged fruits fall prematurely, the productivity decreases. As a control measure, fallen damaged fruits should be collected regularly and removed from the garden. In early spring, when insects swarm the umbrellas, early in the morning the bushes should be shaken on cloths spread on the ground, and the fallen insects should be immediately collected and destroyed.

Gypsy moth (Lymantria dispar)-females are 75 mm in wings spread, and the last segment consists of a large gizzard surrounded by dense brown hairs. The male is 45 mm with the wings spread. The mass flight of butterflies begins in the second half of July and continues until the middle of August. Females lay eggs in a ball and coat the surface of the ball with the liquid they secrete through their abdomen (6). The eggs are covered in a coating of hairs. The number of eggs in a ball is sometimes less than 850-1000. Under optimal conditions, their development ends in 34-40 days, at relatively low temperatures it ends in 50-80 days (9). Caterpillars begin to pupate in the second half of June. The covering provides protection from predators and parasites, and may be important for insulating the eggs from cold and for sealing in moisture. Larvae (caterpillars) emerge from egg masses in the spring. The larva will first feed on the leaf hairs and then move onto the leaf epidermis.

Brown Marmorated Stink Bug (BMSB) (Halymorpha halys). Adult Halymorpha halys are typically 15mm to 17mm in length and are most easily identified by their "shield-shaped body" and characteristic, brown and white marbled coloration, hence the use of the term "marmorated". The eggs are deposited on the underside of leaves and range in number from 20 to 30 eggs per cluster. To date, over 300 different types of plants have been identified as host plants (Nielsen et al., 2008) Both nymphs and adults feed continuously through the summer .The BMSB over-winters in its adult stage in man-made structures, such as houses and sheds, but may also over-winter in leaf debris and other organic material that provides sufficient protection from the elements. Brown Marmorated Stink Bug is more dangereous pets and it is spread in the village of Aliaabad in Zagatala district.

CONCLUSION

As result of 6 month researching determined that in Shaki -Zagatala region of hazelnut orchards have different pests like Big bud galls, Hazelnut aphids, Nut weevil, Wood boring, Gypsy moth, Brown Marmorated Stink Bug and etc. Our research work continues. In the next years, will be studied their damage rate and pests management.

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CHANGES IN THE AGROCHEMICAL CHARACTERISTICS OF BROWN MOUNTAIN FOREST SOILS UNDER ANTHROPOGENIC INFLUENCE

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The change in the physical and chemical properties of the soil in time and space depends on the factors that form the soil, as well as on farms. One of the regions of our republic with great economic potential for the development of agriculture is the Lesser Caucasus. The production of a number of agricultural products and industrial crops, the Lesser Caucasus occupies a unique place. It can be seen from the studies carried out that in recent decades, the anthropogenic impact on the land cover due to human economic activity in this province has become increasingly widespread. The assessment of soil diagnostic indicators and fertility parameters is due to the recent increase in negative changes in the soil as a result of anthropogenic pressure and the impact of natural factors. For this reason, the main goal of the research is to analyze the changes in the main physicochemical parameters of brown mountain forest soils, which are widespread in the mesophilic forest zone of the Lesser Caucasus and transferred to agricultural fields, meadows and grasslands, due to anthropogenic impact, based on laboratory analysis. Basically, easily soluble substances are not observed or they are few in typical and washed brown mountain-forest soil types. Also, these soils are leached from carbonates under leaching conditions. CO_2 is very low across almost the entire profile. $CaCO_3$ was relatively high and amounted to 3.29-4.26%. Humus, which is one of the main indicators, is unevenly distributed along the profile; it is more concentrated in the upper layers of the profile, which is closely related to the forest litter. The amount of humus decreases from the upper layers to the lower ones, respectively, it is 5.8-7.2% in the upper layers and 0.7-0.3% in the lower layers. Organic carbon decreased from upper to lower layers in each profiles. In typical brown mountain forest soils, depending on the composition of forest and undergrowth herbaceous plants, accumulation of various nutrients and nitrogen is observed on the soil surface throughout the year. The amount of total nitrogen in typical brown mountain forest soils was 0.55-0.05%. Under the influence of forest cover and moisture regime, the reaction of the environment in these soils was slightly acidic and close to neutral. In typical brown mountain forest soils, pH varied from 7.5 to 8.4. In the washed brown mountain-forest soils, the pH was 5.6-6.0. The amount of absorbed bases in the washed brown mountain forest soils increases from the upper layers to the lower ones, the absorbed Ca in the upper layer was 32.2, and in the lower layers 38.7 mg/eq. layers and 16.8 mg/eq. in the lower layers. The transformation of forest cover into agricultural land affects the decomposition and accumulation of organic matter, sandy and silt fractions in the soil.

Key words: *brown mountain-forest typical, washed mountain-brown, humus, absorbed bases, soil profile.*

INTRODUCTION

The modern statistical analysis of the physical and chemical soil indicators of our republic is particular importance from the point of the high degree of the territory use in terms of agriculture and the increase in the productivity of agricultural plants. The soil cover is formed as a result of the impact of abiotic (relief, climate, parent rocks), biotic (flora, fauna) and anthropogenic factors that form the soil as an important component of the ecosystem and an independent natural object [2].

The conducted studies show that the soil cover of the Lesser Caucasus is subject to anthropogenic impact degree or another. Assessment of the vegetation cover of the area is associated with soil erosion, pollution and other processes under the influence of anthropogenic factors. The satisfaction of natural human needs and the activities and development of the agricultural sector, which is directly related to land, are associated primarily with the land factor, and then with the state of its use. This is relevant from the point of view of soil assessment, as the ecological state of soils is getting worse and worse, undesirable processes occurring in the soil cover as a result of anthropogenic impact, deforestation, reduction of fertile soils [3.4].

Undesirable processes occurring in the soil cover as a result of anthropogenic impact, the problems of reducing fertile land as a result of deforestation are always on the agenda, necessitating the analysis and evaluation of the main physical and chemical (agrochemical) indicators of the soil. The greatest changes in the physicochemical properties of soils in the mountainous zone of the study area relate to areas cultivated in farms. Potato cultivation prevails in the study area, mainly under monoculture conditions.

MATHERIAL AND METHODS

The object of study covers the mid-mountain regions of the Lesser Caucasus. The Lesser Caucasus occupies a large territory in the western part of our republic [1.5].

The soils of the study areas are predominantly brown mountain forest soils of mesophilic forests, xerophilic forests, shrubs, and steppes. The modern soil-ecological conditions of the Lesser Caucasus were studied, a number of field and laboratory works were carried out. Studies have shown that some soil parameters are subject to anthropogenic impact to one degree or another. The ecological problems of the soil cover of the region are closely related to the change in the soil under the influence of anthropogenic factors and, at the same time, its exploitation from the point of view of agriculture. Organic and mineral fertilizers are introduced without systematic scientific justification. Soil samples were analyzed under laboratory conditions in accordance with international standards.

Granulometric composition - according to Kachinsky, hygroscopic moisture - according to the thermal method, humus - according to Tyurin I.V., absorbed bases - according to Ivanov D.I., the reaction of the medium - by a pH meter, carbonization - by a calcimeter.

RESULTS AND DISCUSSION

The main physicochemical parameters of the soils of the middle mountain belt of the Lesser Caucasus, which are developed to varying degrees, are analyzed based on the analysis of numerous soil samples, especially dynamic organic carbon (OC), hygroscopic moisture (HgM) and granulometric composition.

Table 1

Physico-chemical indicators of mountain-forest soils

Soil crops and depths	Hygroscopic moisture	pH	Granulometric composition%		Humus
			<0,001	physical clay <0,01	
Crop 1					
0-12	4.89	5.64	21.12	34.52	5.8
12-26	2.90	5.92	20.14	41.89	3.0
26-58	4.14	5.94	31.2	55.84	1.8
58-85	4.91	5.96	30.1	45.56	0.7
85-116	4.94	6.00	26.1	50.43	1.3
Crop 2					
0-17	6.18	7.50	13.5	58.74	7.2
17-42	5.28	7.76	9.87	35.88	3.33
42-80	4.63	7.83	12.1	40.78	2.31
80-95	1.49	8.43	12.4	44.98	0.3

Table 2

Some chemical indicators of mountain-forest soils

Soil crops and depths	Organic Carbon	Nitrogen %	Sum of absorbed elements, mg/eq	CO_2	$CaCO_3$
Crop 1					
0-12	3,36	0,40	42	0,04	0,09
12-26	1,74	0,22	40	0,04	0,09
26-58	1,04	0,15	62	0,04	0,09
58-85	0,41	0,08	54	0,04	0,09
85-116	0,75	0,12	51	0,07	0,09
Crop 2					
0-17	4,76	0,55	75.5	0,11	0,26
17-42	1,93	0,24	61.5	1,50	3,42
42-80	1,34	0,18	56	1,45	3,29
80-95	0,17	0,05	21.5	2,24	4,26

In the course of our field soil studies, a significant thinning of the forest cover on the northeastern slopes of the forest was noted as a result of anthropogenic impact and human economic activity. The relative intensification of the erosion process due to the predominance of shrub-grass areas, a significant reduction in the pomegranate layer of the soil and the humus layer, etc., determines morphological features. These soils are subject to varying degrees of erosion due to the influence of rainfall, slope inclination and mainly due to anthropogenic impact.

Basically, easily soluble substances are not observed or they are few in typical and washed brown mountain-forest soil types. Also, these soils are leached from carbonates under leaching conditions [2]. As can be seen from crop 9, the CO_2 content is very low almost over the entire profile. $CaCO_3$ increased relatively in crop 37 and amounted to 3.29-4.26%. Unlike other subtypes, this type of soil is characterized by humus content along the profile and dark soil color due to low carbonate content. Humus as main indicator, is unevenly distributed along the profile; it is more concentrated in the upper layers of the profile, which is closely related to the forest litter. In both crops, the amount of humus decreases from the upper layers to the lower ones, in the upper layers it was 5.8-7.2%, and in the lower layers - 0.7-0.3%. The amount of humus in typical brown mountain forest soils is higher than in washed brown mountain forest soils. Organic carbon decreased from the upper layers to the lower along the profile in each crops. In typical brown mountain forest soils, depending on the composition of forest and undergrowth herbaceous plants, accumulation of various nutrients and nitrogen is observed on the soil surface throughout the year.

The amount of total nitrogen in typical brown mountain forest soils was 0.55-0.05%. Under the influence of forest cover and moisture regime, the reaction of the environment in these soils was slightly acidic and close to neutral. In typical brown mountain forest soils, pH varied from 7.5 to 8.4. In the washed brown mountain-forest soils, the pH was 5.6-6.0. The amount of absorbed bases in these soils is distributed quite differently. In leached brown mountain-forest soils, absorbed Ca in the upper layers was 32.2, in the lower layers - 38.7 mg/eq, in the upper layers - 9.8 mg/eq, in the lower layers - 16.8 mg/eq. In typical brown mountain forest soils, the amount of cations decreases from top to bottom. Among the absorbed bases, the amount of the Ca cation predominates. According to their granulometric composition, washed brown mountain forest soils are mainly heavy and light granular, while typical brown mountain forest soils have a heavy and partially medium granular structure. This is favorable for the development of plant roots, the normal movement of water and air. In the middle part of the profile, the accumulation of particles of silt and physical clay was observed.

CONCLUSION

Based on the analysis of comparative geographical desert-soil and chamber-laboratory results, the change in the diagnostic parameters of brown mountain forest soils as a result of the influence of various anthropogenic processes has been studied. Due to both erosional processes and the intensive involvement of these soils in crop rotation, a decrease in the amount of the accumulative putrefactive layer, humus and nitrogen, absorptive capacity, and lightening of the granulometric composition was established.

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EFFECT OF SOIL CULTIVATION AND MINERAL FERTILIZERS ON SOIL AGGREGATES

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In accordance with result of the conducted research, it was determined that soil cultivation and mineral fertilizer norms have a significant effect on the aggregate state of the soil. Plowing at a depth of 27-30 cm in autumn, after the winter wheat predecessor and softening at a depth of 6-8 cm before sowing in spring, particles with a size of 10. <10 mm have been detected in the $N_{120}P_{150}K_{120}$ norm of mineral fertilizers in soil tillage carried out with a plow at a depth of 27-30 cm in autumn and with a disk trowel at a depth of 14-16 cm before sowing in spring.

***Key words**: cotton, soil tillage, gray-brown, mineral fertilizers, aggregate state.*

INTRODUCTION

In accordance with the State Statistics Committee, in 2021, cotton was planted on 100,590 ha in our Republic, 287,041 tons of raw cotton products were produced, and the average yield of cotton was 28.5 s/ha. In the Karabakh economic region, 81,312 tons were produced from 27,855 ha, and the average yield was 29.2 s/ha. In Tarter region, which is the research area, 3440 ha, 10701 tons and 31.1 s/ha of raw cotton were produced respectively [18].

According to many authors, it is not necessary to increase product production in an extensive way. It is possible to increase the agrophysical properties of the soil and the productivity of plants by using modern technologies, soil cultivation, fertilizers, high-yielding varieties, and plant protection products. [4, p.31-33, 15, p.61-66].

In the research conducted in Russia, the efficiency of soil tillage under winter wheat was studied. It was determined that soil tillage has a significant influence on the composition of soil aggregates. The maximum amount of medium-sized soil aggregates was observed in direct sowing. The high grain yield was 44.2 s/ha when the soil of mineral fertilizers $(NPK)_{60}$ was covered with a disc trowel at a depth of 8-10 cm, and in the case of direct sowing, the grain yield was 36.7 s/ha [16, p.12 -16].

In the studies conducted in Russia and Ukraine, the productivity of agricultural plants decreases every year because the physical properties of the soil in the cultivated fields change and the soil layer hardens [8, 71-81, 9, p. 1247-1261].

According to the Russian scientist V.A. Nikolayev, the reason for the change of the agrophysical properties of the soil and the formation of the soil is the use of heavy wheeled equipment [10, p. 24-25].

With reference to many researchers, long-term cultivation of different soils in the same area, especially in the case of simultaneous sowing, increases the density of the soil and, consequently, decreases the productivity [11, p.23-25, 12, p.21-24, 14, p.5 -7, 2, pp. 15-17].

In the research conducted by N.V. Shevchenko in the Republic of Ukraine, the impact of the main soil tillage on soil fertility was investigated. It was concluded that the amount of humus in the plow layer of the soil did not increase in the process of plowing for 12 years without turning the soil [17, p.57-59].

Concerning the Russian scientist V.A. Voronsov, intensive soil tillage leads to a decrease in the amount of soil nutrients. Especially in plowing process by turning the soil, soil fertility decreases in the soil. [3, p.23-26]

Numerous types of soil cultivation are carried out in Russian agriculture. The most widespread of these is plowing at different depths without turning the soil. In rotational crops, no-tillage, tillage, and zero-tillage technologies are being conducted. This method slows down the mineralization of organic compounds in the soil, protects the soil from erosion and reduces costs per hectare [7, p.5-7, 13, p.3-5].

The impact of the main soil tillage on the aggregate state of the soil has been investigated in the Republic of Kabardino-Balkaria. Subsequently, it has been determined that the soil tillage significantly affects the agronomic indicators of the soil. The highest values were indicated between 78.5 and 78.3% of aggregates between <0.25 mm and >10 mm when covering the soil with flat cutters. [5, p.89-93].

In recent years, research conducted by S. Ditmar indicates that the soil tillage escalates the structural soil indicators in all soil types. According to the consequences by F.G. Bakirov, the minimization of soil tillage enhances structural soil indicators by 6.6-9.8% [6, p.56-59, 1, p.19-21].

Cotton growing is one of the areas of great importance in solving the current problems of the population in our republic, particularly in providing permanent employment to the rural population and enlarging the fodder base of animal husbandry. Fiber as the main product of cotton is an invaluable raw material for the textile industry and is always in great demand in the world market. Nowadays, inappropriate utilization of poor quality seed material, soil tillage, water, mineral fertilizers in the farms and non-compliance with agro technical measures is one of the main factors causing the decrease in the cotton yield amount. The development of high-quality soil tillage in cotton crops and the application of mineral fertilizers is the most essential ones among the mentioned agrotechnical measures. It is possible to maintain soil fertility and increase cotton productivity by carrying out high-quality soil tillage and applying mineral fertilizers.

Karabakh region occupies one of the main places in cotton production in our republic. In order to increase the soil fertility, productivity and quality of the cotton plant in the conditions of the Karabakh region, the implementation of proper soil cultivation and the determination of effective mineral fertilizer norms are among the actual problems of both scientific-theoretical and experimental importance.

MATERIALS AND METHODS

The main aim in research conducting is to identify the efficient soil tillage and mineral fertilizers norm that ensures high cotton yield in the Karabagh region conditions according to soil fertility, as well as the water-physical properties of the soil.

In 2019-2022, the research works was conducted with Ganja-110 variety of cotton plant, on gray-brown (chestnut) soils, at the Tartar Regional Agricultural Science and Innovation Centre of the Ministry of Agriculture located in Tartar region.

The soil samples analysis indicates that, these soils are not provided with assimilated forms of nitrogen, phosphorus and potassium to a high degree. The pH in water solution in of 0-30 cm layer indicated as 8.0, in the lower layers (60-100 cm) was 8.5. However, it decreases significantly towards the lower layers, corresponding to 0.83; 0.04; 0.05; 2.45% in the layer of 60-100 cm. Absorbed ammonia nitrogen 17.6-7.2; nitrate nitrogen 10.3-3.3, activated phosphorus 18.5-6.3; exchangeable potassium fluctuates between 265.3-96.5 mg/kg. Conducted agrochemical analyzes indicates that according to the gradation adopted in our republic, these soils are poorly supplied with nutrients. Therefore, application of mineral fertilizers against the background of soil tillage is very inevitable and necessary for the growth, development, high yield and preservation of the cotton plant in these lands.

Field experiments were followed by a winter wheat predecessor with 2 factors (2x6).

Factor A: Soil tillage:

1.Plowing at a depth of 27-30 cm in autumn + softening at a depth of 6-8 cm in spring;

2.Plowing at a depth of 27-30 cm in autumn + disc trowel at a depth of 10-12 cm in spring;

3.Plowing at a depth of 27-30 cm in autumn + disc trowel at a depth of 14-16 cm in spring;

Factor B: Mineral fertilizer norms:

1. Control (without fertilizer); 2. Farm option N_{120}; 3. $N_{60}P_{90}K_{60}$; 4. $N_{90}P_{120}K_{90}$;

5. $N_{120}P_{150}K_{60}$; 6. $N_{150}P_{180}K_{150}$.

Field experiments were carried out in 3 replicates, with the total area of each variant being 108.0 m^2 (30x3.6 m), sowing in a row method of 90x8 (1 plant) cm, in the 1st decade of April (25 kg of seeds per hectare) was conducted. Among mineral fertilizers, in the form of nitrogen-ammonium nitrate (34.7%), phosphorus single superphosphate (18.7%) and potassium-potassium sulfate (46%), 80% of phosphorus and potassium are plowed in autumn, the remaining 20% in feeding, and nitrogen is given in the form of 2 feedings. Experimentation,phenological observations, agritechnical measures and cotton plant economic idicators were carried out in accordance with the generally accepted rules.

RESULTS AND DISCUSSION

In the process of soil tillage, if the soil is not crushed well, hardened clods are formed in the upper layers of the soil. Consequently, this prevents the seeds from coming out evenly during sowing, and as a result, uneven output is obtained. From this point of view, the degree of soil compaction is of great agrotechnical importance.

The influence of soil tillage and mineral fertilizer norms on soil aggregate state at cotton crops in gray-brown (chestnut) soils has been studied in the conducted researches. In order to determine the aggregate state of the soil, 30x30x20 cm soil samples were taken, then sifted through a set of 40, 20, 10, 5 mm diameter sieves. Afterwards, each soil fraction passed through the sieves was weighed separately. The consequences of the research are given in the table as an average of 3 years. Studies show that from an agronomic point of view, the best soil particles are considered to be 10...<10 mm in size. Inasmuch as can be seen from the table, in the control (without fertilizer) variant, in soil cultivation with plowing at a depth of 27-30 cm in autumn and softening at a depth of 6-8 cm before sowing in spring, particles with a size of 10...<10 mm in the 0-20 cm soil layer 53.3%, in the farm variant (N_{120}), these indicators increased significantly and became 55.2%.

There is a perceptible increase in the studied indicators of mineral fertilizers norms in comparison with the control and farm versions. Inasmuch as in the $N_{60}P_{90}K_{60}$ variant, 10...<10 mm particles in the 0-20 cm soil layer made up 56.4%. The highest results observed in the 10...<10 mm particles in the $N_{90}P_{120}K_{90}$ variant as 58,4%. As an increase observed in mineral fertilizer norms, studied particles in 10...<10 mm in the $N_{120}P_{150}K_{120}$ variant decreased perceptibly as 57,2%, appropriately in the $N_{150}P_{180}K_{150}$ variant was 56,3%.

As illustrated in the table, studied 10...<10 mm particles in soil tillage plowed at a depth of 27-30 cm in autumn and 10-12 cm deep with a disk trowel before sowing in the spring, was noticeably higher in each of the versions softened before sowing at a depth of 6-8 cm in spring, it was 55.1% in the 0-20 cm soil layer in the control (without fertilizer) variant, and 55.9% in the farm variant (N_{120}). Indicators such as softening of 6-8 cm in the increasing norms of mineral fertilizers, is perceptible high in comparison with the control and farm versions. Thus, in the $N_{60}P_{90}K_{60}$ variant , 10....<10 mm particles set up as 58,9%, while the highest indicators observed in $N_{90}P_{120}K_{90}$ variant as 62,1%. There is reduction in the mineral fertilizer rates as in soil tillage softened in a 6-8 cm depth before sowing in spring and plowed to a depth of 27-30 cm in autumn as following: $N_{120}P_{150}K_{120}$-59,8% və $N_{150}P_{180}K_{150}$ - 58,8%.

As it is obvious in the table, studied indicators of the ploughing at the 27-30 cm deep in autumn and 14-16 cm deep soil tillage with a disc trowel in the spring before sowing, 10. <10 mm particles were perceptible high in each versions compared to soil tillage conducted in a 6-8 cm and 10-12 cm depth before sowing in spring. It can be explained with the fact of disc trowel conducted in a 14-16 depth before sowing in spring. As in a control (without fertilizer) version 10....<10 mm particles indicate 58,1%, in the farm version (N_{120}) is 59,2%. Indicators in the mineral fertilizers increasing rates is high in an apparent way as in the previous two planting scheme, in comparion with the control and farm versions.

In view of the fact that indicators in the $N_{60}P_{90}K_{60}$ variant , 10....<10 mm particles is 62,8%, in the $N_{90}P_{120}K_{90}$ variant this indicator is 63,2%. The highest indicators illustrate in the $N_{120}P_{150}K_{120}$ as 66,4%, meanwhile 64,5% in $N_{150}P_{180}K_{150}$.

The impact of soil tillage and mineral fertilizers on soil aggregation

Soil cultivation	Mineral fertilizer norms	Depth, cm	Soil particles, %					
			>40mm	40mm	20 mm	10mm	5...<5	10..<10
Plowing to a depth of 27-30 cm in autumn + loosening to a depth of 6-8 cm before sowing in spring	Control (without fertilizer)	0-20	10,9	18,9	16,9	20,2	33,1	53,3
	Farm option N_{120}	0-20	11,3	18,2	15,3	20,9	34,3	55,2
	$N_{60}P_{90}K_{60}$	0-20	11,1	18,2	14,3	21,5	34,9	56,4
	$N_{90}P_{120}K_{90}$	0-20	10,7	17,3	13,6	22,3	36,1	58,4
	$N_{120}P_{150}K_{120}$	0-20	11,4	18,1	13,3	22,1	35,1	57,2
	$N_{150}P_{180}K_{150}$	0-20	11,6	18,9	13,2	22,2	34,1	56,3
Plowing at a depth of 27-30 cm in autumn + disc trowel at a depth of 10-12 cm before sowing in spring	Control (without fertilizer)	0-20	9,4	19,9	15,6	20,4	34,7	55,1
	Farm option N_{120}	0-20	9,2	18,5	16,4	21,1	34,8	55,9
	$N_{60}P_{90}K_{60}$	0-20	8,7	16,5	15,9	22,3	36,6	58,9
	$N_{90}P_{120}K_{90}$	0-20	7,8	13,1	17,0	23,1	39,0	62,1
	$N_{120}P_{150}K_{120}$	0-20	9,5	14,6	16,1	22,8	37,0	59,8
	$N_{150}P_{180}K_{150}$	0-20	9,4	14,7	17,1	24,0	34,8	58,8
27-30cm deep plowing in autumn + 14-16cm deep disc trowel before sowing in spring	Control (without fertilizer)	0-20	8,8	17,8	15,3	21,3	36,8	58,1
	Farm option N_{120}	0-20	7,6	15,8	17,4	22,1	37,1	59,2
	$N_{60}P_{90}K_{60}$	0-20	7,0	12,4	17,8	24,2	38,6	66,8
	$N_{90}P_{120}K_{90}$	0-20	6,3	12,9	17,6	23,2	40,0	63,2
	$N_{120}P_{150}K_{120}$	0-20	5,2	10,4	18,4	24,2	42,2	66,4
	$N_{150}P_{180}K_{150}$	0-20	6,0	13,2	16,4	24,0	40,4	64,5

CONCLUSION

Consequently, it was determined in accordance with the conducted research that soil tillages and mineral fertilizer norms have significant impact on the soil aggregate state. The particles of 10....<10 mm, in the soil tillage, on which conducted the process of softening in a depth of 6-8 cm before spring sowing and plowed to a depth of 27-30 cm after the predecessor of winter wheat increased in comparison with the control (without fertilizer) version between 3,1-5,1%, plowed to a depth of 27-30 cm in autumn and disc troweled process to a depth of 10-12 cm before spring sowing 3,8-7,0%, plowed to a depth of 27-30 cm in autumn and disc troweled process to a depth of 14-16 cm before spring sowing 4,7-8,3% realtively. Comparing each of three soil tillage, it can be concluded that the highest indicators observed in soil tillages plowed to a depth of 27-30 cm in autumn, and disc troweled to a depth of 14-16 cm before spring sowing in mineral fertilizers norms of $N_{120}P_{150}K_{120}$.

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MAIN AGROPHYSICAL INDICATORS AND CLASSIFICATION OF SOILS IN THE DRY STEPPE ZONE OF AZERBAIJAN

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The results of studies on changes in the main agrophysical indicators of gray-brown soils [WRB (2008), Haplic Kastanozems / Haplic Calcisols] of the dry steppe zone of Azerbaijan, depending on their agricultural use, have been studied and presented. Changes in morphological profiles, granulometric and microaggregate compositions, structure and density of virgin and irrigated gray-brown soils were revealed. Statistical investigation of factual data the heavy loamy granulometric composition is characteristic for virgin soils of the arid field zone of A-layer. On average < 0.01 mm – 56.7+1.18%. A quantity of notable claying particles < 0.01 mm is noted in the middle part (25-50 cm) of profile. The high dispersion fraction is 45% of physical clay, this confirms claying of the same profile. The weak loamy is noted in the one-metre layer, a composition of silt fraction is 28.3± 1.08-31.8±0.83 % physical clay is 63.0±1.8 - 65±1.1. It is accordingly 3-5%, more than virgin zonal soils. An assessment is given and the dependence of soil density on factors: granulometric and microaggregate compositions, irrigation prescription, agricultural technology, etc. is given. Statistic study of the factual information indicates that the high water-proof aggregates of the arid subtropic soils are 54.08 – 2.47% in the arid first half – meter layer of virgin soils, large aggregates are 20.25 mm. The irrigative arid field soils zone have less water-proof aggregates in comparison with the virgin zonal soils (45.29 ± 1.26%). Based on the results obtained, the place of grey Cinnamonic soils in the international classification system WRB (2014) was determined: Virgin soils - Saturated gley calcareous heavy loamy - Duric Gleyic Calcic Kastanozems (Loamic); for a long time-irrigated Grey Cinnamonic (over 300 years Powerful gley cultivated for a long time irrigated calcareous heavy loamy Grey Cinnamonic - Gleyic Petrocalcic Kastanozems (Anthric, Loamic).

***Key words**: agrophysical indicators, classification, gray-brown soils, structure.*

INTRODUCTION

According to Krasilnikov (1999)[9] in the classification and diagnostics of soils of the USSR in 1977, gray-brown soils belong to the reference group - Grey-cinnamonic soils / Luvic Calcicoils / Luvi-Calcic Kastanozems (clayey carbonate soils with a low-humus profile, chestnut-brown color of the upper horizon, according to the structure and properties are transitional between brown soils and serozems), according Babayev and oth.(2017) [2] to the soil classification of Azerbaijan - to gray-brown (Grey Cinnamonic), according to WRB (2014)[7,11]-Haplic Kastanozems/Haplic Calcisols. The prolonged and systematic irrigation is a reason for strong change of agrophysical features in the zonal soils Ganieva and oth.(2019) [6], Babaev and oth.(2020)[3]**.** According Kovda (1973)[8] indicates that an appli-cation of cultivation in the arid field condition improves water-physical features of virgin soils, rises their waterproofing, water-penetration, ability to retain moisture reserve in soil. Mammadov (1980) [10] who carefully studied the agrophysical features of soil of the Azerbaijan Republic noted a positive impact of cultivation on perennial arable soils. A great attention is paid to change of agrophysical characters of the cultivation process in foreign references (Brezny and oth. (1975)[4], Vormstein and oth. (2017) [12], [WRB of Soil Resources (2014) [11]. The aim of the study is to assess changes in the main agrophysical parameters of soils in the dry subtropical zone of Azerbaijan under the influence of their agricultural use and determine their place in WRB (2014).

MATERIALS AND METHODS

The studies were carried out in 1998-2021. on virgin and irrigated gray-brown soils of the dry subtropical zone. The Soil-forming rocks are mainly represented by modern gypsum calcareous deluvial-loess clayey for virgin and irrigated soils. Agrotechnics of cultivation - zonal with some changes for each option. The climate is subtropical with dry hot summers, the amount of active t0 is 4500 - 48480C, the arrival of PAR is 120-133 kcal / cm2, the amount of precipitation is 180 - 330 mm per year; days from air t0 > 100-285-330 and soil > 50 -315-360. Soil profiling, soil sampling, determination of granulometric and microaggregate particles, soil structure and density were carried out according to the Guidelines for soil description (FAO, 2012 [5] and methods (Agrochemical methods of soil research,1975) [1]. Based on morphological and physicochemical properties, the name of gray-brown soils was given according to the International Soil Classification based on the Abstract Base (WRB) 2014 [11].

RESULTS AND DISCUSSION

Granulometric composition. Statistical investigation of factual data (tabl.1). The heavy loamy granulometric composition is characteristic for virgin soils of the arid field zone of A-layer. On average < 0.01 mm – 56.7+1.18% . A quantity of notable claying particles < 0.01 mm is noted in the middle part (25-50 cm) of profile. The high dispersion fraction is 45% of physical clay, this confirms claying of the same profile. It is known that a granulometric composition of the initial zonal soils aggravates during irrigation. The soil composition in the condition of the Ganja-Kazakh massif changes under the influence of multi-factor irrigation and the source of irrigative waters, antiquity of irrigation, gathering of irrigation floats depend on their lithological composition. The weak loamy is noted in the one-metre layer, a composition of silt fraction is 28.3± 1.08-31.8±0.83 % physical clay is 63.0±1.8 - 65±1.1. It is accordingly 3.5% more than virgin zonal soils. This is explained with the intensive collection of agroirrigation floats and their heavy composition (tabl.2).

Sometimes if the granulometric composition is light loamy – 52.2%, in all cases a composition of the particles (a composition mode is <0.01 mm 63.6%), then the irrigated soils are heavy loamy 51.2% - 188 (58.6%) regularly rise and a composition of the light loamy (17.9% from188) compared to (13.5%-from150). A relative increase in loamy (4.7% in all cases) and light loamy (5.2%) is observed depending on irrigation relief in the irrigated soils.

Microaggregate composition. A quantity and aggregation rate of aggregates are calculated to create a general view about micro-aggregation and cultivation in the zone of soils of different cultivation degrees and composition of soil microaggregates. The calcareous and loessial loamy virgin soils are rich in water-resistant micro-aggregates as maternal rock. Their total amount was adapted to humus layer and it is 28-34% on average in the dry field. Sharp increase of the aggregate number is noticed in AB layer which left large traces in life activity of soil fauna. The number of aggregates is 20-22% and 24-25% in the bogharic condition and initial stage (newly irrigated soils) and this is 5-10% lower in the soils of the arid field zone in comparison with virgin soils (in the soils under grain).

Table 1

Average statistical data of the granulometric composition in the soil

Soils	Average depth, cm	Fraction<0,01mm,%				Fraction<0,001mm,%				Siltness Degree,%
		X	s	V	s_x	x	s	v	s_x	
Virgin	0-25	56,7	6,76	11,93	1,18	24,2	5,99	24,81	1,04	43
	25-50	64,3	5,36	8,34	0,93	28,6	5,01	17,45	0,88	45
	50-100	60,8	5,21	8,58	0,85	25,4	4,80	18,91	0,68	42
	100-200	58,0	12,17	21,00	2,33	20,4	6,37	31,21	1,23	35
irrigated	0-25	57,6	4,64	8,04	0,80	25,8	1,71	6,60	0,30	45
	25-50	59,2	7,38	12,45	1,25	27,7	5,41	19,54	0,92	47
	50-100	58,7	8,47	14,42	1,26	26,7	5,52	14,42	0,82	45
	100-200	53,8	11,00	20,40	1,59	24,3	2,93	12,06	0,42	45
Anciently rrigated	0-25	63,0	6,66	10,60	0,97	29,2	7,71	26,12	1,12	46
	25-50	65,4	7,30	11,15	1,10	31,8	5,51	11,15	0,83	49
	50-100	64,7	7,90	12,21	0,98	30,6	7,58	27,74	0,94	47
	100-200	59,4	10,64	17,81	1,40	26,0	5,29	20,34	0,70	44

Table 2

Distribution of physical clay in the irrigated soils (layer 0-3m)

Particles composition <0,01mm,%	Granulo-metric composition	Virgin		Irrigated		Anciently irrigated	
		quantity number	%	quantity number	%	quantity number	%
0-5	Sand	-	-	-	-	-	-
6-10		-	-	-	-	-	-
11-15	Sand	-	-	1	0,5	2	0,8
16-20		1	0,7	1	0,5	2	0,8
21-25	Light loamy	1	0,7	1	0,5	2	0,8
26-30		2	1,4	2	1,0	3	1,2
31-35	Average loamy	3	2,0	7	3,7	4	1,6
36-40		4	2,7	10	5,3	5	1,9
41-45		10	6,7	12	6,4	6	2,3
46-50	Heavy loamy	11	7,3	15	8,0	13	5,1
51-55		14	9,3	28	14,9	24	9,3
56-60		24	16,0	53	28,3	31	12,1
61-65	Light clayey	45	29,8	30	16,0	64	24,7
66-70		25	16,7	18	9,6	59	23,0
71-75		9	6,0	8	4,3	30	11,7
76-80	Average clayey	1	0,7	2	1,0	9	3,5
81-85		-	-	-	-	3	1,2

The number of aggregates in the irrigative condition of the soils under the gardens forms 32-37% in comparison with the zonal virgin soils under an influence of well-developed grass cover and it rises.

But it reduces in the soils under the vineyards (40-50 years) (17-24%), and this is explained with its working at 30-40 cm depth every year. The number of aggregates is 29-31%-i.e. as it is in zonal virgin soils. Majority of microaggregates in the irrigated soil layers of modern cultivation (30-38%)is explained with the useful impact of lucerne.

Structure. The structure is one of the cultivated soil diagnostics in the condition of intensive irrigation of agriculture. The assimilation of the initial virgin soils and structural change of irrigation were weakly studied and the researchers' ideas are contradictious. Growing the different herbs and grass seeds is a reason for increase of the number of water – resistant aggregates in the grey-brown soils. An amount of water-proof aggregates in connection with the moisture increase in soil during the correct agrotechnical rules. This is confirmed by comparing hydrothermal indices (Volobuyev, 1963) with the amount of water – resistant aggregates with size > 0.25 mm. According to the principle, perennial intensive irrigation which increases the average annual humidity about 2 times, creates favorable conditions for the formation of water – resistant aggregates.

Statistic study of the factual information (tab.3) indicates that the high water-proof aggregates of the arid subtropic soils are 54.08-2.47% in the arid first half-meter layer of virgin soils, large aggregates are 20.25 mm. Recultivation and irrigation cause a slight decrease of aggregate of soil in the initial stage. The irrigative arid field soils zone have less water-proof aggregates in comparison with the virgin zonal soils (45.29 ± 1.26%). The irrigated soils are distinguished with the high agronomical aggregates; 61.83 ± 2.02% in the arid field zone. Decrease of the number of the water-proof aggregates in cultivation process is closely connected with the state of soil cultivation and plants. A quantity of water-proof aggregates is >0.25 mm, in the arid steppe zone under bogharic grain crops and irrigated cotton soils. This decreases in comparison with the zonal virgin soils without crop rota-tion. An amount of the water-proof aggregates in the irrigated soils under lucerne is slightly higher (51-68%) in the one-meter soil layer.

Table 3.

Average quantity of aggregates in a size of > 0,25(Arid field zone, grey – brown, 0-50 cm)

Soils	The number of samples	X	Sx	Average reliability interval at the level of 0,05.
Virgin	24	54,08	4,27	48,99 – 59,17
Irrigated	24	45,29	1,26	42,69 – 46,89
Anciently irrigated	24	61,83	2,02	57,67 – 65,99

Table 4

Average statistical indicators of soil density (Arid field zone, grey – brown, g/cm^3)

Soils	Middle depth, cm	The number of samples	X¯	S	V	Sx	Average reliable interval till 0,05
Virgin	0 – 25	14	1,190	0,080	6,88	0,021	1,145 – 1,235
	25 – 50	14	1,352	0,098	9,29	0,034	1,279 – 1,425
	50 –100	15	1,414	0,115	6,98	0,025	1,361 – 1,467
	100 – 200	14	1,345	0,115	8,51	0,031	1,279 – 1,411
	200 – 300	14	1,227	0,098	7,94	0,029	1,163 – 1,291
Irrigated	0-25	10	1,186	0,161	13,54	0,041	1,091 – 1,291
	25-50	10	1,402	0,093	6,63	0,021	1,355 – 1,449
	50-100	15	1,403	0,093	6,93	0,020	1,360 – 1,446
	100-200	18	1,423	0,145	10,22	0,034	1,352 – 1,494
	200-300	10	1,438	0,232	16,16	0,073	1,275 – 1,601
Anciently Irrigated	0-25	16	1,178	0,118	10,04	0,029	1,117 – 1,239
	25-50	22	1,302	0,127	9,72	0,027	1,246 –1,359
	50-100	28	1,371	0,117	3,93	0,022	1,326 – 1,416
	100-200	32	1,406	0,130	9,25	0,023	1,363 – 1,455
	200-300	22	1,341	0,103	7,64	0,022	1,295 – 1,387

A quantity of the water-resistant aggregates rises in cultivation process (in all the cultivated soils of the arid field zone. This is clearly seen in the modern cultivated layers under gardens and in the soils with the water-proof aggregates of which quantity is 70 – 75% since ancient times. A slight increase (depth –1m -50%) of the water-resistant aggregates is also observed. The water-proof aggregates rise in the irrigated soils during the next crop rotation of cotton and lucerne. (65 – 85%).

Density. The soil density changes at a large limit in the Kur – Araz valley in dependence with some factors (granulometric and micro-aggregate, supply of organic substantive, adopted agrotechnics, irrigation period and so on). The profile of virgin soils is distinguished with the density (tabl. 4). An upper part of profile is considerably humificated and it is characterized with the lower density in all cases; 1.19 g/cm^3 – changing coefficient is 6.88% (arid – field zone). The density usually rises in calcareous layer and it is accordingly 1.414 ± 0.025 g/cm^3. Density of soil-forming rocks depends on its granulometric composition. Decrease is 1.22 – 1.34 g/cm^3 in the loessed loamy soils. The density over all layers (irrigation with transparent water) in the irrigated soils is higher than zonal virgin soils (1.40 – 1.44 g/cm^3) except the ploughed soils which exposed to intensive cultivation during tilling and it regularly rises towards depth. The cultivated layer that is formed from upper one – meter agro-irrigation sediments is distinguished with the density weakness as a result of the long cultivation in irrigated soils – 1.18 – 1.37 g/cm^3. The second meter – layer differs by – 1.41g/cm with a slight increase of density (change coefficient – 9.25% , fixed great quantity – 32), this is explained with a higher saltness.

A great difference (50-60%) belongs to highly cultivated and cultivated irrigative, ploughed soils.

CONCLUSION

1. The agricultural use and antiquity of irrigation of gray-brown soil in the arid subtopic zone of Azerbaijan significantly influenced the main agrophysical properties of gray-brown soils.

2. Based on the results obtained, the place of grey Cinnamonic soils in the international classification system WRB (2014) was determined: Virgin soils - Saturated gley calcareous heavy loamy - Duric Gleyic Calcic Kastanozems (Loamic); for a long time-irrigated Grey Cinnamonic] (over 300 years Powerful gley cultivated for a long time irrigated calcareous heavy loamy Grey Cinnamonic - Gleyic Petrocalcic Kastanozems (Anthric, Loamic).

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THE EFFECT OF THE NUMBER OF İRRİGATİON AND MINERAL FERTILIZERS IN GRAY-BROWN SOILS ON THE COMPOSITION AND QUANTITY OF NITROGEN, PHOSPHORUS, POTASSIUM ENTERED INTO THE SOIL WITH ROOT AND STRAW RESIDUES

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The presented article is devoted to the effect of mineral fertilizers on the composition and quantity of nitrogen, phosphorus, potassium entering the soil with the roots and straws of oat (Avena Sativa L), against the background of the number of irrigations in the irrigated gray-brown soils of Ganja-Dashkasan economic region. It was determined that the amount of nutrients included in the nettle varies depending on the number of irrigations, mineral fertilizer rates, the amount of root and straw residues, and the chemical composition. 3.0-10.5 kg/ha of nitrogen, 2.1-5.7 kg/ha of phosphorus and 6.7-17.7 kg/ha of potassium entering the soil with root and straw residues due to the effect of mineral fertilizers on the background of 2 irrigations Among the control-fertilizer variants, more nutrients entered the net in the $N_{90} P_{90} K_{60}$ variant. Against the background of the number of irrigations 3 times, due to the effect of mineral fertilizers, nitrogen entering the soil with root and straw residues is 3.9-11.0 kg/ha, phosphorus 2.2-7.0 kg/ha, and potassium 6.8-18, More nutrients entered the soil in the $N_{120} P_{120} K_{90}$ variant than in the control-no-fertilizer variant by 9 kg/ha. Against the background of the number of irrigations, the amount of nutrients entering the soil in 3 irrigations was significantly higher than in 2 irrigations in each of the studied options.

Key words: *oat(Avena Sativa L), mineral fertilizers, nitrogen, phosphorus, potassium, root, straw*

INTRODUCTION

According to the information of the State Statistics Committee, in 2021, 6,365 ha of autumn oat(Avena Sativa L) was planted in our republic, 11,736.5 tons of sorghum were produced, and the average yield was 18.4 s/ha, while in the western region it was 233 ha and 595 tons. and formed 25.5 s/ha [15].

Oat is a valuable food and fodder plant. Its grain is an invaluable feed for cattle-breeding and poultry. Groats, cookies, coffee, (oatmeal, herkules) etc. are prepared from oat grain . Since these foods contain easily digestible protein, fat, starch and vitamins in the body, they are of great importance for diet and children's food . Oat seed is rich in vitamins V_1 and V_2 , iron compounds , calcium and phosphorus. Grain contains 12-13% protein, 40-45% starch, 4.5% fat. At the same time, it contains 11-12% cellulose, 3.5% ash, and 14% water. In baking , oat flour is added to wheat or rye flour. It is of great importance to have significantly more protein, starch and fat in the composition of the most bare oat compared to the veiled oat according to the food attitude . It is equal to 99.8 feed units from 100 kg. Oat stubble is considered more valuable for animals than the stubble of other grains . The content of stubble is 6.9% protein, 40.7% nitrogen-free extractive substances, 1.8% fat, 27.8% cellulose, 6.8% ash, 16% water, 100 kg contains 31 feed units [2, p. 138] .

Prokina L.N and Khvostov E.N studied the effect of soil cultivation and mineral fertilizers on the grain yield of the oat Horizont variety. In the background of soil cultivation, the grain yield is 2.83 t/ha when the rate of $(NPK)_{32}$ is given under the plow, and 3.03 t/ha when the rate of background+N30 kg/ha is fed in the tillering phase and the rate of 60 kg/ha of background+nitrogen is in the form of feeding in the tillering phase. 3.37 t/ha was obtained when given, and 2.34 t/ha in control [12, p30-33].

V. V. Vasin, A. V. Savachev and A. N. Burunov at the Samara Agar University studied the effect of mineral fertilizer norms on the grain yield of different varieties of oat. The highest grain yield was 2.18 t/ha in the Tumenskiy variety at the norm of mineral fertilizers (NPK) 30, and 1.0-1.39 t/ha in the variant without fertilizers [4, p.24-30].

In the Northern Urals, the grain yield of 5 t/ha programmed by D.M.Eremin and M.N.Moisiyeva with mineral fertilizers from the intensive type Velamir varieties was 5.47 t/ha in the Talisman variety, 6.44 t/ha in the Foma variety, and 6.30 t/ha in the Otrada variety. and in the variant without fertilizer, 1.60, 1.87 and 2.13 t/ha were obtained respectively [8, p.58-61, 9, p.45-48].

In the forest-steppe zone of the Urals, in other studies conducted by Demina O.N. and Eremin D.I. , 3.45 t/ha were obtained from the Talisman variety due to the effect of mineral fertilizer norms planned to get 3 t/ha from oat [6, p.63-71].

According to Russian scientists D.I.Eremin and A.A.Akhtyamova (2017), plant residues play an important role in enriching the soil with nutrients in the modern farming system. It was determined by the authors that in the ash of oat, nitrogen is 0.5-0.7%, phosphorus is 0.2-0.3%, and potassium is 1.6% [10, p.32-38].

According to V.M. Semenova and A.K. Khodjaeva, among other authors, plant residues of various agricultural crops play an important role in restoring soil fertility. Plant remains are a source of carbon dioxide and biogenic elements in the soil and regulate microbiological processes [13, pp. 68-81] .

According to many authors, the accumulation of nutrients in the non-yielding part of plants depends on its biological characteristics. Studies show that the amount of nitrogen, phosphorus, and potassium in the stubble of cereal crops is 0.60, depending on the cultivation characteristics of the plant and the soil-climate conditions. It is 0.20 and 0.78% [3, pp. 35-38, 14, pp. 76-79] .

According to other authors, the chemical composition of plants affects the decomposition of residues in the soil [7, pp. 12-18].

A.H.Kulikova and K.Ch.Khusamova determined in their researches that the chemical composition of barley stubble is almost the same as that of velimir stubble [11, pp. 13-17] .

According to E.A.Voloshin and N.Q.Rudo, the remains of various agricultural plants are a source of fertilizer and enrich the soil with humus and microelements. The widespread use of plant residues in agro-industrial complexes affects the stabilization of soil fertility in the plow layer, the negative balance of nutrients and the improvement of the ecological condition of agrocenoses. [5, pp. 3-10] .

The application of mineral fertilizers under the oat plant against the background of the number of irrigation plays a key role in increasing the yield and soil fertility as one of the important agrotechnical measures. Therefore, taking into account its importance as food and fodder in the western region, which is of decisive importance in the production of agricultural products in our Republic, it is one of the urgent problems to increase the yield and quality of oat in irrigated gray-brown (chestnut) soils and to determine mineral fertilizer norms to increase soil fertility. .

Taking into account the urgency of the problem, the main goal of the research is to determine the number of irrigations and effective mineral fertilizer norms that affect the productivity of the autumn oat plant, the quality of the crop and the improvement of soil fertility in the irrigated gray-brown (chestnut) soils of the western region.

MATERIALS AND METHODS

The researches were carried out in 2020-2022 at the Ganja Regional Agrarian Science and Innovation Center located in the Samukh district of the Ministry of Agriculture on irrigated gray-brown soils with the "Azerbaijan-60" variety of oat(Avena sativa L) in the following scheme: 1. Control (without fertilizer); 2. Farm option N_{60}; 3.$N_{60}P_{60}K_{30}$; 4. $N_{90}P_{90}K_{60}$; 5. $N_{120}P_{120}K_{90}$; 6. $N_{150}P_{150}K_{120}$.

The total area of each option is 56.0 m^2 (8.0x7.0), the calculated area is 50.4 m^2 (7.2x7.0), with a 0.8 m defense strip between each repetition, the experiment was carried out in 4 repetitions . 220 kg/ha of seeds per hectare (4.5 million germinated seeds) were collected by sowing in the usual row method. Sprinkling was carried out in the first decade of October in the fall. Mineral fertilizers in the form of nitrogen-ammonium nitrate, phosphorus-simple superphosphate and potassium-potassium sulfate were used in the experimental area. Every year, phosphorus 60% and potassium fertilizers were applied 100% under the plow, nitrogen 50%, phosphorus 40% in early spring in the form of feeding in the bushing phase , and 50% of nitrogen at the beginning of the tuber . Phenological observations were carried out on 25 plants, and agrotechnical measures were carried out in the order adopted for the region .

In our studies, the main agrochemical properties of soils to determine the amount of nutrients in the experimental field are 0-30; It was determined in layers of 30-60 and 60-100 cm. The results of the analyzes show that these soils are not highly supplied with assimilated forms of nitrogen, phosphorus and potassium. In these soils, the pH in the water solution is 7.6 in the 0-30 cm layer, total humus is 2.18%, nitrogen is 0.17%, phosphorus is 0.16% and potassium is 2.45%, decreasing in the 60-100 cm layer. In water solution was 8.2, total humus 0.87%, nitrogen 0.06%, phosphorus 0.07% and potassium 1.65%. Absorbed ammonia nitrogen 20.3 mg/kg in 0-30 cm layer; nitrate nitrogen 12.0 mg/kg, activated phosphorus 19.5 mg/kg; exchangeable potassium is 273.6 mg/kg. In the layer of 60-100 cm, ammonia nitrogen absorbed by decreasing is 8.2 mg/kg; nitrate nitrogen 3.3 mg/kg, activated phosphorus 7.7 mg/kg; exchangeable potassium was 115.5 mg/kg . In the soil samples taken: pH on the potentiometer, humus according to I.V. Tyurin, absorbed ammonia to D.P.Konev, nitrate nitrogen to Grandval-Lyaju, total nitrogen, total phosphorus to K.E.Ginzburg and Q.M.Sheglova, activated phosphorus to B.P.Machigin's method, total potassium to Smith, exchangeable potassium to P.B.Protasov determined in a flame photometer. In plant samples: total nitrogen, phosphorus and potassium were determined according to K.E.Ginzburg, Q.M.Sheglov and E.V.Wulfus [1, 264 p.].

RESULTS AND THEIR DISCUSSION

Against the background of the number of irrigations, the composition and amount of nitrogen, phosphorus, potassium entering the soil with the roots and straws of oat(Avena Sativa L) in gray-brown (chestnut) soils was studied in our research in 2020-2022. In our research, it was determined that the amount of nutrients entering the soil with the residues of roots and straws varies depending on its chemical composition and the amount of residues. The results of the study are given in table 1-2.

As can be seen from Table 1, on the background of 2 irrigations of vegetation (1750-1850 m3/ha) in the control (without fertilizer) option, the root and stem residues of velamir are 13.2-15.3 s/ha, depending on the productivity, in air-dry residues total nitrogen in the substance 0.22-0.25%, phosphorus 0.20-0.22%, potassium 0.63-0.65%, nitrogen entering the soil 3.0-3.8 kg/ha, phosphorus 2, 6-3.4 kg/ha, potassium 8.3-10.0 kg/ha, root and stem residues 16.5-17.8 s/ha in farm option (N60), total nitrogen in air dry matter in residues 0.25 -0.28%, phosphorus 0.20-0.23%, potassium 0.63-0.67%, nitrogen entering the soil 4.1-5.0 kg/ha, phosphorus 3.3-4.1 kg /ha, potassium was 10.7-12.0 kg/ha.

Due to the combined effect of mineral fertilizers, the amount of nitrogen, phosphorus and potassium entering the soil increased significantly compared to the control without fertilizer and farm options. Thus, in the $N_{60}P_{60}K_{30}$ variant, root and straw residues are 21.3-23.5 s/ha, total nitrogen in air dry matter in residues is 0.31-0.33%, phosphorus is 0.22-0.25%, potassium is 0.70- 0.74%, nitrogen entering the soil fluctuated between 6.6-7.8 kg/ha, phosphorus 4.7-6.0 kg/ha, potassium 15.0-17.4 kg/ha.

Entered into the soil a higher amount of nitrogen, phosphorus and potassium was observed in the $N_{90}P_{90}K_{60}$ variant, with root and straw residues was between 29.1-32.6 s/ha, total nitrogen in air dry matter in the residues 0.41-0.44% , phosphorus 0.26-0.28%, potassium 0.81-0.85%, nitrogen entering the soil 12.0-14.3 kg/ha, phosphorus 7.6-9.1 kg/ha, potassium 23.6-27.7 kg/ha

As the mineral fertilizer norms increase, the amount of root and straw residues, chemical composition and the amount of nitrogen, phosphorus and potassium entering the soil significantly decrease compared to the $N_{90}P_{90}K_{60}$ option, and the root and straw residues in the $N_{120}P_{120}K_{90}$ option are 27.1-30.8 s/ha, total nitrogen in air dry matter in residues 0.37-0.41%, phosphorus 0.25-0.27%, potassium 0.78-0.82%, nitrogen entering the soil 10.0-12.6 kg/ha, phosphorus 6.8-8.3 kg/ha, potassium 21.2-25.3 kg/ha, 16.5-17.8 s/ha according to $N_{150}P_{150}K_{120}$ option; 0.25-0.28%; 0.20-0.23%; 0.63-0.67%; 4.1-5.0 kg/ha; 3.3-4.1 kg/ha, 10.7-12.0 kg/ha.

Table 1.

The effect of mineral fertilizers on the composition and amount of nitrogen, phosphorus, potassium entering the soil with root and straw residues of oat against the background of the number of irrigations (2 irrigations)

s/s	Mineral fertilizer norms	Remains of roots and straws, s/ha	In air dry matter, %			Per hectare, kg		
			N	P_2O_5	K_2O	N	P_2O_5	K_2O
2020 year								
1.	Control (no fertilizer)	**13.2**	**0.22**	**0.20**	**0.63**	**3.0**	**2.6**	**8.3**
2	Farming option No. 60	**16.5**	**0.25**	**0.20**	**0.65**	**4.1**	**3.3**	**10.7**
3	$N_{60}P_{60}K_{30}$	**21.3**	**0.31**	**0.22**	**0.70**	**6.6**	**4.7**	**15.0**
4	$N_{90}P_{90}K_{60}$	**29.2**	**0.41**	**0.26**	**0.81**	**12.0**	**7.6**	**23.6**
5	$N_{120}P_{120}K_{90}$	**27.1**	**0.37**	**0.25**	**0.78**	**10.0**	**6,8**	**21.2**
6	$N_{150}P_{150}K_{120}$	**25.1**	**0.35**	**0.23**	**0.75**	**8.8**	**5.8**	**19.0**
2021 year								
1	Control (no fertilizer)	**14.1**	**0.23**	**0.21**	**0.64**	**3.2**	**3.0**	**9.0**
2	Farming option No. 60	**17.0**	**0.26**	**0.21**	**0.65**	**4.4**	**3.6**	**11.1**
3	$N_{60}P_{60}K_{30}$	**22.3**	**0.32**	**0.23**	**0.72**	**7.1**	**5.1**	**16.1**
4	$N_{90}P_{90}K_{60}$	**31.2**	**0.42**	**0.27**	**0.83**	**13.1**	**8.4**	**26.0**
5	$N_{120}P_{120}K_{90}$	**29.4**	**0.39**	**0.26**	**0.80**	**11.5**	**7.7**	**23.5**
6	$N_{150}P_{150}K_{120}$	**26.5**	**0.37**	**0.24**	**0.78**	**9.8**	**6.4**	**20.7**
The year 2022								
1	Control (no fertilizer)	**15.3**	**0.25**	**0.22**	**0.65**	**3.8**	**3,4**	**10.0**
2	Farming option No. 60	**17.8**	**0.28**	**0.23**	**0.67**	**5.0**	**4.1**	**12.0**
3	$N_{60}P_{60}K_{30}$	**23.5**	**0.33**	**0.25**	**0.74**	**7,8**	**6.0**	**17.4**
4	$N_{90}P_{90}K_{60}$	**32.6**	**0.44**	**0.28**	**0.85**	**14.3**	**9.1**	**27.7**
5	$N_{120}P_{120}K_{90}$	**30.8**	**0.41**	**0.27**	**0.82**	**12.6**	**8.3**	**25.3**
6	$N_{150}P_{150}K_{120}$	**27.5**	**0.38**	**0.26**	**0.80**	**10.5**	**7.2**	**22.0**

As can be seen from Table 2, against the background of 3 times irrigation of vegetation **(** 2500-2700 m^3 /ha) in each of the options, the mass of root and straw residues, chemical composition, and as a result, the amount of nutrients entering the soil were 2 times higher than in irrigation.

Thus, in the control (without fertilizer) option, the root and straw residues of oat are 14.5-16.5 s/ha, depending on the productivity, the total nitrogen in air dry matter in the residues is 0.24-0.27%, phosphorus is 0.22-0, 24%, potassium 0.65-0.67%, nitrogen entering the soil 3.5-4.5 kg/ha, phosphorus 3.2-4.0 kg/ha, potassium 9.4-11.1 kg/ha ha, in the farm version (N_{60}) root and straw residues 17.7-19.6 s/ha, total nitrogen in air dry matter in residues 0.27-0.31%, phosphorus 0.22-0.25%, potassium 0 ,65-0.69%, nitrogen entering the soil was 4.8-6.1 kg/ha, phosphorus 4.0-5.0 kg/ha, potassium 11.5-13.1 kg/ha .

Due to the combined effect of all three mineral fertilizers, the amount of nutrients entering the soil increased significantly compared to the non-fertilizer and farm options, as well as in the background of 2 times irrigation. Thus, in the $N_{60}P_{60}K_{30}$ option, root and straw residues are 22.5-

25.4 s/ha depending on productivity, total nitrogen in air dry matter in the residues is 0.33-0.37%, phosphorus is 0.24-0, 27%, potassium 0.72-0.76%, nitrogen entering the soil 7.4-9.4 kg/ha, phosphorus 5.4-7.0 kg/ha, potassium 16.2-19.3 kg /ha, in the $N_{90}P_{90}K_{60}$ option, the root and straw residues are 28.5-30.7 s/ha depending on the density, the total nitrogen in air dry matter in the residues is 0.37-0.40%, phosphorus 0.25-0 ,28%, potassium 0.77-0.83%, nitrogen entering the soil 10.6-12.3 kg/ha, phosphorus 7.1-8.6 kg/ha, potassium 22.0-25.5 kg /ha was between.

The highest amount of nitrogen, phosphorus and potassium entering the soil with root and straw residues is observed in the $N_{120}P_{120}K_{90}$ option, depending on the chemical composition and quantity of the residues. total nitrogen 0.41-0.45%, phosphorus 0.28-0.32%, potassium 0.83-0.87%, nitrogen entering the soil 12.8-15.5 kg/ha, phosphorus 8.7 -11.0 kg/ha, potassium 26.0-30.0 kg/ha, and at the high rate of mineral fertilizers, the amount of nutrients entering the soil in the $N_{150}P_{150}K_{120}$ option compared to the $N_{120}P_{120}K_{90}$ option was significantly reduced.

Table 2.

The effect of mineral fertilizers on the composition and amount of nitrogen, phosphorus, potassium entering the soil with root and straw residues of oat against the background of the number of irrigations (3 irrigations)

s/s	Mineral fertilizer norms	Remains of roots and straws, s/ha	In air dry matter, %			Per hectare, kg		
			N	P_2O_5	K_2O	N	P_2O_5	K_2O
2020 year								
1	Control (no fertilizer)	**14.5**	**0.24**	**0.22**	**0.65**	**3.5**	**3.2**	**9.4**
2	Farming option No. $_{60}$	**17.7**	**0.27**	**0.22**	**0.65**	**4.8**	**4.0**	**11.5**
3	$N_{60}P_{60}K_{30}$	**22.5**	**0.33**	**0.24**	**0.72**	**7.4**	**5.4**	**16.2**
4	$N_{90}P_{90}K_{60}$	**28.5**	**0.37**	**0.25**	**0.77**	**10.6**	**7.1**	**22.0**
5	$N_{120}P_{120}K_{90}$	**31.3**	**0.41**	**0.28**	**0.83**	**12.8**	**8.7**	**26.0**
6	$N_{150}P_{150}K_{120}$	**29.7**	**0.39**	**0.26**	**0.80**	**11.6**	**7.7**	**23.8**
2021 year								
1	Control (no fertilizer)	**15.2**	**0.25**	**0.23**	**0.67**	**3.8**	**3.5**	**10.2**
2	Farming option No. $_{60}$	**18.3**	**0.29**	**0.24**	**0.69**	**5.3**	**4.4**	**12.6**
3	$N_{60}P_{60}K_{30}$	**24.6**	**0.35**	**0.25**	**0.74**	**8.6**	**6.2**	**18.2**
4	$N_{90}P_{90}K_{60}$	**29.5**	**0.39**	**0.26**	**0.80**	**11.5**	**7.7**	**23.6**
5	$N_{120}P_{120}K_{90}$	**33.7**	**0.43**	**0.30**	**0.85**	**14.5**	**10.1**	**28.7**
6	$N_{150}P_{150}K_{120}$	**30.0**	**0.41**	**0.28**	**0.82**	**12.3**	**8.4**	**24.6**
The year 2022								
1	Control (no fertilizer)	**16.5**	**0.27**	**0.24**	**0.67**	**4.5**	**4.0**	**11.1**
2	Farming option No. $_{60}$	**19.6**	**0.31**	**0.25**	**0.67**	**6.1**	**5.0**	**13.1**
3	$N_{60}P_{60}K_{30}$	**25.4**	**0.37**	**0.27**	**0.76**	**9.4**	**7.0**	**19.3**
4	$N_{90}P_{90}K_{60}$	**30.7**	**0.40**	**0.28**	**0.83**	**12.3**	**8.6**	**25.5**
5	$N_{120}P_{120}K_{90}$	**34.5**	**0.45**	**0.32**	**0.87**	**15.5**	**11.0**	**30.0**
6	$N_{150}P_{150}K_{120}$	**31.4**	**0.43**	**0.30**	**0.85**	**13.5**	**9.4**	**26.7**

CONCLUSION

Thus, the amount of nutrients entering the soil varies depending on the number of irrigations, mineral fertilizer rates, the amount of root and straw residues, and the chemical composition. On the background of 2 times of irrigation, the amount of nitrogen entering the soil with root and straw residues is 3.0-10.5 kg/ha, phosphorus 2.1-5.7 kg/ha, and potassium 6.7-17.7 kg. /ha, more nutrients entered the soil in the $N_{90}P_{90}K_{60}$ option than in the control-no-fertilizer variant. Against the background of the number of irrigations 3 times, as a result of the effect of mineral fertilizers, nitrogen entering the soil with root and straw residues is 3.9-11.0 kg/ha, phosphorus 2.2-7.0 kg/ha, and potassium 6.8-18 more nutrients entered the soil in the $N_{120}P_{120}K_{90}$ option than in the control-no-fertilizer variant between .9 kg/ha. In the background of the number of irrigations, the amount of nutrients entering the soil in 3 irrigations was significantly higher than in 2 irrigations in each of the studied options.

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DENDROCHRONOLOGICAL STUDY OF *CARPİNUS SCHUSCHAENSIS* H. WİNKL. İN HİRKAN DENDROFLORA

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Because of human‘s poorly thought-out economic activity, biological diversity has beenaltered and degraded, and the range of species has decreased. The modern vegetation biological diversity does not match the contemporary climate as a result of the biological diversity of the vegetation being violated in various places of our Republic. Monitoring the areas where rare and endangered species are distributed, developing a plan of measures for the purpose of evaluating andprotecting those ecosystems, and dendrochronological analysis of the processes occurring in the populations of rare species in the natural and cultural flora of Azerbaijan are the main goals of the scientific research work that has been conducted. Given this, it should be considered strengthening the oversight of environmental safety protection and executing challenging projects in other closely relatedareas. The old Shusha hornbeam (*CARPINUS SCHUSCHAENSIS* H. WINKL.) species was studied in the article using a sample from the Hirkan flora. Modern research techniques were used to examine the Shusha tree's age, development dynamics, and the impact of climatic conditions on the species.

Keywords: *Carpinus Schuschaensis H. Winkl., Dendrochronology, Edificatory, Hirkan Flora, Radial Growth*

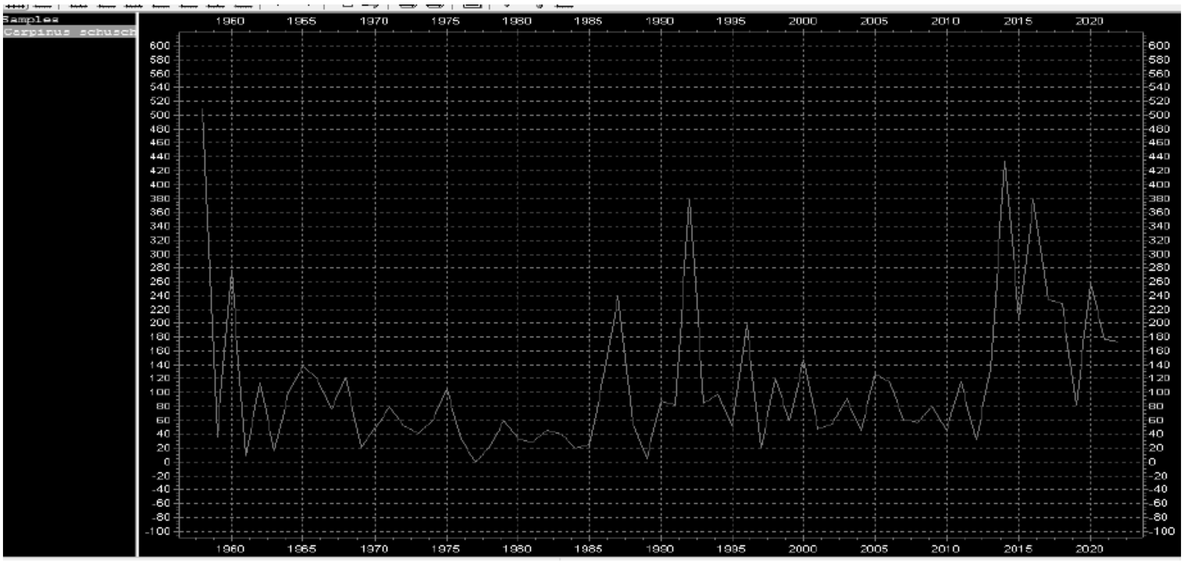
INTRODUCTION

Carpinus schuschaensis H. Winkl. – Shusha hornbeam is spread out in the northwesternpart of İran. It's a big shrub or a tiny tree. The forests of Azerbaijan's Shusha area are where it was first described. It is located in the Talysh mountains in Azerbaijan, despite the fact that the Shusha hornbeam's distribution area is not very large. İt is a rare and extinct plant species in Azerbaijan. İt is included in “Red Book”. It thrives in moderately shaded soils that were created on calcareous and marlyrocks. Its fruit (seed) ripens in June and July after it blooms in March and April. When cut, it develops several fruits from the stump and reproduces by seeds and rhizomes. Human actions are the primary causes of the change in natural resources. It is advised to set up reserves and shelters [6]. The primaryedifiers in Hirkan woods are ironwood (parrotia persica), hornbeam, chestnut-leaved oak, and orientalpistachio. Plain forest consisted of 2-3 layers:the layer is usually made of oak, hornbeam, Hirkan poplar, the second layer is ironwood,birch,elm,and etc.consists of types.

MATERIAL AND METHODS

The primary objectives of the scientific research projects are the biometric analysis, dendrochronological analysis of the processes occurring in the populations of the rare and endangered species in the natural and cultural flora of Azerbaijan, monitoring the areas where thespecies are distributed, and developing an action plan for the evaluation and protection of those ecosystems. In light of all of this, it should be considered strengthening control over the protection of environmental safety and undertaking difficult work in other related directions. In the paper, a sample ofthe ancient Shusha hornbeam species was taken from the Hirkan flora, and studies were conducted on it.

The antiquity of the Shusha hornbeam, development dynamics, and the impact of climatic conditionson the species were investigated using contemporary techniques and tools. Every ten years, data on thechanges in the species’ rings was gathered, the samples were put in a container, and the name of the species and the date of collection were noted. One registration point equates to 10, two points to 20, and three points to 30 [7,1].

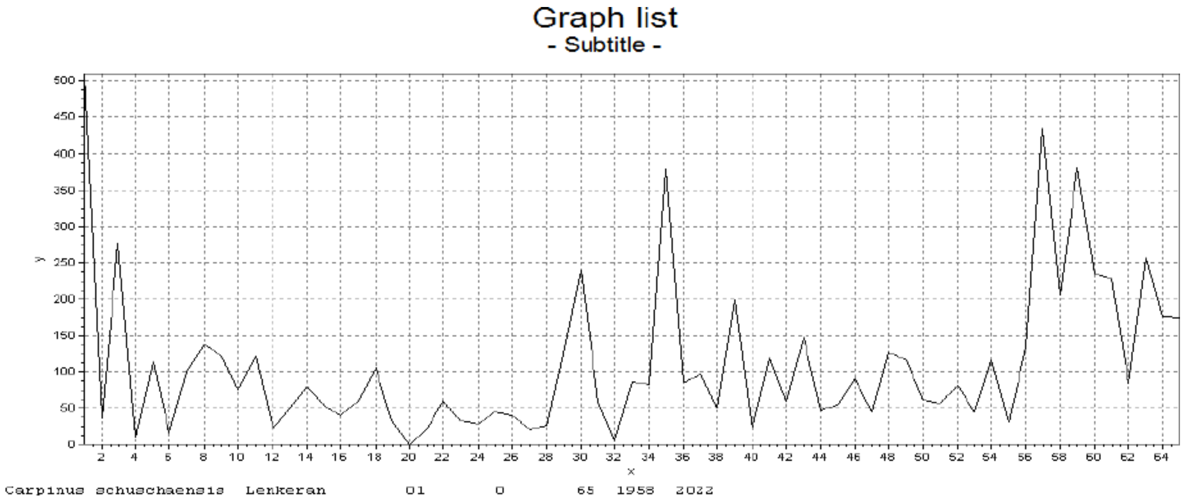


Using the Schweingruber approach, reading data from type rings was carried out. False and lost rings were discovered using the Cook-Kairiukstisn method of ring determination with a microscope Ring detection using TSAPwin and Crossdating software from Rin [9,2].

Figure 1. View of annual rings under a Lintab6 binocular microscope.

H. Winkl's *Carpinus schuschaensis*. It was put into place in accordance with updated pertinent systems that satisfy standards for the type of Shusha hornbeam set forth internationally. According to the current methodical rules, observation, registration, accounting and reporting operations, and quality study wereall studied. The age of the species and the development dynamics dependent on environmental conditions were investigated using LINTAB6 equipment and the TSAPwin statistical programme [4,5].

When senopopulations in Hirkan flora phytocenoses are being monitored, one of the most common edifying species in the Khanbulan region is *Carpinus schuschaensis* H. Winkl, which has a stem diameterof 122 cm. Based on the dendrochronological history - application, it was found that the Shusha hornbeam species is 65 years old according to the number of yearly rings, and the developmentdynamics by years are provided (Table 1.).



Graph 1. German Carpinus Schuschaensis H.Winkl from TSAPwin -Development dynamics of Shusha

Table 1.

Development dynamics of the species over the years

Species	The diametr of stem	Field coordinates	The area and date where the sample was taken	The age of the tree
Carpinus schuschaensis H. Winkl.	122 sm	N 38^0 40,445 Eo 48 44,237	Lankaran 2022	65 (1956)

At 35, 57 and 59 years old, or in 1991, 2013 and 2015, respectively, high radial growth was noted in the species. The development of the species progressed more favourably throughout the juvenile and reproductive phases than during the senile phase. Dendrochronological research showed that its development slowed down at the ages of 12, 20, 32, 40 and 55, or in 1968, 1976, 1988 and 1996. Despite this, the species' current development is thought to be normal (Graph 1.).

RESULTS AND DISCUSSION

Wide yearly rings are created in environments that are favourable for the growth of trees, and the rate of growth varies between neighbouring years. The variation in environmental conditions is reflected in the radial growth of trees. The species is substantially impacted year after year when unfavourable conditions cause the space between the rings to close. At this time ,ring loss is often observed,so such series are called sensitive. The stronger the annual variability of tree growth,the more reliable the indicator of changes in environmental conditions.

İncreasing anthropogenic impacts (expansion of agriculture and animal husbandry, mining industry expansion, building new settlements, building oil and gas pipelines, etc.) and intensifying acute climate changes (drought, flood, flood, rain, fire, storm, etc.), all against the backdrop of serious ecosystem degradation. Compared to other ecosystems, the aforementioned causes had less of an impact on forest ecosystems. As a result, forestslose area, density, quality, and productivity; natural regeneration is weakened; the replacement of desirable species with less valuable ones increases; and the forest type is degraded and altered as a result of the forest floor and dead cover. Since xerophytic and mesophytic species predominate, some trees and shrubs are scarce and in danger of going extinct. *Carpinus schuschaensis* H. Winkl, a decorative-looking tree that is frequently used in landscaping. Given the significance of the Shusha hornbeam ,stricter regulation,safer ecological pratises and more effective utilisation of natural resoursesare required.

CONCLUSION

Despite the fact that the area belongs to the ancient relic period, as a result of research, it was found that the average age of the trees here reaches 120-350 years. The reason for this is the well-known events of the 90s, lack of energy, anthropogenic, etc. as a result of the influence of factors, many plant species have been exposed to the threat of extinction, their areas have shrunk. It was observed that in the studied species in the forest ecosystems of Hyrkan flora, the radial growth is faster during adulthood, and the radial growth weakens with increasing age. During the dendrochronological analysis of the dominant edifice species during the monitoring of senopopulations in their phytocenoses, the age of the species was determined based on the number of annual rings based on the dendrochronological history-application. Taking all of this into account, more efficient use of natural resources, strengthening of control over the protection of environmental safety, and complex work in other similar directions should be considered.

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UDC 631:47

THE EFFECT OF FERTILIZERS ON THE AMOUNT OF NUTRIENTS IN THE ABOVE-GROUND MASS AND ROOT FRUITS OF SUGAR BEET PLANTS IN THE MUGAN-SALYAN REGION

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The research was carried out in the irrigated fields belonging to farmers, located in Shirinbey village of Saatli district in Mugan-Salyan region. During the research, it was determined that the maximum amount of nutrients was collected at all stages of development among the tested variants when N120P90K150+B3Mn1.5 was given.

Keywords: *light gray brown (light chestnut) soils, sugar beet, accumulation dynamics, nitrogen, phosphorus, potassium.*

INTRODUCTION

Sugar beet is a very valuable technical plant and it is grown for sugar production in industry and as fodder in animal husbandry.

Our republic has favorable soil and climate conditions for growing this valuable plant and obtaining high sugar content. Currently, in order to satisfy the population's demand for sugar, the need to cultivate sugar beet in the industrial direction has emerged. 17-19% sugar is accumulated in the beetroot of modern sugar beet varieties, which means approximately 5000 kg of sugar from each bush. Sugar beet is much better than fodder beet in terms of nutritional quality, 100 kg of beets contain 26 nutrients and 1.5 kg of digestible protein, 0.5 kg of calcium and 0.5 kg of phosphorus. Sugar beet is also important as a predecessor plant. [1,4]

In this regard, in recent years in our republic, the areas near sugar beet have been expanded, and within the framework of the State Program, a processing plant with a daily processing capacity of 5000 tons of sugar beet was built and started operating in Imishli district by Azarsun-Holding company. It is one of the important issues to carry out scientific-research works in different areas in order to meet the needs of the plant. In general, the high percentage of sugar in sugar beet carrots is one of the factors affecting the supply price of raw materials. Taking all this into account, we have set ourselves the goal of conducting scientific research work on the preparation of a fertilization system under the sugar beet plant based on the balance of nutrients in the Mugan-Salyan region.

THE OBJECT AND METHODOLOGY OF THE RESEARCH

The research was carried out in the irrigated fields belonging to farmers, located in Shirinbey village of Saatli district in Mugan-Salyan region. The impact of different rates and ratios of fertilizers on the dynamics of nutrient accumulation in sugar beet plants was determined by taking the above-ground mass and root tubers from each option at the stages of 7-8 true leaf formation, inter-row leaf thickening and harvesting stages and analyzed in laboratory conditions.

Experiments were carried out with NZ (high yield - high sugar) "Portofina KWS" variety of sugar beet plant produced in Turkey in 4 replicates in 8 variants.

Field experiment was carried out on the following variants:

1. Control (free fertilizer)
2. N60P90K90
3. N90P90K120
4. N120P90K150
5. N120P90K120+B3

6. N120P90K120+Mn1.5
7. N120P90K120+ B3 Mn1.5
8. N120P90K150+ B3 Mn1.5

In practice, from mineral aggregates, ammonium salt of nitrogen (34% of the active substance in the composition), simple superphosphate of phosphorus (18% of the active substance in the composition), 46% potassium-sulfate compounds of potassium, manganese-sulfate (20% of manganese), Boron boric acid (17.5%) forms were used. The numbers (NPK) were given in 3 periods with the annual rate of 3 places. The full annual norm of microfertilizers (Mn, B) was carefully mixed with macrofertilizers, divided into 2 parts, and given to the soil 10-12 cm deep under the trowel before sowing and at the time of exit. NPK was determined in the collected soil and root samples (by the method of K.E. Ginzburg, G.M. Seglova and E.V. Wulfius).

Plant care and agrotechnical measures (besides giving seeds) were carried out in accordance with the accepted agrotechnical rules for the sugar beet plant.

ANALYSIS AND DISCUSSION

The assimilation of nutrients during the vegetation period of the plant is different. In this respect, the demand for nutrients varies during the stages of development. The amount of nutrients collected in the green mass of the plant at different stages characterizes the quantity and quality of the product. It is of great importance to study the relationship between green mass and nutrients in the product. By knowing these, it is possible to regulate the productivity of the plant and the quality of the product. The amount of nutrients absorbed by the plant during its vegetation period varies greatly depending on the rate, application time and forms of applied fertilizers.

The application of mineral fertilizers increases nitrogen, phosphorus, potassium, calcium, magnesium, etc. in plants. increases the amount of compounds.

During the period of strong development of leaves, plants should be supplied with nitrogen food. This increases the leaves, which ensures high yield, as well as intensifies the use of potassium during root development and sugar accumulation [6].

As a result of a sharp decrease in nitrogen input to sugar beet leaves, premature destruction of beet leaves occurs [8].

When the plant is given 50-150 kg of nitrogen per hectare, the total amount of nitrogen in the organs during harvesting is 176-402 kg/ha; and the nitrogen deficiency of the plant is on average 1.0-2.0% [9].

It is shown that the application of mineral fertilizers increases the amount of nutrients in the root and green mass of the sugar beet plant [7].

It has been established that high doses of phosphorus and potassium eliminate the negative effect of excess nitrogen [5].

During the period of intensive sugar collection, sugar beet absorbs more potassium nutrients. Potassium deficiency increases non-protein nitrogen.

When the plant lacks phosphorus, the vegetation period is extended, the crop ripens late, and the leaves turn red or purple. In aphids well supplied with phosphorus, bar organs are formed quickly. The only sources of phosphorus for the plant are reserve phosphorus compounds in the soil and phosphorus fertilizers applied to the soil [2].

As a result of the research, it was determined that the amount of nutrients in the mountain black soils washed from moderately eroded carbonates, either without fertilizers (control), or in the variants given mineral fertilizers and individual microelements in their background, from the first development phases of the sugar beet plant to the end of the vegetation began to decrease, and at the end of the vegetation, their further decrease was observed. This is closely related to the fact that the sugar beet plant uses nutrients intensively, develops its organs and produces its productivity (root tubers). It should also be noted that individual microelements given against the background of mineral fertilizers have a strong effect on better assimilation of plants from both fertilizers and nutrients contained in the soil [3].

Influence of fertilizers on the dynamics of the accumulation of nutrients in sugar beet plants, % (2022 year)

Variants	Growth stages																	
	Formation of 7-8 true leaves						Interspersion of leaves						Harvest					
	N		P_2O_5		K_2O		N		P_2O_5		K_2O		N		P_2O_5		K_2O	
	leaf	**root**	**leaf**	**root**	**leaf**	**root**	**leaf**	**root**	**leaf**	**root**	**leaf**	**root**	**leaf**	**root**	**leaf**	**root**	**leaf**	**root**
Contol (free fertilizer)	2,94	1,32	0,76	0,88	2,72	1,20	2,60	1,10	0,52	0,36	2,20	0,68	2,26	1,06	0,42	0,24	2,08	0,54
$N_{60}P_{90}K_{90}$	3,14	1,34	0,82	0,90	2,76	1,24	2,64	1,14	0,58	0,40	2,36	0,76	2,28	1,10	0,44	0,22	2,12	0,60
$N_{90}P_{90}K_{120}$	3,18	1,40	0,84	0,92	2,80	1,30	2,68	1,20	0,64	0,42	2,38	0,84	2,32	1,20	0,56	0,24	2,14	0,62
$N_{120}P_{90}K_{150}$	3,22	1,42	0,86	0,80	2,82	1,32	2,72	1,24	0,66	0,46	2,40	0,88	2,38	1,26	0,60	0,26	2,32	0,64
$N_{120}P_{90}K_{120}+B_3$	3,24	1,48	0,88	0,88	2,84	1,34	2,76	1,30	0,74	0,58	2,54	0,78	2,60	1,30	0,68	0,28	2,30	0,67
N120P90K120+ $Mn_{1.5}$	2,92	1,44	0,84	0,88	2,86	1,36	2,72	1,32	0,68	0,58	2,44	0,92	2,48	1,28	0,58	0,32	2,20	0,66
N120P90K120+ B_3 $Mn_{1.5}$	3,30	1,46	0,92	0,92	2,90	1,38	2,78	1,26	0,70	0,48	2,52	0,94	2,52	1,30	0,66	0,28	2,22	0,70
N120P90K150+ B_3 $Mn_{1.5}$	3,38	1,54	0,94	0,96	2,94	1,40	2,80	1,34	0,80	0,60	2,58	0,98	2,64	1,38	0,74	0,33	2,34	0,78

The analysis of samples taken from different organs of plants characterizes the degree of their supply with nutrients better than the analysis of the soil.

It is necessary to use the results of plant analyzes in determining the fertilizer demand of agricultural plants.

It is clear from the literature data mentioned above that fertilizers have a significant positive effect on the accumulation of nutrients in plants. The sugar beet plant absorbs nutrients at different levels at different stages of its development. Therefore, in order to characterize the plant's nutritional needs, the amount of nutrients in the leaves and roots was determined by developmental stages.

The characteristic feature of the dynamics of the accumulation of nutrients in the sugar beet plant is that in all variants of the experiment, the highest level of assimilation of nutrients by plants is observed from the stage of formation of 7-8 true leaves to the stage of harvesting.

But it should be noted that the assimilation of individual nutrients during the stages of compaction of inter-row leaves and harvesting is uneven.

In the results of the table below, the amount of nitrogen, phosphorus and potassium in both the roots and leaves of the plants during the entire vegetation period was low, which indicates the lack of nutrients.

Depending on the application of fertilizers in different rates and proportions to the sugar beet plant, different amounts of nutrients change in the plant.

Compared to the control (no fertilizer) variant, application of fertilizers increases the amount of NPK in plants. This is the result of the increase in compounds in the soil that can be easily assimilated by plants due to the effect of fertilizers.

At all stages of plant development, the maximum amount of nutrients was observed in the N120P90K150+B3 Mn1.5 option. This is related to the good supply of plants with nutrients and the increase of the coefficient of fertilizer use in that version.

In this variant, the amount of nitrogen in leaves and roots at the stages of formation of 7-8 true leaves, compaction of inter-row leaves and harvest is 3.38 and 1.54, respectively; 2.80 and 1.34; 2.64 and 1.38; phosphorus 0.94 and 0.96; 0.80 and 0.60; 0.74 and 0.33; potassium 2.94 and 1.40; 2.58 and 0.98; 2.34 and 0.78%.

According to the results of the analysis of the samples taken from the leaves and root fruits of the sugar beet plant, the different rates and proportions of the applied fertilizers not only increase the amount of nutrients in the plant organs, but also create conditions for obtaining a high yield from the plant.

CONCLUSION

Different rates and ratios of the sugar beet plants increase the amount of total nitrogen, phosphorus and potassium in the leaf and stem of the sugar beet plant during the development stages and activate the exchange of substances. Among the variants tested, the maximum amount of nutrients was collected at all stages of development when N120P90K150+B3Mn1.5 was given.

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ECOLOGICAL SIGNIFICANCE OF THE SYNTHESIS AND RESEARCH OF CORROSION INHIBITORS IN LITHOSPHERE PROTECTION

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One of the main reasons for unexpected man-made environmental disasters in the oil-gas and petrochemical industry, as in any other industry, is the corrosion of steel technological equipment. As a result of this, oil, gas, oil and petrochemical products containing various ecotoxic compounds in those production areas spilled into the ground, explosions, fires occurred on the upper and lower surface of the lithosphere and at different depths depending on its relief, composition, and type. causes pollution of all components of the biosphere.

Key words: *steel technological equipment, corrosion inhibitor, ecotoxic compounds*

INTRODUCTION

As it is known, industrial waste, which is currently formed in all industrial enterprises, depending on its composition and physico-chemical properties, ultimately creates long-term environmental problems in the lithosphere, which is the main space of the biosphere. Therefore, there are short-term and long-term special programs for the ecological protection of the lithosphere in every industry by the state and the enterprise.

At the same time, it can be noted that one of the main reasons for the unexpected occurrence of man-made environmental disasters in the oil-gas and petrochemical industry, as in any other industry, is the corrosion of steel technological equipment. As a result of this, oil, gas, oil and petrochemical products containing various ecotoxic compounds in those production areas spilled into the ground, explosions, fires occurred on the upper and lower surface of the lithosphere and at different depths depending on its relief, composition, and type. causes pollution of all components of the biosphere.

From this point of view, the synthesis, research and application of corrosion inhibitors in the protection of steel technological equipment operated in a strong aggressive environment in the oil-gas, petrochemical industry, as in other industries, is one of the most relevant topics.

For this purpose, we are continuing our long-term research on the synthesis and research of new organic compounds that meet all the requirements of modern environmental safety with higher corrosion inhibitory properties and contain a lot of nitrogen atoms and functional groups.

It is known from the technical literature and the results of our studies that compounds containing nitrogen, carbon atoms C6H5-, -CH2OR, azonyl groups, and double bonds have high environmental corrosion inhibitor properties.

Taking into account the above, we have synthesized new compounds with 16, 18, 20, 21, 27, 28 nitrogen atoms based on diphenylcarbazidin, diphenylcarbazone, guanidine, diphenylguanidine based on octyl, decyl, dodecyl alcohols and chlorazone, which are ecologically effective and meet the requirements of ecological safety. has been done. Those compounds 2; 1.5; 0.5; 0.1; 0.01; At concentrations of 0.001, the corrosion inhibitor efficiency was 99.96-100%. It can be scientifically considered that these compounds are of high ecological and economic importance in increasing the range of new environmentally effective corrosion inhibitors and in preventing environmental pollution of the lithosphere if they are applied in the oil-gas and petrochemical industries.

ECOLOGICAL ASSESSMENT OF IRIS SPECIES SPREAD IN THE WESTERN REGION OF AZERBAIJAN BY SOIL FACTORS

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The increased anthropogenic pressure on natural ecosystems over the past decades has led to changes in the natural conditions of plant resources growth.

Changes in soil and climatic factors caused a decrease in populations of wild species of irises. The purpose of this study is to determine the soil factors that have a limiting effect on the species of irises. The study is according to D. N. Tsyganov's scale, it is to determine the limiting soil factors affecting the distribution of some iris species (Iris L) in the western region of Azerbaijan.

For this purpose, an assessment of the potential and real ecological valence of species was carried out, the coefficient of ecological efficiency and the index of tolerance of species in relation to soil factors were calculated.

With the help of amplitude ecological scales, it is possible to determine the state of the growing environment of cenopopulations of iris species.

It was determined that the species of irises growing in the western part of Azerbaijan can be bioindicators of the environment. The narrower the ecological range of the species, the higher its indicative significance.

The results of the research can be used for phytoindication of territories and monitoring of plant resources.

Keywords: *phytoindication; potential ecological valence; real ecological valence; soil moisture; species; tolerance index.*

INTRODUCTION

Measuring the influence of multiple complex elements, such as the soil fertility and water regime, can be a challenging task. However, the phytoindication method is an essential tool that allows us to accurately assess and understand such factors. Local environmental conditions can be best estimated by looking at natural vegetation and soil, which have adapted to the area over a long period of time and are thus the most reliable and trustworthy indicators.Modern times vegetation is often widely used in various science and Industrial Research, geobotany, geology, soil science, hydrogeology, earth structure and landscape structure as an environmental bioindicator.

Ecological features of plants are characterized by their distribution in different areas. It is known that the plant world becomes very sensitive to the influence of environmental factors. The characteristics of the plant community have led numerous researchers to assert that it is feasible to determine the ecological conditions of a specific environment. The presence of any cenopopulation in the ecotope under certain conditions is evidence of the interaction of their abiotic factors, solar radiation and anthropogenic impact.

Measuring the influence of multiple complex elements, such as the soil fertility and water regime, can be a challenging task. However, the phytoindication method is an essential tool that allows us to accurately assess and understand such factors. Local environmental conditions can be best estimated by looking at natural vegetation and soil, which have adapted to the area over a long period of time and are thus the most reliable and trustworthy indicators.

Thus, it is possible to use phytocenosis as a bioindicator of ecological areal. The narrower the ecological range of the species, the higher its indicative significance.

MATERİALS AND METHODS

Iris (Iris L.) from the iris family in the Western region of Azerbaijan was used as the research material). The studies were carried out in 2014-2022 at altitudes from 200 to 1500 m above sea level and on various plant groups. To ascertain the distribution patterns of the species in the research area, over 100 geobotanical observations were conducted detailing the various species' growth characteristics. (Flora of Azerbaijan. In I-VIII tt. (1950-1961); Grossheim, (1940); Grossheim, (1949)).

For ecological assessment of areas where cenopopulations spread, D.N. Siganov's ecological range scale was used. Taking into account Siganov's scale, L.A.Zhukova's method of assessing the potential and real ecological valence of species was used. (Tsyganov, (1983); Zhukova, (2004); Zubkova, (2008); Dorogova et. al.(2010);

The purpose of the study is the D. N. Tsyganov's scale was applied to identify the primary soil restrictions that influence the distribution of particular *Iris* L species in the western part of Azerbaijan.

RESULTS AND DİSCUSSİON

In the western region of Azerbaijan, 13 species of Iris are common. The richness of such species diversity is influenced by the soil and climatic conditions of the area. As many researchers note, its own vegetation forms on clayey soil outcrops. Relict and endemic plants are more common in such areas. (Flora of Azerbaijan. In I-VIII tt. (1950-1961); Grossheim, (1940); Grossheim, (1949)).

Protection and effective use of rare species of rhizome *Iris* is of great importance, since recently phytocenoses have been subjected to strong anthropogenic impact. (Ibadullayeva & Huseynova (2021)). As a result, these species included in the “Red Book”of Azerbaijan were threatened with extinction. (The Red Book of the Republic of Azerbaijan. (2013)).

The Floristic composition of the phytocenosis is determined by the phytoindication method. (Tsyganov, (1983)).If euribiont species predominate here, then the ecological amplitude of the ecotope is wide. The presence of Stenobiont species, on the other hand, narrows this amplitude. In each biotope there are plant species with a wide and narrow ecological amplitude. The sustainability of the population of rare plant species does not depend on the general characteristics of the ecotope, but on environmental factors that are at a minimum in this ecotope. (Dorogova, et.al. (2010)).

Assessing the ecological condition of areas based on the studied species is achievable by identifying the features of the vegetation cover. (Viktorov, , & Remezova, (1988)).

Soil moisture (Hd); acidity (Tr); soil nitrogen richness (Nt); salinity (Rc); variable moisture (fH) (Zhukova, (2004); Kharitontsev & Sharafutdinova (2017); Dorogova (2019)). were studied in the calculation of potential ecological valence of Iris Species (Table 1).

According to the soil moisture (Hd) scale, 11 iris species are narrow-valent (Iris germanica L, i. lineolata (Trautv) Gross, I. ImbricataLindl, I. camillae Gross, I.shelkownikowii Fomin, I. iberica Hoff, I. paradoxa Stev, I. annae Gross, I. acutiloba C. A. Meyer, Iris grossheymii Woronow ex Grossh), 1 species (Iris carthalinia Fomin).- hemistenovalent, 1 Type (I. pseudacorus L) is mesovalent. Thus, in this ecocenotic group, all species are considered to be of a very narrow range and, according to these indicators, are an important limiting factor for the distribution of plants. (Askerova (2019).

According to the soil salinity (Tr) scale, 92.3% (*Iris germanica* L, *I. lineolata* (Trautv) Gross, *I. Imbricata* Lindl, *I. camillae* Gross, *I.shelkownikowii* Fomin, *I. iberica* Hoff, *I. camillae* Gross, *I. paradoxa* Stev, *I. annae* Groos, *I. acutiloba* C. A. Meyer, *Iris grossheymii* Woronow ex Grossh, *Iris carthalinia* Fomin) is stenovalent, single 1 species (*Iris pseudacorus* L) is hemievivalent.

According to the soil nitrogen richness (Nt) scale, species 6 – 46% is hemistenovalent (*I.shelkownikowii* Fomin; *I. lineolata* (Trautv) Gross; *I. camillae* Gross; *I. annae* Gross; *I. acutiliba* C.A.Meyer; *Iris grossheymii* Woronow ex Grossh), 4 species-stenovalent (*Iris alexeencoi* Fomin, *I. carthaliniae* Fomin, *I. iberica* Hoff, *I. paradoxa* Stev), 2 species of which are hemievivalent (*Iris germanica* L, *I. imbricata* Lindl), 1 species – mesovalent (*Iris pseudacorus* L). Thus, due to these environmental factors, iris species can also adapt to soils that are poorly supplied with nitrogen.

As can be seen from the soil reaction (salinity, alkalinity) (Rc) scale, 6 of Iris species steno-6 are hemistenovalent. It means that not all irises spread in this area are tolerant of increased acidity in the soil. A single species (*Iris pseudacorus* L) is euvalent due to this factor.

Table 1.

Potential and real ecological valences of iris species according to D.N. Tsiganov's soil scale (PEV, REV), environmental efficiency coefficient (Envir. eff. coefficient) and tolerance index (Ti)

№	Species	Hd			Tr			Nt			Rc			fH			Tİ
		PEV	REV	Envir eff. coeff	PEV	REV	Envir eff. coeff	PEV	REV	Envir eff. coeff	PEV	REV	Envir eff. coeff	PEV	REV	Envir eff. coeff	
1	*İris germanica*L	0,3	0,2	81	0,2	0,2	71	0,6	0,5	86	0,4	0,3	79	-	-	-	0,3
2	*İris pseudacorus*L	0,5	0,4	91	0,6	0,5	91	0,5	0,5	83	1	0,9	92	0,5	0,4	0,4	0,62
3	*İris alexeencoi*Fomin	0,3	0,2	81	0,2	0,2	71	0,3	0,2	56	0,2	0,2	65	0,3	0,2	67	0,26
4	*İrislineolata*(Trautv) Grossh.	0,3	0,3	87	0,2	0,2	71	0,5	0,4	80	0,4	0,3	79	0,3	0,2	67	0,34
5	*İriscarthaliniae*Fomin	0,4	0,4	91	0,2	0,2	71	0,3	0,2	67	0,2	0,2	65	0,5	0,4	80	0,32
6	*İrisimbricata*Lindl	0,2	0,2	81	0,2	0,2	71	0,6	0,54	83	0,2	0,2	65	0,5	0,4	80	0,34
7	*İriscamillae*Grossh.	0,3	0,2	81	0,2	0,2	71	0,5	0,4	80	0,4	0,3	79	0,4	0,3	75	0,36
8	*İ. shelkownikowii*Fomin	0,3	0,2	81	0,2	0,2	71,4	0,4	0,4	100	0,3	0,2	65	0,4	0,3	75	0,32
9	*İris iberica*Hoff	0,3	0,2	85	0,2	0,2	76,2	0,3	0,2	67	0,3	0,2	77	0,4	0,3	75	0,30
10	*İris annae*Grossh.	0,3	0,3	87	0,2	0,2	71,4	0,5	0,4	80	0,4	0,3	79	0,3	0,2	67	0,34
11	*İrisparadoxa*Stev	0,2	0,2	81	0,2	0,2	71,4	0,2	0,1	50	0,2	0,2	65	0,5	0,4	80	0,26
12	*İris acutiloba C.A.Meyer*	0,3	0,3	87	0,2	0,2	71,4	0,5	0,4	80	0,4	0,3	79	0,3	0,2	67	0,34
13	*İris grossheymii* Woronow ex Grossh.	0,3	0,3	87	0,2	0,2	71,4	0,5	0,4	80	0,4	0,3	79	0,3	0,2	67	0,34

Note: Hd-soil moisture; Tr-soil salinity; Nt-soil nitrogen richness; Rc-soil reaction (salinity, alkalinity); fH-soil variable moisture;
PEV-potential ecological valence; REV-real ecological valence; Envir. eff. coefficient - coefficient of environmental efficiency; Ti-tolerance index

According to variable moisture (fH), half of the species are stenovalent (*Iris alexeencoi* Gross, *I. lineolata* (Trautv) Gross, *I. annae* Gross, *I. acutiloba* C.A.Meyer, *Iris grossheymii* Woronow ex Grossh), while 7 species (*Iris germanica* L, *I. alexeencoi* Gross, *I. carthaliniae* Fomin, *I. imbricata* Lindl, *I. Camillae* Gross, *I.shelkownikowii* Fomin) is hemistenovalent. Therefore, this factor is limiting for iris varieties.

The indicators of this scale once again confirm that these species spread in the arid zone have adapted to drought in the area.

Due to area illumination (Lc) most iris species are more common in illuminated areas. Of the irises, 2 species (*Iris alexeencoi* Fomin, *I. iberica* Hoff) - stenovalent, 7 species hemistenovalent (*Iris germanica* L, *I. lineolata* (Trautv) Gross, *I. camillae* Gross, *I. shelkownikowii* Fomin, *I. annae* Gross, *I. acutiloba* C.A.Meyer, *Iris grossheymii* Woronow ex Grossh), 3 species mesovalent (Iris *pseudacorus* L, *I. carthaliniae* Fomin, *I. paradoxa* Stev), and species 1 is hemievivalent (*Iris imbricata* Lindl). According to the indicators of this ecological scale, the species were mainly light-loving, spread in open areas, forest glades.

Table 2

Tolerance index (TI) and ecological niche of iris species according to soil and area illumination

№	Species	Soil factors	
		Ti	Ecological niche
1	*İris germanica L*	0,30	Stenobiont
2	*İris pseudacorus L*	0,62	Hemievri-biont
3	*İris alexeencoi*Fomin	0,26	Stenobiont
4	*İrislineolata*(Trautv*)* Grossh.	0,34	Hemisteno-biont
5	*İriscarthaliniae*Fomin	0,32	Stenobiont
6	*İrisimbricata*Lindl	0,34	Hemisteno-biont
7	*İriscamillae*Grossh.	0,36	Hemisteno-biont
8	*İ. shelkownikowii*Fomin	0,32	Stenobiont
9	*İris iberica*Hoff	0,30	Stenobiont
10	*İris annae*Grossh.	0,34	Hemisteno-biont
11	*İrisparadoxa*Stev	0,26	Stenobiont
12	*İris* acutiloba*C.A.Meyer	0,34	Hemisteno-biont
13	*İris grossheymii* Woronow ex Grossh	0,34	Hemisteno-biont

CONCLUSION

Thus, it has been established that in the western region of Azerbaijan, species against soil factor in ecological-cenotic groups have a narrow range. The soil conditions have resulted in a lack of equivalent species, which has limited the potential for irises to thrive and spread in this region. Most of the iris species distributed in this area are stenovalent and hemistenovalentlidids.

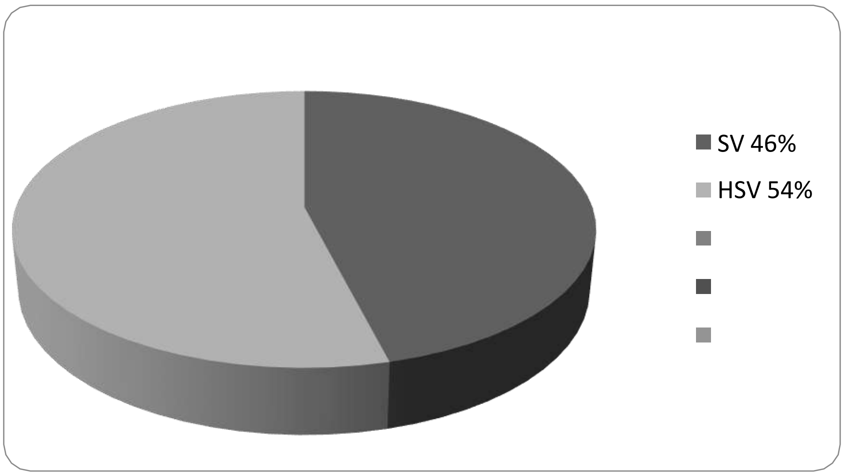

Figure 1. Distribution of tolerance groups of species according to soil factors.

According to the indicators of the soil scale, the iris species distributed in the area are mainly hemistenovalent (54 %). Stenovalent species - 46%, mesovalent, hemievrivalent, evrivalent species were not found (Figure 1).

The study revealed that root-bearing iris species in the western region of Azerbaijan have a limited tolerance due to their specific adaptation to the local climate and soil scales, which only have a narrow range suitable for their growth and survival. It can be said that most of the iris species distributed here are steno - and hemistenovalent, so their distribution areas are small. Since these species are considered spectators, they have had little impact on the structure of their ecological-cenotic groups in which they spread. Most of these species are steno - and hemistenovalent. It belongs to rare and endangered species for the Region and needs special protection measures.

The results of the study can be used in environmental bioindication and monitoring of plant resources.

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GEOECOLOGICAL CASES ON SOIL INVESTIGATIONS IN ABSHERON PENINSULA

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Presented paper covers issues of the study of environmental and eco-geographical issues of the territory of Absheron peninsula. Would be impossible to create a harmonious environment for live life without knowledge of efficient use of natural resources and systematic mechanisms. Our topic on environmental issues, based on substantive researches of reputable scientists is actual for Absheron peninsula and natural components. An article concerns of protection of diversity of soils, flora and fauna of the Absheron Peninsula, identification of endangered plant and animal, preservation of natural complexes of Absheron Peninsula, also touches study of the ecological and geographical characteristics of the Absheron Peninsula by using GIS.

We tried to introduce modeling and research methods, assessing the interaction of territorial development of the natural potential in Absheron peninsula, planning methods and strategic programs for the development of social and economic priorities.

Another aim was determination of the impact of social and economic development on Absheron peninsula on soils and biodiversity, use of indicative functions of bioresources in different fields of researches, impact of social and economic development on soil/land and water resources in Absheron peninsula, as well as assessment of impact of air pollution, optimal criterias for maintaining of natural balance in Absheron peninsula.

Keywords: *Absheron peninsula, Contamination, Environmental aspects, Natural ecosystems, Soil pollution*

Environmental problems have great importance all over the World and humanity made serious efforts for solving these aspects. Environmental studies are very important as the major global issue presented in SDG (Sustainable Development Goals).

Complexity of landscapes of peninsula Absheron has typical dry steppe and semi-desert character. Formerly widespread throughout South Caucasus, these types of landscapes remain in Absheron as well cultivated territory produces vines, figs, olives and mulberry and local vegetables since long period of time.

INTRODUCTION

Landscapes of Absheron shaped by peculiar physical and geological-geomorphological circumstances modeling major environmental conditions. Height amplitude of the area fluctuating from -28 m at the coastal line of Caspian Sea to 1222 m on Mt Gadi and 2205 m on Mt Dubrar.

Relief is mainly hilly plain and low mountainous, surface character presented by wide wavy plains, gentle slopes and hills separated by seasonal streams and various sediments; area composed by limestone, sand and clay. Soils maturate by alluvial-proluvial, deluvial-proluvial and eolian processes, while western part of the study region composed by the mixture of river stones and gravel.

Sediments developed during Paleogene and Neogene periods.

These lands also famous with mud volcanoes phenomena – appearance of endogenic processes with immediate influences of volcanic matters to the soils’ patterns.

MATERIAL AND METHODS

Research methods: comparative – analytical method; statistical method and modeling method; historical analyze method; philosophical approach method; Remote sensing and decryption (interpretation) method.

Natural development of essential landscapes of Absheron linked to the harmony of natural components and influence of humanity. Among natural devastating events, we've to mention slides and erosion, particularly water erosion and eolian (wind) erosion, also acidulation, erosion denudation, abrasion and accumulation processes. These acts have major impact to development of local landscapes; besides of these, we emphasize anthropogenic factor as the negative influences to the ecosystems.

Authentic types of soils of peninsula considered as the light and medium sized clay-gray and with some patterns of gray-brown soils in certain areas. Main characteristics of these bedrocks present low carbon dioxide. In sandy soils occurs acidic reaction in clay rocks.

Extraction of oil and gas resources has grandiose effect to the landscapes in total, particularly on soils. During fieldwork we've collected samples of oil-contaminated soils to define morphological and genetic features. Amount of oil pollution estimated between 20 to 26% in most contaminated areas, 16 to 18% in average polluted areas and 10 to 13% in low polluted territories.

Assessment of interaction of potential of the development of the territory has identified key indicators. These signs based on petrochemical industry, gas industry, electro-technical industry and construction materials industry, as well as development of agricultural sector and dense logistic network. These production fields have enormous pressure on soils, as well as air and water, damages fragile landscapes.

Soils of areas of progress of oil and chemical industries exposed to huge contamination according to technical growth. Fertility of soils varies inter natural and anthropogenic factors; contamination of land cover by chemical substances; and required re-cultivation based on essential process of recovery of soil funds.

Basic principles of assessment of economic and social development presented by demographical indicators and process of growing urbanization reflect current conditions. Absheron has biggest figures of population and agglomeration in Azerbaijan. Approximately 70% of increase appeared between 1959 and 1999 in parallel with extension of cities of Baku, Sumgayit and Khyrdalan. It's outcome of regional activities based on multiple evaluation criteria. According to the "State Programme on social and economic development of regions" implies up-growth in industrial spheres and, unfortunately, growing of pollution and pressure on lands and soils.

Pollution, as a result of impact of oil gravity, penetrates deeper into soil layers and has detrimental effect to the root systems of plants.

Prevention of these – re-cultivation of polluted lands.

In general, lean on contamination of soils, we can highlight 3 categories:

- first – contamination by oil products,
- second - contamination by industrial wastes and construction industry's mullock,
- third - contamination by soils, reservoirs, stones and sands quarries, wetlands, drilling mud, wells and atmospheric sediments, as well as salinization and erosion processes.

Particularly soils of Absheron are affected by oil industry and derivatives, which have great pragmatic impact to the budget of our State and negative impact to the environment. Environmental conditions of peninsula are determined by the high concentration of industrial production – today above 70% of Country's business prospective concentrated in 2 cities ~ Baku and Sumgayit, which covers only 2.5% of Country's total area. These pressure - a priori - work upon high percentage of contamination.

Territory modeling processes replaces the object during investigations and give a new knowledges concerning of terrain. Territory modeling as the analysis method contributes outstanding place in social development of nature and ways of exploring and changing of environment in Absheron. Method of landscape modeling is effective for defining and investigating of new details and decision making aspects.

Key indicators identify assessing of dynamic development of landscapes, particularly polluted soil resources. We took into consideration also ecological-geobotanical approaches. Absheron peninsula has been one of the dry subtropical plants, such as olive, grape, fruit and berry orchards, vegetable and saffron.

And smallest of Azerbaijan's national parks – Absheron NP – encompasses the narrow south-eastern tip of Peninsula, launched for protection of dynamic coastal ecosystems with the authentic semi-desert right next to sandy shores and shallow lagoons. This NP located on the spit of Absheron peninsula, surrounded by Caspian Sea. The landscapes along the coast have been subject to several significant modifications, most important among them the natural changes of the level of Caspian Sea.

As maintained by the Sustainable Development Goals and "State Programme on social and economic development of regions" ascertained by these different clarifications of the stability category for dynamical systems in nature and society with the ultimate aim to create ecological and economic models of evaluation of these approaches. Emphasized on risk assessment for natural disasters in conjunction with elaboration of innovative models and consequences of emergency situations. Outlines of new techniques for monitoring of natural objects and prediction of global and local changes via remote sensing capability.

Techniques are methods of doing or performing certain tasks by using and/or implementing devices, using particular functions.

RESULTS

While working on this topic, author used modern GIS data. GIS is a framework on gathering, operation, analyzing important records. Since GIS based on geography and operates spatial evidences, supports modeling and visualizing basic info of topographic maps and 3D platforms.

We're using GIS in a wide area as the research tools for environmental planning and landscape modeling. GIS allow perspectives for efficient management of wildlife conservation, particularly on example of Absheron National Park which is situated in study area and provided etalon complexes of dry steppe and semi-desert landscapes.

For modeling of biodiversity, including soils, most useful are three functions:

- area research
- data combination
- data visualization.

DISCUSSION

GIS provide data on local richness, fragmentation, area density of the landscapes. By creating DIM (Digital Elevation Models) we ensure net fundamental production rates, amount of biomass and major indicators. Evaluation of vegetation coverage by NDVI (Normalized Difference Vegetation Index) secures supportive tools for monitoring of agriculture, livestock manufacture and desertification thus provides RS (remote sensing) primary data on regional scale and landscape standards.

Our researches of peninsula could be divided to three phases:

- theoretical gradation - main scientific and methodological references based on location, climate, hydrology and hydrogeology
- field surveys – practical issues of floristic and faunistic diversity, evolution and evaluation of landscapes' complexes
- modeling stage – positioned on GIS data and different simulation types.

In this topic we challenged an idea of investigations of historical and modern landscapes, studying soil resources and impact of contamination, tracking biodiversity and endemic vegetation, identifying rare and endangered species of plants (and animal), preserving unique ecosystems of Absheron.

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ON THE PRODUCTIVITY OF THE KHINDOGNY GRAPE VARIETY AND PRODUCT THE RESULT OF DIFFERENT CULTURAL OPERATIONS AFFECTING THE QUALITY

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The yield of grapes, increasing the quantitative and qualitative indicators of the product on a scientific basis is one of the important issues ahead. To the growth of the grape responsible achieve to be for grapes cultivated of the region climate-soil conditions, reprimand economic-technological features, to the trunk various of forms giving, spontaneous on the picture not differential of agricultural technology modern scientific to the basics leaning on application making many important of issues is one. Past of years according to the indicators in Azerbaijan various in the regions cultivated technical and the table grapes in accordance with the direction of use of varieties high productivity is possible. That's why to the relief in the grape fields, to the grape varieties to be planted should be treated with high care, modern cultivationwide space should be given to the application of systems. For this purpose, the end for the development of winemaking in our country grape varieties such as Khindogny, Madrasa, Bayanshire, Rkasiteli, which were in great demand at the time, are given ample space to create a vineyard. Therefore, in the Absheron Auxiliary Experimental Farm (Ampelography collection garden) differential of agricultural technology some elements application by doing Khindogny grapes of the variety Factors affecting productivity, product quantity and quality, that is, different loads on forms norms to give and to learn goal ahead is set.

Key words: *agrotechnics, cultivation, fan shape, cordon shape, grape, cargo norm*

INTRODUCTION

Market economy development of viticulture in the conditions important importance earns Viticulture is a more profitable and profitable field than other agricultural crops was a field that solved the employment problem of the population. From this point of view, the vineyard area is always country of the president in general to work of the state attention in the center which is one was the field. of the population foodone of the main products in the payment of insurance is grapes and at the same time wines, juices made from grapes, jams, various without alcohol drinks, raisins, wave and other this whom products both fresh, bothtoo year-round in storage conditions meets people's needs.

In our republic of the population fruits and vegetables, grapes and other to products which is demand important government programs are implemented to pay. President of the country's "Agriculture on state support to producers of their products" January 23, 2007 of the Cabinet of Ministers Order No. 1907 was issued. In this regard, the products grown in agriculture from grapes and grapes in both economically efficient and human nutrition the excess demand for other manufactured products stimulates the development of this field. To him according to too scientists and specialists of viticulture development provided make for scientific in terms of the demand for sustainable, highly productive, multi-field use based on justified biotic-abiotic factors paying and producing high-quality wines of the Khindogny grape variety productivity increase extensive research is being conducted for

Khindogny grapes variety of our republic basically Karabakh and other zones cultivated is one of the important grape varieties. It is a local Azerbaijani variety. This variety is high quality red of table wines, It is suitable for the preparation of grape juice in regions where dessert wines are hot. It ripens in the middle period. Vegetation period is 160-170 days. It has a very strong dyeing power. Harvesting 12-18 tons of grapes per hectare, mainly by forming a multi-armed fan and cordon possible. The average weight of the clusters is 150-200 grams, the sugar content in the juice is 19.4-22%, and the acidity is 6.2-7.9becomes g/dm³. It is resistant to frost and drought, strong to mildew and weak to oidium degree is infected. The clusters are medium-large, conical in shape, very densely located, color it is black.

MATERIAL AND METHODS

Experience Bubal according to the new farming system methodology with is being conducted. This for the purpose experience Apsheron Helper Experience On the farm (Ampelography collection garden) is laid out on the following scheme (Salimov et al., 2020, p. 17).

Experiment I - 15-20 eyes were kept on the fan form of pruning in the I variant, 20-25 eyes in the II variant, 25-30 eyes in the III variant, II experiment - 15-20 eyes were kept on the cordon form of pruning again in the I variant, 20-25 in the II variant eyes, 25-30 eyes were kept in variant III (Salimov et al., 2019, p. 317).

In the Khindogny grape variety

I Experience

Option I - keeping 15-20 eyes on 5 stems by giving them a fan shape

Option II - by giving 5 stems a fan shape, keeping -20-25 eyes on it

Option III - by giving 5 stems a fan shape, keeping -25-30 eyes on it

Experiment II

Option I - 15-20 eyes are kept on it by giving 5 stems a cordon shape

Option II - by giving 5 stems a cordon shape, keeping -20-25 eyes on them

Option III- by giving 5 stems a cordon shape, keeping 25-30 eyes on them

Research of the results calculation of HIV Ampelodescriptor indicators basicallythe following will be conducted in order.

Clusters weight grapes ampelographic of genotypes research methods intended caughtIt is indicated according to the HIV method (Shukurov et al., 2018/ Salimov et al., 2020).

502. Productivity (gr)

The total mass of a cluster

1. Very small bunch (100g)
3. Small bunch (150-250g)
5. Medium-sized bunch (350-450g)
7. Large bunch (650-950g)
9. Very large bunch (2000g and more)
10. During the experiment, the mass of all large bunches in 10 bunches during the full ripening period of the grape variety was weighed and the average value was calculated.

504. Productive area (s/ha)

1. Very low area (40s/ha)
3. Low area (40-80s/ha)
5. Medium area (90-120s/ha)
7. High area (130-160s/ha)
9. Very high area (170s/ha and above)

505. Degree of sugar in berries (g/100cm ^{3})

1. Very low grade (12g/100cm ^{3})
3. Low grade (12-15g/100cm ^{3}
5. Medium grade (15-18g/100cm ^{3})
7. High grade (18-21g/100cm ^{3})
9. Very high grade (21.24g/100cm ^{3})
10. The degree of sugar content of berries is determined in all bunches collected in the field.

506. Degree of acidity in juice (g/dm ^{3})

less than 3g/dm $^{3)}$

3. Low degree (3.1-6 g/dm ^{3})
5. Medium grade (6.1-9 g/dm ^{3})
7. High degree (9.1-12 g/dm ^{3})
9. Very high degree (12.1-15 g/dm ^{3})
10. The indicator is determined from all the large clusters collected on the horn, and the average value is calculated from the total indicator and found.

Ampelodescriptor indicators were applied based on newly accepted literature data (Salimov et al., 2020, p. 112/ Shakir et al., 2011) .

Table 1.

Cordon in the Khindogny grape variety the impact of the load norm on productivity by giving shape medium indicator

Variants	Cordon formcargo don't givenorm	of experience repetition	One in tin		One of my bunch weight, in grams	Ten in tin		Productivity,hec/sec	In juice sugariness g/100cm³	acidity,g/dm³
			lusters number, number	lusters weight, kg		Clusters number, by number	Clusters weight, kg			
I	In 5 tins 15-20 eye keep	1	6	2	332	60	20	45	24.1	7.2
		2	9	2.7	300	90	27	60	23.8	6,7
		3	15	4.4	290	150	44	98	23.1	6.9
		medium	10	3.1	307	100	31	68	23.8	6,8
II	In 5 tins 20-25 eye keep	1	9	2.7	305	90	27	60	23.7	7.1
		2	1	0.2	202	10	2	45	24.0	6,7
		3	10	2.8	280	100	28	63	23.2	6.9
		medium	7	1.8	262	70	18	56	23.6	6,8
III	In 5 tins 25-30 eye keep	1	19	5.1	270	190	51	114	23.1	6.6
		2	41	6.2	150	410	62	138	23.3	6.9
		3	5	1.5	300	50	15	34	24.1	6,8
		medium	22	5.3	240	220	53	95	23.0	6,7

Table 2.

Khindogny grapes in the variety fan form by giving cargo of the norm to productivity of influence medium indicator

Variants	We love it formcargo don't givenorm	of experience repetition	One in tin		One of my bunch weight, in grams	Ten in tin		Productivity,hec/sec	In juice sugar,g/100 cm³	acidity, g/dm³
			Clusters number, number	Clusters weight, kg		Clusters number, by number	Clusters weight, kg			
I	In 5 tins 15-20 eye keep	1	5	1.1	220	50	11	25	23.1	6,8
		2	12	2.8	230	120	28	45	23.2	6,7
		3	15	3.5	235	150	35	78	22.8	6.6
		medium	11	2.5	228	110	25	49	23.2	6.9
II	In 5 tins 20-25 eye keep	1	18	3.9	220	180	39	87	22.4	6,8
		2	17	3.6	210	170	36	80	22.3	6.9
		3	1	8	80	10	8	178	20.8	6,7
		medium	12	2.1	170	120	21	115	21.7	6,8
III	In 5 tins 25-30 eye keep	1	10	2	200	100	20	45	20.1	5,6
		2	8	1.7	210	80	17	38	21.0	5.9
		3	26	4.2	160	26	42	94	22.1	6.1
		medium	15	2.8	190	150	28	59	21.1	5.8

RESULTS AND DISCUSSION CONCLUSION

Khindogny grapes in the variety cordon form when givenindicators was as follows (table 1).

In option I - when keeping 15-20 eyes on one vine, the average number of bunches is 10 pieces, weight of bunches is 3.1 kg, one the average weight of a cluster is 307 g, the average number of clusters in ten vines is 100, the average number of clusters is the weight is 31 kg, and the yield is 68 centners per hectare, the sugar content in the juice is 23.8 g/100 cm ^{3} and the acidity 6.8 g/dm^3 it happened

II in the variant - a cluster when 20-25 eyes are kept in that form the average number is 7 units, of my bunch weight 1.8 kg, bunch weight 262 g, average number of bunches in ten vines is 70 pieces, average weight 18 kg, of a hectare productivity 56 centner, given. So that in the juice sugariness 23.6 g/100 cm ^{3} acidity to work

6.8 g/dm^3 record was done.

III in the variant - 25-30 in the same form in that variety bunches on a vine when you keep an eye the average number is 22 pieces, the average weight is 5.3 kg, one bunch weight 240 g, ten the average number of clusters on a vine is 220numbers, of clusters medium weight 53 kg, of a hectare productivity 95 centner, in the juice sugariness23.0 g/100cm ^{3} acidity was 6.7 g/dm^3.

Khindogny grapes in the variety fan form when given indicators the following whom it happened (table 2).

In option I - when keeping 15-20 eyes in one tin the average number of clusters is 11 pcs., clusters weight 2.5 kg, one the average weight of a bunch is 228 g, bunches in ten vines the average number of clusters is 110 pieces the average weight is 25 kg, and the yield is 49 centners per hectare, the sugar content of the juice 23.2 g/100 cm ^{3} acidity to work 6.9 g/dm^3 it happened

II in the variant When 20-25 eyes are kept in the same form, bunch in one tin the average number is 12 numbers, of my bunch medium weight 2.1 kg, one of my bunch weight 170 q, ten in tin of clusters medium number 120 numbers, medium weight 21 kg, of a hectare productivity 115 centner given. So that in the juice sugariness 21.7 g/100cm ^{3}, while acidity 6.8 g/dm^3 record has been done.

III in the variant - 25-30 in the same form in that variety when you keep an eye on it the average of bunches on a vinethe number is 15 pieces, the average weight is 2.8 kg, one bunch weight 190 g, ten the average number of clusters per vine is 150 numbers, of clusters medium weight 28 kg, of a hectare productivity 100 centner, in the juice sugariness 21.1g/100cm ^{3}, and acidity is 5.8 g/dm^3 has been (table 2).

Thus, when the Khindogny grape variety is given a cordon form, the yield per hectare is 56-68 s/ha which is in the third option, it was 95s/ha.

That one in the variety fan in the form of I in the variant 49s/ha, II, III in options to work 100-115 s/harecorded received.

As a result, the highest yield among variants in the Khindogny grape variety in the form of a fan 100-115 s/ha received.

This of the result farmer viticulture in their farms application recommendation is being

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AGROCHEMICAL AND ECOLOGICAL EFFICIENCY OF ORGANIC AGRICULTURE

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At uses of organic fertilizers accumulation of nutritious elements in soil considerably improves. Thanks to organic fertilizers there was possibility to raise a crop entering of organic fertilizers made of local waste products which pollute ecolojy promotes increase in accumulation of mineral forms of nutritious elements entering of organic fertilizers of local waste products which pollute ecology promotes increase in accumulation of mineral forms of nutritious elements. Organic fertilizers promote increase in the maintenance (contents) of nutritious elements in an elevated part of plants.

Azerbaijan has enough resources to produce organic fertilizer based on new technology. These include industry, agriculture, household waste, dry, water, lilies ans so on.. Using new fertilizers made using bioconversion methods from named waste not only meets the need for organic fertilizers but also plays a major role in protecting environmental ecology in that zone. The physical properties of temperature , moisture and soil play a major role in the decay of the remains. In winter, at very low temperatures, the process of decay and humidity is weakened in cases of lack of moisture in the summer, since the microorganisms that create the process do not reproduce in such conditions.

Keywords: *agriculture, fertilizer, organic, waste*

INTRODUCTION

Carbohydrates fulfill a mechanical function in the cells of the plant being a main energy source. 85-90% of dry matter in the organic form gathering in the plant falls to carbohydrates share. The source of glucose, fructose, saccharine, starch, inuline, cellulose, lignin, hemicelluloses, pectin and organic acids in the plants are considered carbohydrates owing to this proteins,oils, vitamins and physiological active matters are formed with the complicated chemical reactions which go in the plant [1].

The organic fertilizers not only increase humus maintenance in soil, but and define the structure of newly formed humus of matters? Its energetic potential.

In the arable soils of the Azerbaijan Republic for a last period at long cultivation of agricultural plants without or with the application of the insufficient quantities of fertilizers happened original biological degradation of the soil, so losing humus, the soil loses the ability to absorb and to keep water, at this the process of dehumification and exhaustion of supplies of the nutrients.

It is established by the science and practice that the long application of the same mineral fertilizers results in humus maintenance decrease in soils, potential opportunity to provide them with the receipt of hogh stable crops of agricultural plants, decrease of soil ability toi transfer pesticide, heavy metals in inaccessible for the plant combination.

The carried out experiments confirm that for the fertility protection and soil productivity it is necessary to bring in 10-12 t/ha of organic fertilizers, in order to return in soil annual waste by agricultural plants 75-80 kg?ha nitrogen, 25-30kg/ ha phosphorus , 60-70 kg/ha potassium, 500kg/ha soluble humus and other elements in which the plants are need , to protect soil fertility. Every ton of organic fertilizers maintainsat average ; 50-100 kg humus, 5-10 kg nitrogen, 2.5-3.0 kg phosphorus, 4-6 kg potassium in a pure form and microelements and useful microorganisms.

As a result of decomposition, splitting of the organic fertilizers given into the soil carbon dioxide gas gather in the-air, it is absorbed by the leaves and a photosynthesis process is formed. Thus gathering o f dry matter in the plant increases and productivity rises [3].

It was determined be the carried out investigations that a quantity of carbon dioxide gas going out of one hectare was 100-200 kg more than the areas where organic fertilizer wasn’t given while 30 tons of organic fertilizer (manure) was given into the soil. We can see an importance of carbon dioxide gas that 100 kg CO_2 is necessary for each hectare of them in order to get a high product from cereals, 200-300 kg/ha is necessary for each hectare of the vegetable plants [6].

MATERIAL AND METHODS

The organic fertilizers are energy material and food source for microorganisms living in the soil, while giving it regularly in great doses not only biological, also physical-chemical characters, water and air regime of the soil improve.

The clayey and loamy soils need little organic fertilizers but sandy and sandstone'soils need much, their fertile capacity, absorbent capacity increases and other agronomic characters change, turn into a suitable form.

In the different soil types the humus- forming coefficient, soil layer in a maximum degree are situated in the different depths of the profile depending on soil characters and hydrothermal regime.

Feeding of the plants by carbon dioxide gas is an important biological process.

As a result the organic matter is formed from water and carbon dioxide gas in the process of photosynthesis. K.V.Djakova (1958) shows that more than half of the part of carbon dioxide gas which assimilates in the process of photosynthesis may be provided at the expense of “respiring” of the plant.

A quantity of carbon dioxide gas expose to dynamics change to a great degree for a year. Dynamic of C under a plant increases in spring and autumn periods. In these periods when soil fertility and temperature regime is to optimum degree biological process increases and a quantity of CO_2 in soil air rises to a maximum degree. Chemical process in the irrigative soils (splitting of carbonates under the influence of organic acids which are products of life activity of microorganisms and sour excreta of the plant roots) can play an important a little role in increase of CO_2 quantity [4;5].

In the summer and winter periods a depression happens in a biological activity and CO_2 quantity decreases sharply in soil air. Because of increasing water quantity expending by transpiration and rising a temperature in the summer period an upper layer of the soil under the plant and gas exchange strengthens between soil air and atmosphere. The least quantity of CO_2 is observed in the winter period. At this time as a result of reduction of the temperature the root residues split and this process happens in the hot time of the year reserves of carbon dioxide gas is expended a little by the way of diffusion. [6].

It was determined ‘by the carried out investigations that a quantity of COj going out of one hectare was 100- 200 kg more than the areas where organic fertilizer wasn’t given while giving 30 tons of organic fertilizer (manure), We can see an importance of CO2 in order to get a high product from cereals 100 kg CG2 is necessary for each hectare every day. 200- 300 kg/ ha is necessary’ for each hectare of vegetable plants [7],

Increase of CO2 quantity plays a great role in improvement of soil fertility, gathering of organic matter and respiration. One of the factors, which influence on development, productivity, and quality of the pepper plant and on soil fertility, is CO2 quantity in our field and laboratorial experiments. On the grounds of the literature materials we can say that one of the main and important parameters is CO2 and it’s exporting. In irrigative grey- browTi soils of Absheron the influence of organic fertilizers on a quantity of CO2, dry matter and productivity increase of the pepper plant is presented depending on decomposition degree.

In the research works carried out for 3 years CO_2 quantity vibrates between 45.9-83.8 mg/ hour.m^2 over the versions depending on decomposition degree of new organic fertilizers used under the pepper plant.

RESULTS AND DISCUSSION

The result of the carried out experiments shows that CO_2 quantity gathering from a hectar during a vegetation period changes 198,5-362,2 kg over the versions. From 3 years a weight of matter changes by 275,2-473,2 sen productivity changes by 72,0-120,0 s/ha at the average. Being a while giving 20 tons of wholly decomposed manure for a hectare dry matter and productivity 198,0;40,0 s increase as composed with a control version, if we take it by a percentage calculat most des it will be 58,9%;44,4%, the quantity of the gathering CO_2 is 153,4 kg/ha more than a control, soil cove .

In the version of given 20 tons of half decomposed manure a quantity of dry matter a soil productivity is 116,5; 21,0 s as compared with a control , by a percentage calculation it is 42,3 ting of 29,2% the gathering quantity of CO_2 is 145,2 kg/ha more than a control.

If we take account the other versions in the versions of given 20 tons of life compost and a residue of the canal of Absheron separately a quantity of dry matter and productivity is 170,2; 180 as compared with a control and increase forms 32,0 s/ha in each of them, by a percentage it is 63-67,5% and 44,4%.

The best result is got in the version of given 20 tons of Absheron compost thatan increaseof dry matter and productivity is 187,7 and 48,0 s/ha as compared with a control, by a percentage calculation 68,2% and 66,7%. In this version CO_2 quantity gatheringfrom hectare during vegetation period is more than other versions and as compared with a control it is 171,5 kg/ha.

Thus depending on using fertilizers structure and decomposition degree a quantity of CO_2 connected closely. Thus as a result of decomposition of using fertilizers a source of nitrogen matter which enter the plant increases, a reason of richness of soil and soil surface air.

CONCLUSION

We can come to the conclusion that depending on decomposition degree the given organic fertilizers and CO_2 which is produced from them influence on gathering of dry matter in pepper plant and on increase of productivity; and CO_2 is considered to main food as nutrient (N,P,K) which is necessary for a plant.

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DETERMINATION OF ELECTRICAL CONDUCTIVITY OF SOILS IN KURMUKCHAY BASIN

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Soil electrical conductivity is a fundamental concept in soil science and agriculture, and it is increasingly recognized as an important parameter in understanding and managing the health of river basin ecosystems. Soil electrical conductivity is a measure of the soil's ability to conduct electrical current, and it is influenced by several factors such as soil properties, water content, and organic matter. In river basins, soil electrical conductivity can be affected by geology, topography, vegetation, land use, and anthropogenic activities such as agriculture and mining. High levels of soil electrical conductivity can result in increased soil salinity, which can have detrimental effects on plant growth and ecosystem health. In addition, high soil electrical conductivity can lead to contamination from heavy metals and other pollutants, further exacerbating the impact on the ecosystem. Measuring soil electrical conductivity in river basins is important for managing and protecting the health of the ecosystem. It provides insight into soil properties, nutrient content, and water availability, which are essential for plant growth and ecosystem functioning. Soil electrical conductivity measurements can be used to identify areas with high levels of salinity or contamination, which may require remediation or restoration efforts. It can also help monitor changes in soil properties over time, which can provide insights into the effectiveness of management practices and the impact of climate change on the ecosystem. Several methods are available for measuring soil electrical conductivity in river basins, including soil solution extraction, electrical resistivity measurements, and electromagnetic induction. These methods can provide information about soil properties at different depths, which can be useful for managing soil fertility and irrigation practices. Overall, soil electrical conductivity is an important parameter in understanding and managing the health of river basin ecosystems. It provides valuable insights into soil properties, nutrient content, and water availability, which are critical to plant growth and ecosystem functioning. The measurement and monitoring of soil electrical conductivity can help identify areas of concern and facilitate the development of management practices that promote the health and sustainability of river basin ecosystems.

Key words: *electrical conductivity, basin soils, soil fertility, ecosystem*

INTRODUCTION

Soil electrical conductivity is a crucial parameter for understanding the health and functioning of river basin ecosystems. It provides valuable insights into soil properties, nutrient content, salinity levels, and contamination risks. This essay explores the significance of soil electrical conductivity in river basins, its influencing factors, effects on ecosystem health, and management strategies. Additionally, it discusses various methods used for measuring soil electrical conductivity.

Several factors influence soil electrical conductivity in river basins. Geological characteristics, such as soil type and underlying rock formations, contribute to conductivity variations. Soils derived from weathered and eroded materials often have higher electrical conductivity due to the presence of soluble salts and minerals. Topography also plays a role, affecting water movement and soil moisture levels. Vegetation cover and land use practices, including agriculture and mining, can introduce changes in soil electrical conductivity.

High soil electrical conductivity levels can have significant implications for ecosystem health within river basins. One of the primary concerns is increased soil salinity. Elevated salt levels can negatively impact plant growth and limit species diversity. Salinity also affects water availability, increasing water stress on plants by decreasing the water potential of the soil. This can lead to reduced productivity, plant die-offs, and alterations in the ecological balance.

Soil electrical conductivity can also serve as an indicator of contamination risks. Anthropogenic activities introduce pollutants and heavy metals into the soil, leading to increased conductivity. These contaminants pose a threat to terrestrial and aquatic organisms within the river basin ecosystem, affecting biodiversity, water quality, and overall ecosystem health.

Understanding soil electrical conductivity is essential for effective management and conservation of river basin ecosystems. Regular monitoring can help identify areas with high salinity or contamination, guiding the implementation of remediation strategies and land management practices. Techniques such as soil amendments, irrigation management, and erosion control measures can be employed to mitigate the adverse effects of high soil electrical conductivity. Proper land-use planning and sustainable farming practices minimize the introduction of pollutants and salts into the soil.

MATERIAL AND METHODS

Various methods are available for measuring soil electrical conductivity in river basins. Electromagnetic induction is a widely used technique that measures the soil's response to induced electromagnetic fields. It provides information on soil electrical conductivity at different depths and is particularly useful for large-scale surveys.

There are several methods available for measuring electrical conductivity (EC) in soil. Each method has its own advantages and limitations, and the choice of method depends on the specific objectives of the measurement, the scale of the study, and the equipment available. Here are three commonly used methods for measuring soil electrical conductivity:

1. Direct Measurement:

Direct measurement involves extracting a soil solution sample and measuring its electrical conductivity using a conductivity meter. This method provides a precise measurement of the EC of the soil solution. However, it requires soil solution extraction, which can be labor-intensive and time-consuming. Additionally, direct measurement may not capture the spatial variability of soil electrical conductivity as it represents the solution within the extracted sample only.

2. Electrical Resistivity Measurement:

Electrical resistivity measurement is a non-invasive method that estimates the subsurface electrical properties of soils. It involves placing electrodes on the soil surface and passing a small electrical current through the soil. The resulting voltage is measured, and the resistivity is calculated. Electrical resistivity measurements provide information about the resistivity distribution in the soil profile, which can be correlated with soil properties and moisture content. This method allows for mapping soil electrical conductivity in a spatially explicit manner. However, it requires specialized equipment and expertise to collect and interpret the data accurately.

3. Electromagnetic Induction (EMI):

Electromagnetic induction is a widely used method for measuring soil electrical conductivity. It involves using an electromagnetic sensor or instrument that emits a low-frequency electromagnetic field into the soil. The sensor measures the strength and phase of the electromagnetic signal reflected back from the soil. Based on these measurements, the instrument calculates the apparent electrical conductivity of the soil. EMI provides rapid and non-destructive measurements of soil electrical conductivity over large areas. It is particularly useful for mapping variations in soil EC at different depths. However, interpretation of EMI data requires careful calibration and consideration of environmental factors.

Direct measurement, electrical resistivity measurement, and electromagnetic induction are three commonly used methods for measuring soil electrical conductivity. Each method has its own strengths and limitations, and the choice of method depends on the specific research objectives and the scale of the study. Careful consideration of the measurement technique and proper calibration are crucial for obtaining reliable and meaningful soil electrical conductivity data.

RESULTS AND DISCUSSION

The soils in the Qakh region of Azerbaijan are influenced by the region's geography, climate, and land use practices. Kurmukchay basin is located in the northwest part of Azerbaijan, near the border with Georgia. The region is characterized by mountainous terrain, with elevations ranging from 400 to 4,243 meters.

The predominant soil types found in the Kurmukchay basin include:

1. Mountain Forest Soils: These soils are typically found in the higher elevations where forests dominate. They are characterized by a thick layer of organic matter from decaying plant material, which contributes to their fertility. These soils have good moisture retention capabilities and support the growth of trees and other vegetation.

2. Brown Forest Soils: These soils are found in lower elevations and are influenced by forest vegetation. They have a well-developed organic layer and a high fertility level. Brown forest soils have a moderate water-holding capacity and are suitable for agriculture, supporting the cultivation of various crops.

3. Alluvial Soils: These soils are formed in the floodplains of rivers and streams. They are generally fertile due to the deposition of sediment carried by water, which contributes to their nutrient content. Alluvial soils have good drainage and are suitable for agricultural activities.

4. Mountain Meadow Soils: These soils are typically found in the higher elevations in the meadow areas. They are characterized by a moderate organic matter content and have good water retention capacity. These soils are suitable for grazing and support the growth of grasses and other herbaceous vegetation.

It's important to note that soil characteristics can vary within the Qakh region due to factors such as slope, aspect, and local variations in geology. Therefore, detailed soil surveys and soil sampling in specific areas of interest are necessary to obtain precise information about soil properties, fertility, and suitability for different land uses.The range of electrical conductivity (EC) in river basin soils can vary depending on various factors, including the geological composition of the soil, the presence of organic matter, land use practices, and the proximity to human activities. However, I can provide you with a general overview of the typical range of EC values observed in river basin soils.

EC is typically measured in units of deciSiemens per meter (dS/m) or milliSiemens per meter (mS/m). Here is a general categorization of soil EC levels:

1. Low EC: Low EC values are typically below 1 dS/m or 1 mS/m. These soils usually have a low concentration of dissolved salts and are considered to have good water quality for agricultural purposes.

2. Moderate EC: Moderate EC values range from 1 to 3 dS/m or 1 to 3 mS/m. Soils with moderate EC levels may have slightly elevated levels of dissolved salts, but they are still suitable for most agricultural crops.

3. High EC: High EC values are generally above 3 dS/m or 3 mS/m. These soils have a relatively high concentration of dissolved salts, which can affect plant growth and yield. High EC soils may require additional management practices, such as leaching or the use of salt-tolerant crops.

It's important to note that specific values can vary depending on the classification system used and the region in question. Additionally, different crops and plants have different tolerances to salinity, so what may be considered high EC for one crop may be within the acceptable range for another. The graph below shows Ec values from different types of soils.(Graf.1)

Example	Ec value	Example	Ec value	Example	Ec value	Example	Ec value
K-1 0-17	4330	K-2 0-13	5130	K-3 0-12	6700	K-4 0-18	4300
K-1 17-58	1797	K-2 13-42	3560	K-3 12-43	2920	K-4 18-42	6700
K-1 58-X	2392	K-2 42-62	2405	K-3 43-X	2352	K-4 42-68	2238

Example	Ec value	Example	Ec value	Example	Ec value	Example	Ec value
K-5 0-18	4150	K-6 0-20	3850	K-7 0-12	3520	K-8 0-16	5010
K-5 18-39	3400	K-6 20-38	2188	K-7 12-57	2030	K-8 16-74	4009
K-5 39-67	2554	K-6 38-56	2301	K-7 57-82	2383	K-8 74-110	4350

Example	Ec value
K-9 5-22	3970
K-9 22-55	2290
K-9 55-140	2775

Graf.1 EC indicators of the area(with the mS/m indicators)

CONCLUSION

The value indicators of the area vary between high and low. However, most of the soils are of medium and low grade. Soils with an average level of EC lead to slightly higher levels of dissolved salts. They are also suitable for most agricultural crops.

Soil electrical conductivity plays a crucial role in understanding and managing the health of river basin ecosystems. Its measurement provides insights into soil properties, nutrient content, salinity levels, and contamination risks. By monitoring and addressing high soil electrical conductivity, the negative impacts on plant growth, biodiversity, and water quality within river basins can be mitigated. Implementing effective land management practices and conservation strategies will contribute to the long-term sustainability and health of river basin ecosystems, ensuring their vitality for future generations.

Overall, soil electrical conductivity is a vital parameter that aids in the understanding and management of river basin ecosystems. It helps identify areas of concern, guides remediation efforts, and promotes sustainable land management practices. The advancements in measurement methods enable researchers and land managers to obtain valuable data on soil properties, moisture content, and mineralogy. By integrating knowledge about soil electrical conductivity, we can protect and conserve the health of river basin ecosystems for the benefit of both present and future generations.

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MICROBIOLOGICAL ACTIVITY OF TECHNOGENICALLY AFFECTED SOILS OF THE ABSHERON PENINSULA

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This paper discusses the effect of oil pollutants on soil microbiocenosis and ecological-functional reactions of rhizosphere microorganism. It appears that the structure and functional activity of the soil microbiocenosis is dependent on the time that has passed after hydrocarbon pollution. The greater density of microbial populations in the rhizosphere can testify to more favorable and stable conditions in the rhizosphere compared to soil without plants. Thus, the plant in the conditions of pollution is a factor that supports or increases the number of soil microbial populations.

Keywords: *gray-brown soils, oil-contaminated soils, hydrocarbon-oxidizing bacteria, phytoremediation, rhizospheric microorganisms*

INTRODUCTION

It is known that the activity of biological processes in the soil cover primarily depends on the structure and functional state of soil microbiocenosis - various groups of bacteria, microscopic fungi, algae, and mesofauna. Soil pollution with hydrocarbons contributes to the development of numerous responses of this complex biosystem.

The problem of bioassessment of technogenically impacted soil and water ecosystems is currently developing in various directions [20].

Hydrocarbon pollution is accompanied by strong changes in the structure and functional activity of soil microbiocenosis - their number and qualitative composition change, which leads to partial or complete soil degradation [11].

As a rule, in freshly polluted soils, the number of different groups of soil microorganisms is quite high - hydrocarbon-oxidizing bacteria, ammonifiers, representatives of the genera *Arthrobacter, Pseudomonas, Acinetobacter, Rhodococcus, Mycobacterium, Bacillus predominate*. At the same time, representatives of heterotrophs are suppressed, and with an increase in the content of hydrocarbons in the soil, the development of both groups is inhibited [16]. In the future, with later periods of pollution, the number of oligonitrophils, oligotrophic microflora and CRM increases, however, with all this, the total number of microorganisms can remain high [2, 6, 8, 17, 18]. Bacterial microflora in comparison with fungal one in a number of soil types often turns out to be significantly sensitive to pollution [14,15,19]. Nitrifying bacteria are sensitive to the impact of hydrocarbons, while the number and activity of bacteria involved in other stages of the nitrogen cycle, on the contrary, increases [18]. In gray-brown soil, the number of denitrifying, ammonifying and nitrogen-fixing bacteria can increase [7]. An increase in the number of denitrifiers and nitrogen fixers in oil-contaminated soil may be associated with an excess of organic compounds and an increase in the number of anaerobic microzones in contaminated soil [5,7].

The structure and functional activity of soil microbiocenosis depends on the time elapsed after hydrocarbon pollution. So, according to the study [11] the process of changing activity after hydrocarbon pollution of the soil for the middle taiga zone and the subsequent restoration of soil microbiocenosis is determined by five stages: dying off, adaptation, linear and exponential growth, and stabilization. The duration of microbial succession processes is determined at 12–16 years [17]. Similar changes in the structure and functional activity of the microbiocenosis of oil-contaminated soils have been confirmed by many studies [3, 6, 12, 13,15, 17, 18]. According to the data, the long-term presence of oil and oil products in the soil at a dose of 5 g/kg causes a depressing effect on the soil microbiota, and when the dose is increased to 10 g/kg, it causes a catastrophic effect on the soil microbial system [1].

To date, the impact of oil pollutants on soil microflora has been well studied, but the ecological and functional reactions of rhizosphere microorganisms to pollution by oil pollutants have not been studied enough. At the same time, the characteristics of the rhizosphere as an ecological niche (saturation with nutrients, increased abundance and physiological activity of microorganisms) suggest a different nature of the reactions of microflora to pollution in comparison with soil without plants.

The purpose of the study is to examine the effect of phytocenoses on the structure and functions of the rhizosphere microbiocenosis during hydrocarbon pollution.

OBJECT AND METHODS OF RESEARCH

The main objects of study were the gray-brown soils of the Absheron Peninsula. Soil sampling was carried out according to the methodology corresponding to the conditions [10]. For the quantitative accounting of bacteria of various groups of soil microorganisms, standard methods and media were used, given in the relevant manuals [4].

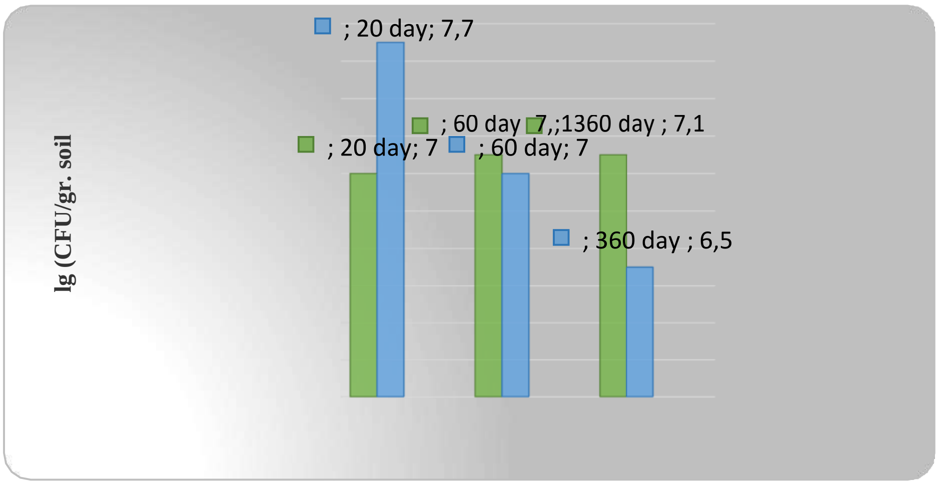
RESEARCH RESULTS AND DISCUSSION

The study of the structure and functions of the microbiocenosis of the rhizosphere of phytocenoses under hydrocarbon pollution makes it possible to find out the causes and consequences of an increase in the degradation of an organic pollutant in soil with plants, which underlies the effect of phytoremediation.

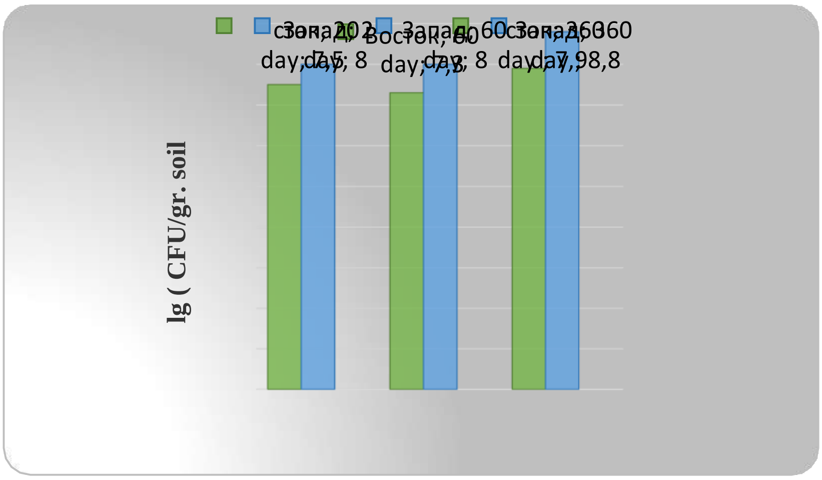
The analysis of *Cynodon* rhizosphere samples grown in clean and crude oil-contaminated soil made it possible to reveal qualitative and quantitative changes in the microbial community of the root zone and a number of general patterns of the influence of hydrocarbon pollution on the functional activity of the rhizosphere microbial cenosis of this plant species. The results of the experiments are presented in Figure 1.

As can be seen, in the rhizosphere of the porcine, in contrast to the soil without plants, under the influence of crude oil, the number of soil microorganisms increases and is maintained at a high level for a long time (Fig. 1a). It was found that 15 days after soil contamination with crude oil, there was an increase in the total number of microorganisms in the soil both with and without plants, however, in the rhizosphere zone, the number of microorganisms was higher.

After 1 year, there was a noticeable decrease in the number of microorganisms in the oil-contaminated soil without plants, while in the soil under plants, it remained at a high level, as before (Fig. 1b). A high density of microbial populations in the rhizosphere may indicate more favorable and stable conditions in the rhizosphere compared to soil without plants. Thus, under polluted conditions, a plant is a factor that maintains and/or increases the number of soil microbial populations, providing them with an econiche and additional nutrient substrates for reproduction and performing protective functions from the impact of oil pollutants, thereby intensifying the processes of self-purification of polluted gray-brown soil.



a)



b).

Figure. 1. The number of heterotrophic microorganisms of soil pollution in the soil (a) and in the rhizosphere of plants (b):
- clean soil, - soil contaminated with oil.

On the other hand, the physiological structure of microbial communities in the rhizosphere is characterized by greater stability and is less susceptible to changes under the influence of hydrocarbons than in soil without *Cynodon*. An analysis of the main physiological groups of soil microorganisms (nitrifying, ammonifying, nitrogen-fixing, denitrifying, and cellulolytic) showed that all studied groups in the rhizosphere community is higher, and changes in its structure under the influence of crude oil are less pronounced than in soil without plants. Consequently, the growth of plants oil-contaminated soil contributes to the growth of the number of microorganisms of all major physiological groups that ensure the transformation of the most important mineral and organic components in the soil, which indicates the activation of the main biochemical processes associated with the transformation of nitrogen compounds, cellulose, etc.

Table 1.

The number of microorganisms in oil-contaminated soil Apsheron Peninsula

Indicators	Control	Oil-contaminated soil
Depth, cm	0-10 10-20	0-10 10-20
Azotobacter, % fouling	5,7 7,2	75,0 98
Hydrocarbon-oxidizing, titer	10^5 10^5	10^7 10^6
Microscopic mushrooms, thousand/g of soil	5,2 3,1	- 3,4
spore-forming bacteria, thousand/g soil	78 126	90 132
Ammonifying, titer	10^5 10^5	10^7 10^7
Cellulose-decomposing soils, thousand/g	2,1 1,1	1,3 0,66
Nitrifiers, titer	10^4 10^2	10^1 10^2

*Note: - no growth

Differences in the reactions of rhizospheric and non-rhizospheric (soil without plants) microflora to environmental pollution by hydrocarbons, quantitative and qualitative advantages of plant rhizosphere microbial communities, which ensure the effectiveness of phytoremediation and its significance - stability and prolongation of purification, were revealed.

The group composition of microorganisms in oil-contaminated soils is similar to pure untreated soil (Table 1). They contain the same taxonomic groups of microorganisms (bacteria, fungi) as in the original soil, but with a different ratio of them in microbial associations. As a rule, in oil-contaminated soil, the percentage the content of bacilli, oil-oxidizing microorganisms - bacteria - was higher than in pure soil.

CONCLUSIONS

The adaptive and destructive potential of plants and their associated microbial complexes in the presence of hydrocarbon pollution can enhance soil purification, on the one hand, and change plant-microbial interactions, on the other. The relationship between plants and microorganisms in the rhizosphere consists of mutually directed actions of partners. The impact of phytocenoses on the formation of microbiocenoses in the soil is realized through the provision of a niche for the habitation of microorganisms (the root system itself) and root secretions that regulate the development of microflora. In turn, the metabolic activity of microorganisms, their ability to produce biologically active substances to a large extent ensure the growth and development of plants.

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DEVELOPMENT OF EFFECTIVE MEDICINAL COMPOUNDS FOR PLANT PROTECTION USING MEMBRANE-ACTIVE ANTIBIOTICS

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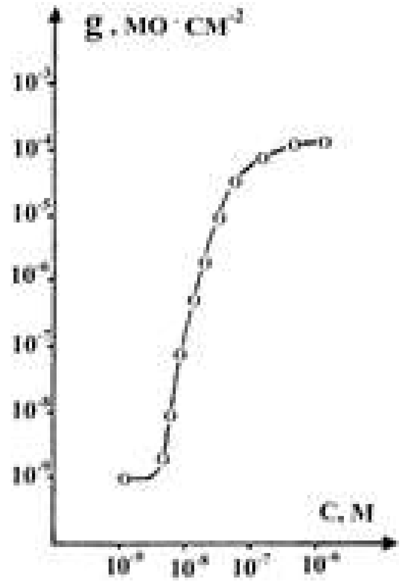
Comparative physicochemical characteristics of dimethyl sulfoxide (DMSO) and polyene antibiotics (PA) are presented, the effects of the complex interaction of DMSO and PA with bilayer lipid membranes are considered, and the results of experimental studies of the physicochemical characteristics of amphotericin B and levorin in membranes are presented. On the basis of PA, a theoretical model for the creation of effective membrane-active drugs against viral and fungal diseases of plants has been developed.

Key words: *polyene macrolide antibiotics, dimethyl sulfoxide, amphotericin B, levorin, lipid bilayer membranes, viral and fungal plant diseases.*

INTRODUCTION

One of the main problems of agriculture - soil science and ecology is the search for drugs that protect vegetable crops from pathogenic microorganisms. The negative impact of viruses on various plants was revealed more than a hundred years ago. All types of plants, both annuals and perennials, become infected with pathogenic microorganisms, which leads to large crop losses. The object of this study is the search for substances that can selectively affect plant infections. Antibiotics have all the properties that are necessary for medicinal preparations used in crop production. There are numerous reports in the literature of the successful use of antibiotics in the control of various plant diseases. It was shown that antibiotics not only protect plants from damage, but also have a therapeutic effect in the presence of infections (phytopathogenic fungi and viruses). Antibiotic drugs have been tested in the treatment of diseases of fruit trees, cotton, grain and vegetable crops, ornamental plants, both in laboratory and in production conditions. Antibiotics became especially widespread in crop production after the adverse consequences of the use of pesticides became apparent, which, along with the suppression of phytopathogenic microflora, poison beneficial species of birds and animals that feed on pollinated plants. Antibiotics have a number of valuable advantages in the fight against phytopathogenic microorganisms in comparison with other substances. Currently existing protective equipment is not able to completely prevent the spread of viral and fungal infections. The use of PA as a basis for the development of effective antiviral and antifungal drugs is not accidental. Currently, PAs are the most effective drugs used in clinical medicine for the treatment of deep systemic fungal infections. The biological activity of PA increases sharply when dissolved in DMSO. DMSO, due to its properties, promotes deeper penetration of PA into cell membranes. In order to search for a biologically active drug against pathogenic microorganisms of vegetable crops, experiments were carried out in greenhouses, as well as in open ground where cucumbers, tomatoes, eggplants and peppers are grown. The conducted studies have shown the high efficiency of the drug on pathogenic microorganisms. The treatment of plants and the soil itself, affected by a viral and fungal infection, by spraying the infected areas, led to the complete destruction of viral and fungal infections.

Antibiotics have a selective action and, suppressing the development of phytopathogenic bacteria and fungi, are practically harmless to plants. When choosing an antibiotic, a necessary condition is the absence of toxicity. Antibiotics used in therapeutic doses are non-toxic to plants. The choice of PA as an object of study was not accidental, because allows research at the molecular level. Research has been carried out to create a biologically active preparation for protecting plants from viral and fungal infections. This work is related to the study of the action of the antibiotic levorin A on plant infections. The studies carried out in this direction made it possible to identify a new compound from the group of aromatic PAs (code name Infanvir), which has the ability to effectively and selectively suppress viral and fungal infections. To date, no effective compound has been found that would have the ability to completely suppress the development of infections in plants. From this point of view, the relevance of the ongoing research is beyond doubt. The biological effect of PA is associated with a change in the permeability of lipid and cell membranes for ions and organic compounds. In order to search for a biologically active preparation for protecting plants from pathogenic infections, the effect of an aromatic antibiotic on plant infections was studied. To determine the effective antibiotic concentration, we studied the dependence of membrane conductivity on the aromatic antibiotic concentration (Fig. 11). As can be seen from fig. 10, the maximum activity of the antibiotic is observed at a concentration of 10-7-10-6 M.



Rice. 1.Dependence of the conductivity of lipid membranes on the concentration of an aromatic antibiotic. The membranes were formed from a mixture of phospholipid:cholesterol 20:1 in aqueous salt solutions containing 10-1 M KCl at pH 6.5, t = 220C.

Based on these data, the minimum concentration of the antibiotic was calculated, which corresponds to its maximum biological activity. This was shown during experiments in greenhouses, as well as in open ground of several companies: "AGRI BIO ECOTEH", "REAL PLUS", "REAL PLUS MP", "MP AGRO", which are located on the Absheron Peninsula in the village of Mardakan. Cucumbers, tomatoes, eggplants and peppers were grown on the experimental plots of these firms. As a result of laboratory studies of a soil sample on which vegetables were grown, it was found that this soil contains the following minerals for plant nutrition: a small amount of nitrogen, a high amount of phosphorus and a small amount of potassium, the pH of the soil sample is slightly alkaline (the pH of normal soil is neutral 6.5 - 7.0). An increased salinity is observed in this soil sample. In tab. 7.1.2. data on the composition of the soil for mineral elements based on soil gradation are given. In order to increase the yield of plants in this soil sample, it is necessary to add the missing mineral elements and substances to it. To do this, before planting plants in the soil under plowed soil, it is proposed to introduce the following chemical and organic fertilizers to ensure the balance of minerals in the soil. For 10 acres of soil, the addition of the following mineral fertilizers is proposed: nitrogen - 40 kg, potassium sulfate - 35 kg, BMX librel (a mixture of trace elements) - 1 kg, calcium nitrate - 10 kg, chelator - 500 gr, nitrocol dust - 10 kg (against decay root hairs), zinc - 1 kg, boron sulfate - 2 kg, iron sulfate - 2 kg, magnesium nitrate - 10 kg. To provide the soil with a neutral pH for every 10 tons of irrigation water, it is proposed to introduce 100 ml of nitric acid. Table 1 shows the soil composition data on mineral elements based on soil gradation. Despite the missing mineral elements in the soil where vegetable crops were grown, studies have shown the high efficiency of the drug on pathogenic microorganisms of vegetable crops.

Table 1.

Soil composition by mineral elements based on soil gradation

	Название образца	pH	Степень обеспечения почвы минеральными элементами на основе почвенной градации			EC соленость (мС)	NaCl (ппм) Норма 150-300	KCl (ппм) Норма 350-700
			Азот 40-120 мг/кг	Фосфор 15-60 мг/кг	Калий 300-600 мг/кг			
			Показатель обеспечения минеральными элементами образца					
			Азот N/NH_3 мг/кг	Фосфор P_2O_5 мг/кг	Калий K_2O мг/кг			
1	Почва	7,55	7,76	133,32	212,08	1,18	520	516

Despite the lack of mineral elements in the soil on which vegetable crops were grown, the conducted studies showed the high efficiency of the drug on pathogenic microorganisms. Treatment of plants, as well as soils affected by a viral and fungal infection, by spraying the infected areas with a solution of Infanvir at the rate of 100 ml of the initial solution dissolved in 10 liters of water at 15-35 ° C, leads to the destruction of viral and fungal infections. It should be noted that the drug Infanvir has the ability to completely inhibit the growth of the tobacco mosaic virus (Tobacco mosaic virus). It should also be noted that after treatment with Infanvir, infected plants are not only cured, but the plants withered from the infection are also regenerated. Moreover, the treated plants had about 1.5 times more yield than the experimental ones. Antibiotic Infanvir can be used both in greenhouse conditions and in open ground against pathogens of plant infections. Studies have shown that Infanvir, created on the basis of aromatic heptaene polyene antibiotics, is an effective means of combating viral and fungal plant diseases. A characteristic feature of Infanvir is its ability to effectively suppress the reproduction of the tobacco mosaic virus (Tobacco mosaic virus). Infected plants after treatment with Infanvir are not only cured, but also completely regenerated. The main problem of agriculture, soil science and ecology is the search for drugs that protect vegetable crops from pathogenic microorganisms that retard the growth and development of plants. Currently available protective equipment is not able to completely prevent the spread of viral and fungal infections. All over the world there is a search for biologically active compounds against plant infections. However, no drug has yet been found that would have the ability to stop and completely suppress the development of viral and fungal infections in plants. The currently available agents that protect plants from pathogenic infections are insufficiently effective and are not able to prevent the spread of plant infections. The created drug contains in its composition DMSO and the active component of the polyene antibiotic levorin A. The specified agent makes it possible to increase the effectiveness of the treatment of viral and fungal diseases and fully promotes the regeneration of vegetable crops withered from infections. The use of PA as a basis for the development of effective antiviral and antifungal drugs is not accidental. Currently, PAs are the most effective drugs used in clinical medicine for the treatment of deep systemic fungal infections. The biological activity of PA increases sharply when dissolved in DMSO. DMSO, due to its properties, promotes deeper penetration of PA into cell membranes. In order to search for a biologically active drug against pathogenic microorganisms of vegetable crops, experiments were carried out in greenhouses, as well as in open ground where cucumbers, tomatoes, eggplants and peppers are grown. The conducted studies have shown the high efficiency of the drug on pathogenic microorganisms. The treatment of plants and the soil itself, affected by a viral and fungal infection, by spraying the infected areas, led to the complete destruction of viral and fungal infections.

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URBOECOLOGICAL MONITORING OF THE AMOUNT OF Cd AND Pb ELEMENTS IN SOIL OF BAKU AGGLOMERATION

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The article shows the study of heavy metals in green areas, in gardens,parking lots, roadside soils in Baku. Were studied about 30 samples of soil from 12 districts of Baku. Considering the comparative nature of the work, there were samples of soil from land plots, parks, gardens and road areas in accordance with the method of urban soil survey.

INTRODUCTION

In modern cities, the activities of industrial and energy complexes, municipal transport systems have a negative impact on the soil cover of urban ecosystems, leading to their pollution, degradation and transformation. This article presents the results of studies the soils of parks, gardens, roadside zones in the core of the agglomeration of Baku. These soils can be significantly changed human-transported materials, human-altered materials, or minimally altered or intact “native” soils. Due to pollution (in comparison with natural analogues), the soils of the city have become alkalized. The urban soils were studied as indicators of the ecological status of the city of Baku.With migration from rural areas and the growth of towns and cities, approximately 55% of the global population is currently living in urban areas. Despite cities occupy 1 percent of the world’s total land, urban areas are estimated to be responsible for more than 90% of the economic output, 65% of the energy consumption, and 70% of the greenhouse gas emission. As urban soils are subject to numerous and diverse anthropogenic activities, and may therefore have high levels of pollution. One of most dangerous pollutants in cities are heavy metals. Irregularity of the technogenic distribution of metals exacerbated by the heterogeneity of the geochemical environment in natural landscapes. **[1,2,3,4]**

MATERIAL AND METHODS

30 soil samples of different densities and depths exposed to anthropogenic impact, untouched and constantly undergoing reclamation processes were taken from parks, gardens and roadsides located in Baku agglomeration. Soil samples were taken from parks located in various parts of the city, and we can see a tangible difference in their properties. The analyzes were carried out with the agilent 7700 icp MS atomic adsorption spectrophotometer device and the Miniflex 600 device. Mapping was carried out with pedo-geographical methods, orthophoto maps and GIS tools.

RESULTS AND DISCUSSION

Considering the comparative nature of the work, soil samples were taken from green zone from the roadside areas, where the soil has not been exposed for years and is under constant pressure. Soil samples were collected from different ground layers depending on soil density. In recent decades, as a result of ongoing reconstruction works in the parks, the natural soil cover remains under transported one from the regions of Azerbaijan. The analysis of soil samples for determination of heavy metals was also carried out. Heavy metals are the most common pollutants on Earth. Spreading by aerosol route, they spread over a large distance and settle around industrial enterprises, metallurgical factories, thermal power plants, highways, therefore, in excess, exceeding natural indicators. **[3,4]**

Heavy metals are determined universally in the soil of cities comparative analysis of elements such as Cr, Pb, Cd, As, Hg, which have an important place in heavy metal pollution, are extremely effective in soil and water pollution. These heavy metals spread to the environment as a result of their mining activities, production of electronic equipment and their subsequent wastes, fertilizers and pesticides used in agricultural areas, sewage wastes, paint and other industries.The lead and its compounds released into the atmosphere are formed mainly as a result of oxidation of tetraethyl lead, which is added to 1 g per liter of gasoline to increase its octane number. To increase the volatility of this compound in gasoline, add special additives (for example, dibromethane) that lead to the release of halides in the environment**. [6]**

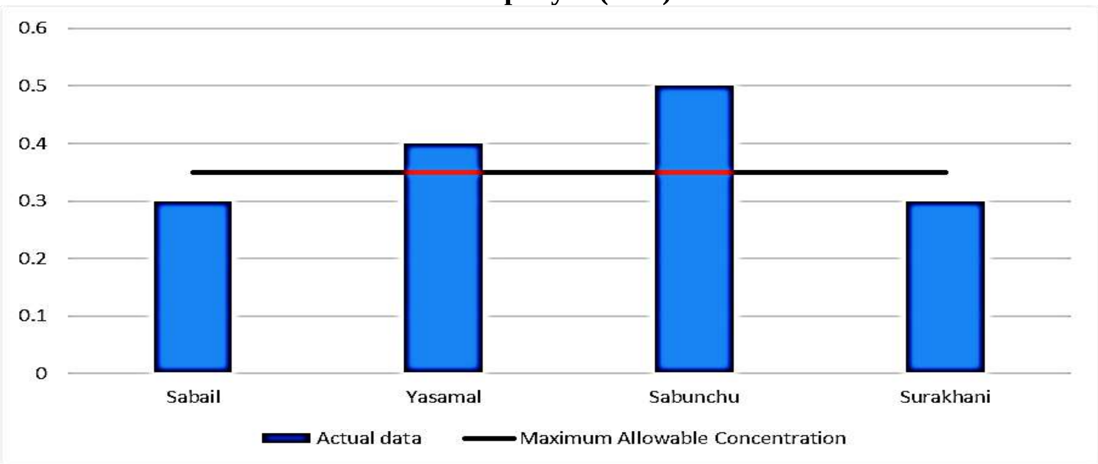
The concentration of Cd, a highly toxic element **(Torshin et al., 1990)**, is 0.35 mg/kg. Cd is also found in many minerals as a rare isomorphous mixture. **[5]** The emission amount of cadmium in nature is 25,000-30,000 tons per year, of which 4,000-13,000 tons are caused by human activities. Important sources of cadmium affecting human life are cigarette smoke, food products, water pipes, coffee, tea, coal burning, fertilizers used in the seed stage of plants, and exhaust gases generated during industrial production stages. Cadmium is used in rechargeable batteries. **[1,3]** Cadmium is rapidly converted to cadmium oxide in air. Inorganic salts such as cadmium sulfate, cadmium nitrate, cadmium chloride are soluble in water.

CONCLUSION

The results show that in most parks the concetration index of highly toxic element Cd (0.35mq/kq) is lower in the top layer (0-20 cm) and higher in the bottom layer (20-50 cm) than tolerable norm. Most reliable explanation of this might be a continuous pouring of humus-rich soil on top of the existing soil in most parks. The chemical composition of the parent rock is another factor determining the background content of cadmium.. It can be seen from the diagram below that, while the amount of Cd in Yasamal and Surakhani regions at a depth of 0-20 cm does not exceed MAC (Maximum Allowable Concentration), this indicator is high in Sabail and Sabunchu regions. However, in some cases, especially in the soil samples taken from the edge of the highways, for examples Yasamal and Surakhani district, the concentration of Cd exceeds the norm both in top and bottom layers, which is due to the absorption of exhaust gases from vehicles into the soil.(Table.1)

Table 1.

Concentration of Cd in top layer (0-20) of the several districts

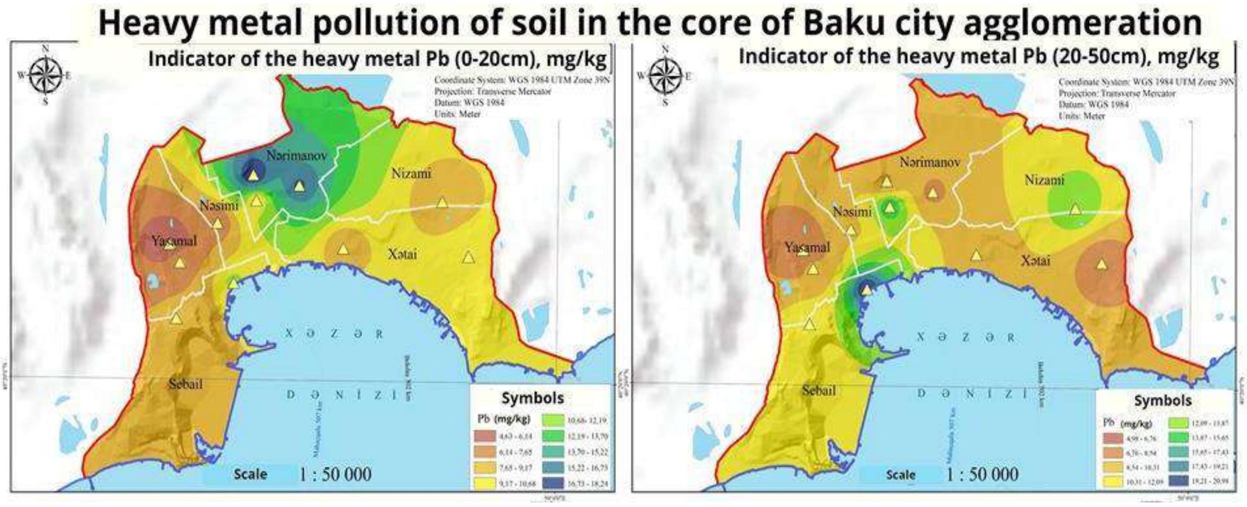


Clark of Pb, the most toxic element **(Torshin et al., 1990),** is 35 mg / kg. At present, Pb is found in almost all components of the environment - atmosphere, water, soil, air, and even food. **[5]** Most of the lead (70-80%) enters the human body through food, more than 10% through water, and up to 2-25% through atmospheric air.The soil and vegetation are most heavily contaminated with heavy metals within a radius of 2-5 km from metallurgical enterprises and 0-100 m from highways. Urban soils, which are more cumulative in nature, are also susceptible to serious contamination from improper disposal of lead-containing items (used batteries, lead-lined cable fragments, motors, etc.). The direct impact of industry and vehicles often leads to an increase in the lead content in the soil by several time.

Based on our observations MAC of Pb in the upper layer of the soil at a depth of 0-20 cm is within the norm, but in the lower layers of the soil at a depth of 20-50 cm this indicator close to the norm.

Map 1.

Indicator of the Pb.



In the map **(Map.1**) prepared by us in 2022, also shows that in the core of the agglomeration of Baku, in the upper or al layers of the soil horizons, this limit has not been exceeded. But these data were higher 10 years ago, today vehicles regulation on the operation of automobiles in Azerbaijan could serve to reduce the level of lead concentration in the soil.

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EFFECT OF TOBACCO WASTE APPLICATION ON BULK DENSITY AND MOISTURE CONSTANTS OF A LOAMY SAND SOIL

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In this study, effect of tobacco waste (TW) application on soil bulk density and soil moisture constants were determined in a loamy sand soil. Tobacco waste was applied into soil surface (0 - 15 cm) with 4 different rates (0, 2, 4 and 6%) and three replications in a randomized plot design. After eight months, changes in soil organic carbon content, bulk density (BD), total porosity (F), field capacity (FC), permanent wilting point (PWP) and available water content (AWC) were determined for each treatment. TW application rates significantly increased organic C contents, F, FC, PWP and AWC values while they significantly decreased BD values of sandy loam soil. While the highest rate of TW increased OC content from 1.03% in control to 1.46%, it decreased BD from 1,45 g/cm^3 to 1.24 g/cm^3. The highest application dose of TW increased F, FC, PWP and AWC over the control as 22.6%, 21.9%, 17.6% and 27.6%, respectively. It can be concluded that application of TW into coarse textured soil improved soil physical properties and moisture constants with increasing OC content of the soil.

Key words: *Tobacco waste, coarse texture, moisture constant, soil structure.*

INTRODUCTION

Soil degradation through loss of soil organic matter destroys soil structure, resulting soil compaction and root growth (Usowics and Lipiec, 2009; Busscher and Bauer, 2003). Organic waste applications affect soil hydraulic properties due to mineralization of organic matter in soil (Gülser and Candemir, 2015) and causes changes in soil structure, aggregate size distribution with increasing pore and aggregate sizes in bulk soil (Gülser et al. 2015). Gülser et al., (2017) reported that hazelnut husk treatment in a sandy clay loam soil increased organic C content, basal soil respiration, saturated hydraulic conductivity and aggregate stability of soil. Candemir and Gülser (2011) reported that increasing aeration due to aggregation occurred by the organic waste application caused increases in basal soil respiration or microbial activity in clay soil. In a study by Demir and Gülser (2021), the rice husk compost applications in field and greenhouse conditions had positive effects on soil properties with increasing organic matter content, electrical conductivity, field capacity, permanent wilting point, available water content and reducing soil pH and soil bulk density over the control. A measure of soil microstructure can be an index of soil physical quality that is consistent with observation on soil compaction, on effects of soil organic matter content and on root growth (Dexter, 2004). Gülser and Candemir (2012) reported that bulk density, relative saturation and penetration resistance decreased while mean weight diameter, total porosity, gravimetric water and organic matter contents of a clay soil increased with increasing application rates of agricultural wastes. Organic matter in soil increases the soil's capacity to hold water by direct absorption of water and by enhancing the formation and stabilization of aggregates containing an abundance of pores that hold water under moderate tensions (Weil and Magdoff, 2004).

Tobacco is one of the most important agricultural productions in the Black Sea region of Türkiye and there are large quantities of tobacco wastes around this region. Therefore, the objective of this study was to determine the effect of tobacco waste (TW) application on soil structural parameters and water holding capacity in a loamy sand soil.

MATERIAL AND METHODS

A field experiment was conducted at a sandy loam field in Ondokuz Mayıs District of Samsun, Türkiye. Tobacco waste (TW) was mixed into surface soil (0 - 15 cm) using a hoe with 0, 2, 4 and 6% of dry weight basis with three replications in a completely randomized plot design. There was no plantation until the soil sampling time and after eight months, some physical characteristics of the soil were determined in the soil samples taken from 15 cm soil depth before planting. After determining the BD, total porosity (F) was calculated by F=1-BD/2.65. Moisture contents at the field capacity (FC) and the permanent wilting point (PWP) were determined equilibrating soil moisture of the saturated samples on the ceramic pressured plates at 33 kPa for 24 hours and 1500 kPA for 96 hours, respectively (Demiralay, 1993). Soil reaction (pH), electrical conductivity, and organic carbon content were determined according to Kacar (1994). According to the soil physical and chemical properties in Table 1, the results can be summarized as; the textural class is loamy sand, none saline (0.185 dS/m), neutral in pH (7.18), low in organic matter (1.82%) (Soil Survey Staff, 1993). Statistical analysis of the results was done by standard analysis of variance, pairs of mean values compared by Duncan test using SPSS 17.

Table 1.

Some physical and chemical properties of the soil.

Sand, %	85.20	pH (1:1, w/v)	7.18
Clay, %	9.40	EC_{25} (1:1, w/v), dSm^{-1}	0.185
Silt, %	5.40	$CaCO_3$, %	13.04
Texture class	Loamy sand	Total N, %	0.11
Field capacity, %	11.00	Organic matter, %	1.82
Wilting point, %	6.10	C/N	9.63

RESULTS AND DISCUSSIONS

Tobacco waste application into a loamy sand soil increased organic C (OC) content in the 0-15 cm of the soil layer (Table 2). The increments in mean values of OC content with the application rates were significantly different from the control ($P<0.01$). Soil OC content increased 36.6% over the control with 6% rate of TW application (Table 3).Tobacco waste treatment decreased the bulk density values and increased total porosity values significantly ($P<0.01$). The increments in total porosity with the application rates were also significantly different from the control ($P<0.01$). The 6% rate of TW application decreased bulk density 14.4% and increased total porosity 23.1% over the control (Table 3). Many studies indicated that addition of organic wastes into soils reduces bulk density and increases total porosity (Anikwe, 2000; Marinari et al., 2000; Candemir and Gülser, 2011; Gülser et al. 2017). Candemir and Gülser (2011) reported that increasing aeration due to aggregation occurred by the organic waste application caused increases in basal soil respiration or microbial activity in clay soil.

Table 2.

The effect of tobacco waste (TW) application on soil organic C (OC), bulk density (BD), total porosity (F) and gravimetric (W) water contents.

Treatments	OC, %	BD, g/cm^3	F, %
TW 0%	1.06 b**	1.446 a**	34.00 b**
TW 2%	1.14 b	1.260 b	41.33 a
TW 4%	1.38 a	1.246 b	42.00 a
TW 6%	1.46 a	1.240 b	42.00 a

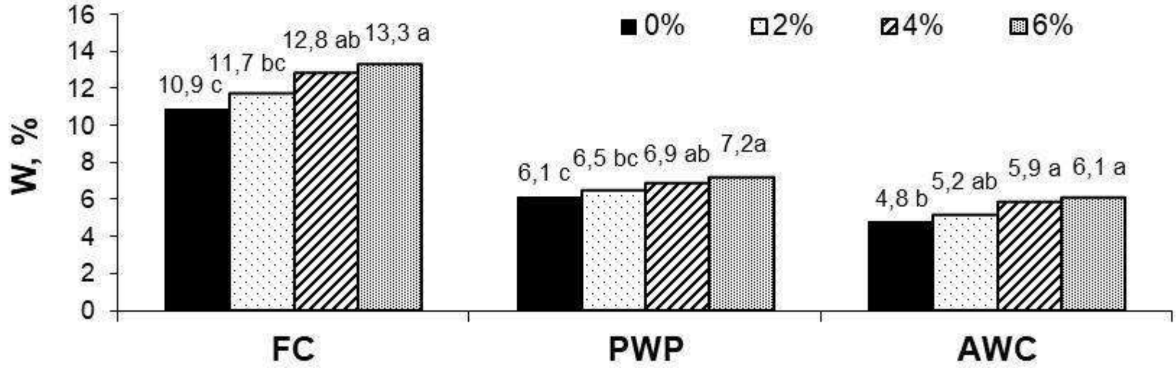
**significant at 0.01 level

Table 3.

Percentage changes of the soil properties over the control by tobacco waste (TW) application.

Treatment	OC	BD	F	FC	PWP	AWC
TW 2%	6.92	-13.12	21.01	7.29	6.26	8.39
TW 4%	28.79	-14.01	22.43	17.22	12.08	23.60
TW 6%	36.60	-14.40	23.06	21.98	17.55	27.44

Soil moisture characteristics (FC, PWP, AWC) were significantly increased over the control with increasing the application rate of TW at 0.01 level (Figure 1). The highest FC (13.3%) and PWP (7.2%) were determined with 6% rate of TW application. The highest AWC (6.1%) was also determined in 6% of TW application. Many studies reported that addition of organic matter to soils increases water holding capacity (Gupta et al., 1977; Candemir and Gülser, 2011; Mamedov et al., 2016; Gülser et al., 2017). The 6% rate of TW application to loamy sand soil increased FC 21.98%, PWP 17.55% and AWC 27.44% over the control treatment (Table 3).



Figures 1. The effects of tobacco waste application rates on moisture content (W) at field capacity (FC), permanent wilting point (PWP) and available water content (AWC).

Soil OC content had the significant positive correlations with F (0.735**), FC (0.856*), PWP (0.920**), AWC (0.715**) and significant negative correlation with BD (-0.728**) values (Table 4). Increasing soil OC content with TW application caused decreases in BD with increasing the total porosity. BD values had significant negative correlations with F (-0.997**), FC (-0.745**), PWP (-0.776**) and AWC (-0.637*) (Table 4). In many studies, it is indicated that soil organic matter content gives a significant negative correlation with bulk density and a significant positive correlation with total porosity (Candemir and Gülser, 2011; Gülser et al., 2016, Gülser et al., 2020). Demir and Gülser (2015) investigated the eeffects of rice husk compost on some soil quality parameters under greenhouse conditions. They reported that the highest positive correlations among the soil quality parameters were determined between OM and PWP, AWC and FC, OM and FC, PWP and FC; while the higher negative correlations were found between BD and FC, BD and PWP, BD and OM. Gülser (2006) reported that increasing macroaggregation in a clay soil due to forage cropping caused increases in organic matter content in soil and decreases in bulk density values. In another study, Gülser (2004) found that increasing soil organic matter content decreased bulk density with increasing total porosity. Air filled porosity had significant positive correlation with F, and negative correlations with BD. PWP also gave significant positive correlation with F, and significant negative correlations with BD and AWC. Iqbal et al. (2005) studied spatial variability of OM, FC, PWP and AWC values and reported that increasing OM content in the field caused increases in FC and PWP values. In this study, soil moisture constants also showed significant positive correlations among each other.

Table 4.

The correlations among the soil properties.

	BD	F	FC	PWP	AWC
OC	-0.728**	0.735**	0.856**	0.920**	0.715**
BD		-0.997**	-0.745**	-0.776**	-0.637*
F			0.750**	0.779**	0.642*
FC				0.887**	0.955**
PWP					0.710**

Correlation significant ** at 0.01 level, * at 0.05 level.

CONCLUSION

It can be concluded that tobacco waste application had positive effects on improving soil structural properties of the loamy sand field. Tobacco waste application increased soil OC content, F, FC, PWP and AWC and reduced bulk density. Increasing organic matter content in coarse textural soil increased water holding capacity of the soil. Total porosity, soil moisture constants and plant available water content values increased with increasing the application rates from 2% to 6% of tobacco waste. Tobacco waste and other local agricultural wastes can be used as a soil conditioner to improve physical properties of coarse textured soils in Black Sea Region of Türkiye.

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EFFECTS OF FOLIAR FERTILIZATIONS AT DIFFERENT GROWTH STAGES ON YIELD PARAMETERS OF WHEAT

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In this study, effects of NPK foliar fertilizer applications at different growth stages on yield parameters of wheat were investigated under greenhouse conditions. Foliar applications of NPK fertilizer containing 10% N, 5% P_2O_5, 5% K_2O were done 0.5% and 1.0% doses at tillering (T), stem elongation (S), heading (H) stages of wheat plant and three combinations of these stages (T+S, T+H and S+H). Biological yields of wheat increased with increasing application doses from 0.5% to 1.0% over the control. While the highest biological yield (7.38 t/ha) and straw yield (4.83 t/ha) values were obtained with the application of 1.0% foliar fertilization at stem elongation stage, the highest grain yield (2.65 t/ha) was obtained with the application of 0.5% doses at stem extension stage. The both foliar fertilization applications increased straw yield values more than grain yield values of wheat plant. The percentage mean values for the increments of biological, grain and straw yield values over the control for both application doses at all over the growth stages were 17.5%, 8.9% and 24.0%, respectively. Although all yield parameters increased over the control with both foliar fertilizations, the harvest index decreased with the foliar fertilization applications at all growth stages due to higher increase in straw yield values. The mean percentage increments in the biological yield over the control were ordered as follows 30.2% at S, 21.8% at H, 16.2% at T, 14.5% at S+H, 11.8% at T+S and 10.5% at T+H stage foliar fertilization applications. The foliar spray of 1.0% NPK solution was generally found to be most effective for increasing yield parameters of wheat when sprayed at stem elongation stage.

Keywords: *Foliar fertilization, NPK, wheat growth stages, yield parameters.*

INTRODUCTION

Foliar fertilizer applications have become widespread in recent years in order to eliminate micro and macro nutrient deficiencies in plants. Producers turn to foliar fertilizers, which cost less, do not need urgent rainfall because they are given with water, and when used mixed with weed pesticides, they allow the pesticide to easily overcome the stagnation caused by the plants and positively affect the grain size (Kınacı, 2001). These fertilizers, which contain one or more of the nutrients required for plants, are applied by spraying on the leaves in liquid form (Kacar and Katkat, 1999). The effects of the plant nutrients applied by spraying are seen much more quickly than the nutrients applied to the soil. In studies on breeding, the emphasis was placed on yield-related features, while quality-related features remained in the background. Today, it cannot be said that sufficient studies have been carried out on the bread quality of genotypes grown in our country and especially in the Aegean region. Some of the studies show that foliar fertilizer application provides increases in yield and yield components or the amount of dry matter in grains (Ceylan et al. 1998; Taban et al. 1997; Özcan and Brohi, 2000).

It is usually assumed that if fertilizer is applied in autumn or spring then all crop nutrient requirements can be met from the soil. This may not always be the case, particularly late in the season when ample nutrients may be present in the soil but unavailable to a crop due to dry conditions. In these situations, soil nutrient supply combined with internal re-translocation may not always be adequate for setting and filling the maximum number of grains, and crops might benefit from supplementary foliar applications of nutrients (Barraclough and Haynes, 1996). Potassium nitrate is readily available and widely used in horticulture (Alexander, 1986; Weinbaum, 1988), and in view of the well-known synergisms between N and K during uptake and translocation in plants, it would seem to be an ideal source of macronutrients for late, supplemental foliar feeding. In a greenhoıuse study, low concentrations of KNO_3 (20 mM) sprayed on wheat at anthesis considerably increased grain numbers (Parkash and Joshi, 1973).

Wheat growth is significantly influenced by the soil moisture content (Gülser and Kizilkaya, 2020). The water holding capacity of the soil is an important indicator of soil quality and plants can benefit from the plant available water content between field capacity and wilting point (Candemir and Gülser, 2011; Demir and Gülser, 2015; Gülser et al., 2015). The aim of this study was to investigate the effects of NPK foliar fertilizations at different growth stages of wheat on biological, grain and stem yields, and harvest index values under full irrigation conditions at field capacity moisture level in soil.

MATERIAL AND METHODS

Experiment was conducted in the randomized plot design with three replications with seeding 17 seeds per pot in the greenhouse of Soil Science and Plant Nutrition Department of Agricultural Faculty in Ondokuz Mayıs University. After the germination, plants were thinned and 14 wheat plants were left in each pot. Soil moisture content in the pots was kept at field capacity by weighing the pots daily and irrigating. Foliar applications of NPK (10% N, 5% P_2O_5, 5% K_2O) were done with 0.5% and 1.0% rates at tillering (T), stem elongation (S), heading (H) stages of wheat plant and the three combinations of these stages (T+S, T+H and S+H). After 92 days, the plants were weighed to determine biological, grain and stem yields for each treatment. Harvest index was determined using the ratio of grain yield to straw yield (Beadle, 1993). Some soil properties were determined according to basic soil analyses methods (Demiralay, 1993; Kacar, 1994). Physical and chemical properties of the soil used in this study are given in Table 1. The soil sample is clay loam, nonsaline, neutral in pH, low in organic matter content (Soil Survey Staff, 1993). The data were analyzed statistically by using SPSS 17.0 programme.

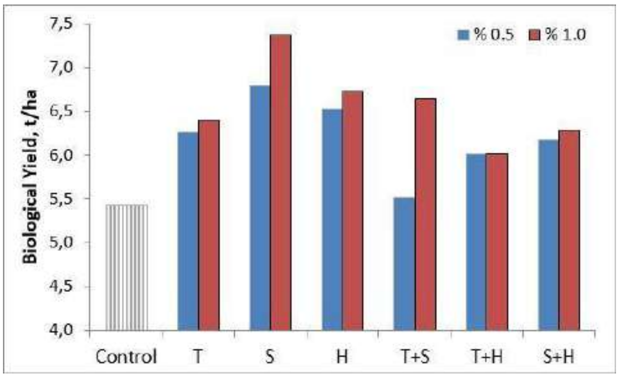
Table 1.

Some physical and chemical properties of the soil.

Sand, %	28.9	pH (1:1, w/v)	7.30
Clay, %	30.3	EC_{25} (1:1, w/v), dSm^{-1}	0.48
Silt, %	40.8	$CaCO_3$, %	13.04
Texture class	Clay loam	Total N, %	0.10
Field capacity, %	27.0	Organic matter, %	1.94
Wilting point, %	12.0	C/N	11.08

RESULTS AND DISCUSSION

Foliar fertilizations at all growth stages increased biological yield over the control statistically ($P<0.05$). Total biological yield increased from 5.44 t/ha in control to 6.80 t/ha and 7.38 t/ha in the 0.5% and 1.0% application doses at stem elongation, respectively (Figure 1). The highest increments in biological yield for 0.5% and1.0% application doses over the control were obtained as 25% and 36%, respectively. The mean percentage increments in the biological yield over the control by the NPK foliar fertilization were ordered as follows 30.2% at S > 21.8% at H > 16.2% at T > 14.5% at S+H > 11.8% at T+S > 10.5% at T+H stage treatment (Table 2).



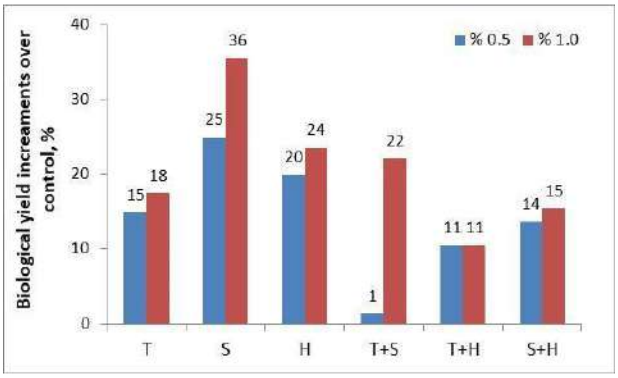


Figure 1. Effects of NPK foliar fertilizations on biological yield and percentage changes over the control at differenf growth sages of wheat (T-tillering, S-stem elongation, H-heading).

Table 2.

Mean values of percentage changes of wheat yield parameters over the control by the foliar NPK fertilizations at different growth stages.

Foliar fertilization stages	Biological Yield	Grain Yield	Straw Yield	Harvest Index
Tillering (T)	16.2	3.9	24.7	**-16.8**
Stem elongation (S)	**30.2**	**16.8**	**39.5**	-15.7
Heading (H)	21.8	10.7	29.5	-14.3
T+S	11.8	9.1	16.7	-10.8
T+H	10.5	5.6	13.9	-7.3
S+H	14.5	7.4	19.4	-10.1
Mean	17.5	8.9	24.0	-12.5

The grain yield increased with the foliar fertilizations at all growth stages over the control statistically (P<0.05). The grain yield increased from 2.22 t/ha in control to 2.65 t/ha and 2.63 t/ha in the 0.5% and 1.0% application doses at S and T+S stages, respectively (Figure 2). The highest increments in grain yield for 0.5% and1.0% application doses over the control were also obtained as 19% and 18% at these stages, respectively. The mean percentage increments in the grain yield over the control by the NPK foliar fertilization were ordered as follows 16.8% at S > 10.7% at H > 9.1% at T+S > 7.4% at S+H > 5.6% at T+H > 3.9% at T stage treatment (Table 2).

The straw yield also increased with the foliar fertilizations at all growth stages over the control statistically (P<0.05). The grain yield increased from 3.22 t/ha in control to 4.16 t/ha and 4.83 t/ha in the 0.5% and 1.0% application doses at S stage treatments, respectively (Figure 3). The highest increments in grain yield for 0.5% and1.0% application doses over the control were also obtained as 29% and 50% at S stage treatments, respectively. The mean percentage increments in the grain yield over the control by the NPK foliar fertilization were ordered as follows 39.5% at S > 29.5% at H > 24.7% at T > 19.4% at S+H > 16.7% at T+S > 13.9% at T+H stage treatment (Table 2).

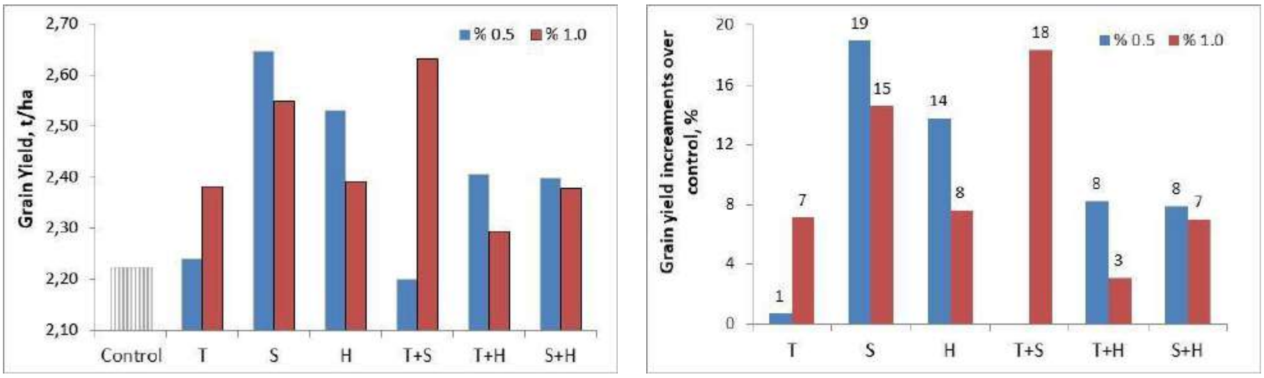


Figure 2. Effects of NPK foliar fertilizations on grain yield and percentage changes over the control at differenf growth sages of wheat (T-tillering, S-stem elongation, H-heading).

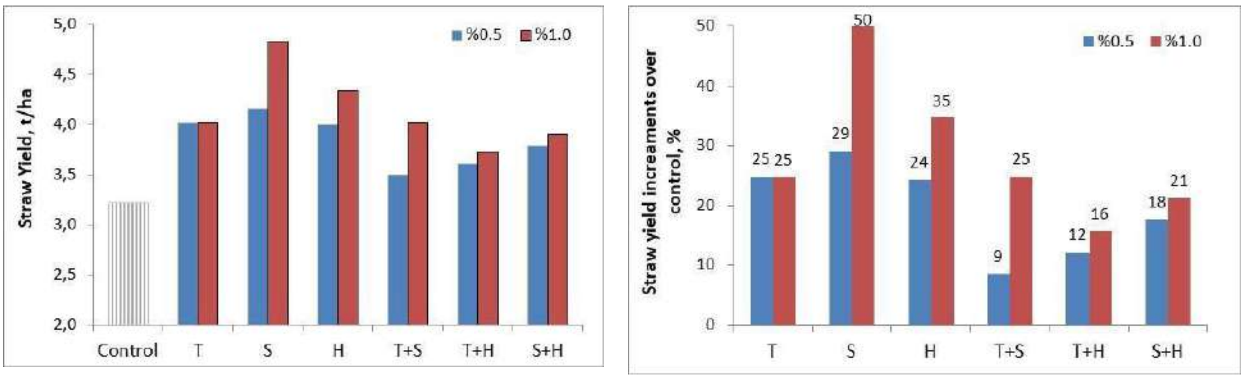
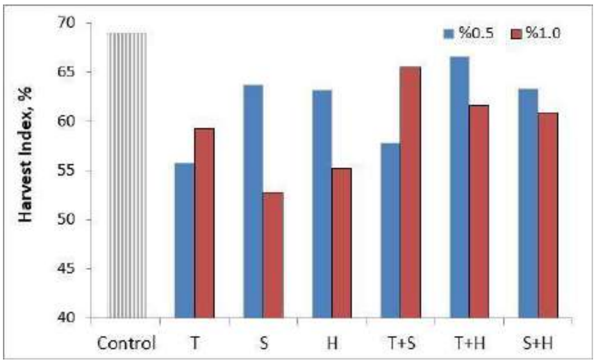


Figure 3. Effects of NPK foliar fertilizations on straw yield and percentage changes over the control at differenf growth sages of wheat (T-tillering, S-stem elongation, H-heading).

Foliar fertilizations at all growth stages reduced harvest index values of wheat over the control statistically (P<0.05). Harvest index decreased from 69.1% in control to 55.8% and 52.8% in the 0.5% and 1.0% application doses at T and S stage treatments, respectively (Figure 4). The highest decrease in harvest index for 0.5% and1.0% application doses over the control were obtained as 19% and 24% at those treatments, respectively. The mean percentage decreases in the harvest index over the control by the NPK foliar fertilization were ordered as follows 17% at T > 16% at S > 14% at H > 11% at T+S > 10% at S+H > 7% at T+H stage treatment (Table 2).



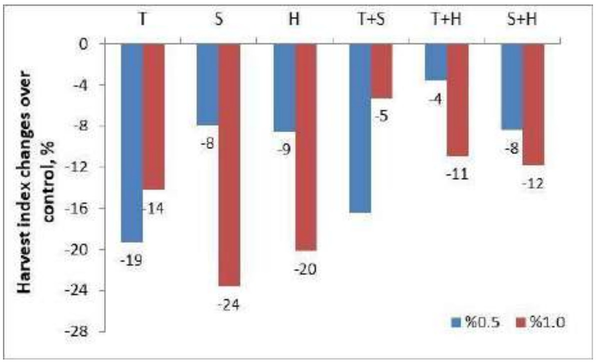


Figure 4. Effects of NPK foliar fertilizations on harvest index and percentage changes over the control at differenf growth sages of wheat (T-tillering, S-stem elongation, H-heading).

The foliar spray of NPK fertilizer at 0.5% and 1.0% ratios in different growth stages increased biological, grain and straw yield values over the control significantly (P<0.05). Generally higher increments in the yield values of wheat were obtained at the stem elongation treatments. Gülser et al. (2019) reported that the 1% rate of NPK (20:20:20) foliar fertilization applied at the different growth stages of wheat increased the grain yield. They found that the highest grain yield (2.14 t/ha) was determined with the foliar fertilization applied at the tillering plus stem elongation (T+S) stages compared with the control (1.32 t/ha) under a field conditions in Kostanai, Kazakhstan. In another study by Parvez et al. (2009) studied the effect of foliar application of urea applied at different stages on yield and yield components of wheat. They found that foliar application of urea significantly increased plant growth parameters such as biological yield, grain yield and N uptake by the crop. They reported that foliar spray of 4% urea solution was most effective for enhancing the quantitative and qualitative traits when sprayed at tillering, stem elongation and boot stage, and grain yield was increased by 32% with 4% foliar spray of urea. In this study application of 1.0% NPK foliar spray at S stage increased biological yield 36%, grain yield 18% and straw yield 50%. Mean values of percentage increments of yield values at all growth stages according to control treatments showed that NPK foliar fertilization increased straw yield (24.0%) greater than biological (17.5%) and grain (8.9%) yields over the control (Table 2). Although the yield parameters increased over the control with both foliar fertilizations (0.5% and 1.0%), the harvest index values decreased with the foliar fertilization at all growth stages due to higher increase in straw yields than grain yields. Abdel-Aziz et al. (2016) reported that the foliar application of NPK fertilizer to wheat plant significantly decreased harvest index value from 21.65% in control to 20.59%. In this study decreases in harvest index values generally were lower in 0.5% ratio than in 1.0% ratio of foliar fertilization.

CONCLUSION

This study indicated that NPK foliar fertilization increased yield parameters of wheat plant depend on the fertilization at different growth stages. The NPK foliar fertilization at S stage was generally more effective on increasing the yield of wheat plant than that at the other stages. The 1.0% rate of NPK foliar fertilization applied at the different growth stages increased the yield parameters of wheat more than 0.5% rate application under the greenhouse condition. When comparing the control treatment, harvest index decreased by the foliar fertilization at all growth stages due to increasing straw yield more than grain yield values.

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RESEARCH OF HEAVY METALS ON THE LANDS OF THE WESTERN TERRITORY OF AZERBAIJAN

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We determinate some heavy metals, which is harmful for heath. We take samples from Western territory of Azerbaijan. The process of extraction of heavy metal ions from model solutions based on activated carbon. The results obtained show that activated carbon can be used as an effective sorbent for extracting ions heavy metals. The adsorption of metals ions was studied at various concentrations of metals ions, Adsorption the ability of Me(III) ions increased with increasing, initial concentration, and time contact.
Key words*: heavy metals, ecology, cupper, chromium, iron*

From an ecological point of view, the study of the soil crust is of great importance. For this, environmental studies were taken from the western region, where industrial areas are located. Since the migration of chemical contaminants in soil is difficult and time consuming, this area needs to be studied. Excessive levels of some heavy metals in the study were an important factor in assessing the state of the environment.

Soil contamination with heavy metals has recently become very relevant. Heavy metals are non-ferrous metals with a higher density than iron (except zinc). These include lead, copper, nickel, cadmium, cobalt, chromium, mercury, etc. The most important feature of heavy metals is that a small amount of all of them is of great importance for living organisms and plants. More than 150 thousand tons of Cu, 120 thousand tons of Zn, 90 thousand tons of Pb, 12 thousand tons of Ni, 1.5 tons of Mo, 800 tons of Co, 30 tons of Hg are emitted annually from metallurgical enterprises. In copper smelting, 1 g of blackened copper contains 2.09 g of powder, of which 15% Cu, 60% Fe and 4% Al, Hg, Zn, Pb. Mechano-chemical wastes contain 1000 mg/kg Pb, 3000 mg/kg Cu, 10000 mg/kg Cr and Fe, 100 g/kg P, 10 g/kg Mn and Ni.

Increased attention to environmental protection is causing particular interest in the effects of heavy metals on soil. Elements such as Fe, Mn, Cu, Zn, Mo and Co are very important for plant life, and therefore for humans and animals. They are sometimes called micronutrients because plants need very little. Microelements also include such common metals in the soil as O (46.6%), Si (27.71%) and Fe (8.1%), which ranks 4th after Fe. All trace elements have a negative effect on plants when the specified concentration is exceeded, and Hg, Pb and Cd, which are not important for plants and animals, are harmful to humans even at very low concentrations [3, 4]. Heavy metals can be adsorbed or incorporated by microorganisms involved in the migration of the respective metals. Heavy metals pass through the trophic chain in the soil to plants, and then are processed by humans and animals [3, 6].

Fresh soil samples are dried in the laboratory in special places in the open air, in the shade or in drying cabinets at a temperature of 30-40°C. Dry samples are poured onto parchment or roots and crumbs are removed, and the roots are shaken to remove dirt. Coarse soils are crushed in solution to a particle size of 5-10 mm. The sample is mixed and distributed in the form of a square on the screen. The average sample (approximately 200 g) is poured into a numbered box or jar for storage (pre-filled with a label filled with sample data) using the double-squaring method and recorded in a laboratory journal under a serial number [2, 5].

SOIL ANALYSIS

The main purpose of soil chemical analysis is to solve theoretical and practical problems of agriculture. The study of the chemical characteristics of the soil is of great importance in the development of agrotechnical measures. Radionuclides, pesticides, herbicides, etc. in the soil. The detection of toxic substances is also of great importance from an environmental point of view. The extraction of the studied compounds from the soil for analysis is carried out by extraction with various solvents, solutions (water, saline, acidic or alkaline). In some cases, the soil is loosened by dissolving carbonates with a small sample and working with hydrofluoric acid or a mixture of acids (HCl + HNO_3; HSO_4 + HNO_3). Most analyzes use air-dried, mortared, sieved soil 1 mm in diameter.

When extracted with water, the alkalis contained in the soil, chlorides of alkaline earth metals and easily soluble organic substances in water pass into the solution. Water-soluble salts can also be harmful.

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LANDSCAPE-ECOLOGICAL CONDITIONS OF ARID MOUNTAINOUS GEOSYSTEMS OF AZERBAIJAN

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One of the urgent problems is the optimization of nature management based on the assessment of natural and anthropogenic factors that affect the landscape and ecological situation in all mountainous areas. In particular, the issues of formation of soils, vegetation and relief under the influence of geomorphological factors, protection of biodiversity are in the focus of attention of many specialists working in this field. In this regard, the mountain-steppe and mountain-forest landscapes of the Greater Caucasus, which is characterized by the manifestation of complex exodynamic processes, is no exception.

The presented article provides a systematic analysis of the factors influencing the formation of landscapes in the mountain-forest and mountain-steppe belt of the republic, based on the determination of the composition and properties of soils and vegetation, the spatial and temporal dynamics of forests, the nature of transformation and the degree of environmental load. On the basis of the conducted studies, it has been established that, for the prevention of desertification, the main measure is the regulation of anthropogenic impact. To regulate the level of anthropogenic pressure on pastures, a proper grazing system is necessary, as well as watering pastures and creating artificial irrigation systems improves the ecological state of landscape complexes. Considering that uncontrolled felling of trees and shrubs in the study areas leads to the creation of potential centers of desertification processes, a strict ban on felling trees and shrubs is of great importance to prevent this process.

Keywords: *ecolandscape condition, mountain geosystems, arid and semiarid landscapes, anthropogenic pressure, desertification.*

INTRODUCTION

It should be noted that mountain-steppe, mountain-forest-steppe and meadow-shrubby geo-systems are widely spread both on the contact zone of mountain-steppe and mountain-forest landscapes and mid-mountain forest belt on the territory of Greater Caucasus (Aliyev, 1964). This is explained as being due to climatic differences of slope expositions, on the one hand, and expansion of economic activity and growth of vital needs of human society in time and space, on the other hand. Note that these landscape complexes were largely formed in the range of absolute altitudes, 300-500 m to 1200-1500 m (Kuchinskaya, 2011).

Account has to be taken of the fact that soil-vegetation cover is well developed within the limits of mountain-forest-steppe and meadow-shrubby landscapes. Widely spread here are residual mountain-brown post-forest, mountain-brown-forest, white-brown soils based on argillaceous and argillaceous-limestone deposits of paleogenic, neogenic and cretaceous periods. The vegetation cover of this landscape type consists primarily of oak, hornbeam, ash, hawthorn, Christ's thorn, pear, etc. while grass cover is made of beard grass, feather grass, wormwood, etc. (Budagov, Garibov, 1986)

Note that aridization of natural conditions and landscape variation is observed within the region from north-west to south-east. As a result, areas of arid and semiarid landscape complexes reach watershed space due to the topographic low within the limits of the second segment.

It has to be kept in mind that the said landscape complexes of intermediate type are, on the one hand, expanded yearly due to anthropogenic influence and transformed into mountain steppes due to the destruction of wood elements, on the other hand. Climatic and relief-soil conditions of the given landscape are favorable for the development of rainfed agriculture with the use of slope terracing. Parts of landscape characterized by unfavorable relief conditions (mostly steep, stony and arid dissected territories) are used as pastures and hayfields. Soil cover is sporadically eroded on this type of landscape.

MATERIAL AND METHODS

The object of research is the mountain-steppe and mountain-forest landscapes of the Greater Caucasus. At the desk-preparatory stage, on the basis of stock and cartographic materials, information was collected on the vegetation and soil cover, relief and climatic conditions, geomorphological factors of the mountain-steppe and mountain-forest landscapes of the Greater Caucasus, the causes of desertification at the research sites were studied and identified.

RESULTS AND DİSCUSSİON

It should be added that mountain-meadow and forest landscapes are replaced by xerophytes and semi-xerophyte-shrubby-steppe and arid-lightly forested shrubby landscapes with typical soil-vegetation cover. More fertile soil types (mountain-meadow, mountain-meadow mold, brown-forest-mountain, etc.) are replaced on this site by slightly humus steppeficated brown, grey-brown and light-chestnut soil types (Budagov, Mikailov, 1985; Guliyev, Kuchinskaya, 2006).

Depending upon orographical conditions and climate features the mountain-xerophyte and semi-xerophyte shrubby-dry steppe landscape is spread at heights from 1600-1200 m to 600-400 m. The given landscape complex is transitional from forest-steppe to dry steppe and semi-arid landscapes. This complex is correlated with watershed ribbon of Mt. Dubrar (Zeynalova, 1998).

This type of landscape is highly diversified with vegetation associations caused by climate characteristics, lithology and relief height. Here, widely spread is sagebrush, fescue and mix herbal dry steppes with xerophyte vegetation. Some specimens of forest timber (oak, hornbeam, etc.) are indicative that mountain-xerophyte landscape of the reviewed territory is characterized by formation of secondary type that arose in place of former mountain forests.

Added to this can be that the arid-lightly forested landscape occupies alluvial ribbon at heights 700-600 m to 200-100 m from river Samur to river Gilgilchay, southern end of Gusar plain, ridged low-hill terrain of Gaynardji, Talabi and partly Lateral Ridges. A characteristic feature of the sparse forest is promiscuity of grassy and shrubby formations following which they are akin to organically integrated grouping. The reviewed landscape is developed of post-forest brown and gray soils. These secondary type formations as evidenced by secondary shibliak largely made of shrubby (oakery, pomegranate, Christ's thorn) are represented by white swallow wort and sagebrush (Budagov, 1988).

It was economic activities that considerably changed the arid-shrubby landscape: the territory is busy with secondary cultural vegetation. Widely spread on xerophyte-shrubby-dry steppe landscape of the eastern part of Greater Caucasus are landslides and mud flows, river valleys, clay karsts, badlands and other arid-denudation forms of relief.

Mountain-steppe landscapes on the territory of the Azerbaijani part of Greater Caucasus are strongly developed in the range of absolute altitudes from 200-500 m to 1500-1700 m on low-hill terrains, as well as on south-eastern fragments of the said mountain systems due to the strengthening of aridization of climate and anthropogenic impact, so forest landscapes go up to lower and medium strata of middle altitude (Budagov, Mikailov, 1985; Mikailov et al., 1985).

It is worth pointing out that mountain steppes located on Greater Caucasus and Jeyranchol-Ajinohur low-hill terrain take up large areas and vary greatly depending upon lithology of matrix lithology, character of relief, climate, vegetation communities to include post-forest meadow-steppes, forest-steppes, shrubby steppes and xerophyte-shrubby steppes. Also, a greater part of steppes within the limits of Greater Caucasus and Ajinohur-Jeyranchol low-hill terrain with fragmentary steppe vegetation and secondary steppes with their typical weedy composition is ploughed under dry farming (Gulieva, 2011).

Owing to intensive mountain deforestation in Greater Caucasus and sparse forestry on Ajinohur-Jeyranchol low-hill terrain, mountain steppes have been transformed into various agro-landscapes in terms of poorly-broken, low inclined and leveled-off relief and sludging while dry granitic plots and steep eroded slopes are as pastures. Hence, a broader area of mountain-steppe landscape on high absolute altitudes of Greater Caucasus is a non-zonal phenomenon caused by centuries-long human activity and subsequent landscape steppe formation and aridization that hampered the self-restoration of forest complex (Budagov, Mikailov, 1985).

Worthy of note is the fact that steppe landscapes are developed by discontinuous ranges on separate heights uncovered by mud-volcanic activity. This is true for relief conditions of South and East Gobustan and Absheron peninsula typified by low-mountain ridge and mud-volcanic plateau separated by flatlands and depressions, as well as halophytization and desertification of mud-volcanic landscapes due to the salt-content of chloride and sulphate composition of breccia on the top of the ground (Budagov, Garibov, 1980).

It should be added that anthropogenic impact on dry steppe landscapes is considerable as compared to neighboring semi-arids. Annual precipitation rate in the region is 280-300 mm which is sufficient for the development of rainfed grain farming and most spread at high relief plots (flatlands Chalayeri, Atali, north of Gyuzdek plateau) (Shikhlinsky, 1969). Note that grain-growing and cattle-breeding is highly developed in the environs of villages Novhany, Binagadi, Fatmai, Sarai, etc. Also, trans-humance grazing is underway on steep slopes unfit for farming (Budagov et al., 1972).

Adjacent to Absheron is a region of Gobustan typified by analogous natural and climatic indices; however, as distinct from Absheron, Gobustan is poorly developed and less involved in the economic life of the Republic. The main sphere of economic activity of this region is agricultural and oil production. However, for some unfavorable natural factors (arid climatic conditions, sharply dissected relief, sparse hydrographic network, poor bio-productivity of soil, and intensive development of halophyte vegetation) a degree of agricultural reclamation of the territory is very low. Thus, present-day landscapes of Gobustan are less exposed to anthropogenic transformation (Kerimova, 2011).

A northern part of Gobustan is more or less reclaimed; it is typified by dry steppe landscape together with ephemerous vegetation on chestnut, gray-brown soils. The territory is ploughed and used for rainfed agricultural crops, particular cereals. There are great potentialities for perspective development of viticulture and cereals. At the same time the sheep breeding is widely developed in the region. The eastern part of northern Gobustan with numerous plateaus (Gyuzdek, Gyulbaht, etc.) is characterized by favorable conditions for intensive development of unirrigated farming thanks to moderate impact of the Caspian Sea and insignificant salinization of soils and flat surface.

The southern part of Gobustan is characterized by narrower agricultural potentialities. For this reason, local landscapes are not overcharged with essential anthropogenic pressures and preserved their natural appearance. Semi-arid landscape complexes of the southern, south-western Gobustan with their sagebrush, sagebrush-halophytic and shrubby vegetation on gray-brown-alkaline soils are largely used as autumn-winter and spring pastures. Note that territories of flood-plain and supra-floodplain terraces across river valleys are, poorly though, used under bally crops and vegetable gardens. As a whole, the said territories of semi-arid landscapes are not used for farming due to poorly developed irrigation system, except for Pirsagatchay valley with its developed irrigated cropping (grain-growing) (Budagov, 1988).

It should be remembered that landscapes of mud volcanoes remain practically inoperative in economic turnover. High density of their spreading and intensity of eruptions result in sharp relief dissection and formation of a special type of salt content lithological principle as a major factor of late ripening of vegetation cover, scarcity and poor efficiency of local soils. With that consideration, crater and top areas of volcanoes covered by young breccia are not practically applied in the agriculture. Also, soil formation processes are intensively carrying on slopes covered with ancient breccia, so a poor soil cover with relatively varied ephemeral vegetation might be used on pastoral holdings (Kerimova, 2011).

As a whole, the anthropogenic influence of the reviewed region is of seasonal nature to attain its maximum in winter and spring periods, i.e. during the maximum atmospheric precipitation. Added to this can be that solid masses of deforested areas of mid- and low-mountain belts of Greater Caucasus are covered by various shrubs (Christ’s thorn, sweet briar, medlar, hawthorn, etc.) littered among meadow, meadow-steppe and steppe vegetation. In most cases theses land plots are regularly used for crop production in river basins of Pirsagatchay, Girdimanchay, etc. There are traces of cropland terraces dissected by bushed benches with a height of 1,5-2 m.

Special features of mountain-meadow-steppe and steppe landscapes, as well as favorable relief conditions help expand the scope of economic activity on low- and mid-mountain belts of Greater Caucasus. Also, favorable relief plots with humid and semi-humid climates (Gusar, Guba, Shabran, Shemakha, etc. regions) are widely used under rainfed farming (grain-growing, viticulture, potato, sunflower, etc.). However, steep slopes are unfavorable for farming development while more arid low-mountain zones of Greater Caucasus are used as pastures. Note that Gobustan and Jeyranchol – Ajinohur low hill-terrains are valuable winter pastures to boost the cattle-breeding.

To protect soil erosion, optimize natural environment and rationally use resources of meadow-forest, shrubby and shrubby-steppe landscapes of low-hill-terrain and middle altitude employed as pastures and hayfields, it is essential to prohibit the forestation of native fruit, berry trees and shrubs, such as pear, cornel, hawthorn, buckthorn, barberry, etc. (Prilipko, 1970). The creation of forest-shelters and trees farming of steep slopes is expected to improve moisture contents and prevent erosion while utilization of their fruits in canning, as was the case in the 1960-s, will boost the economy growth of these regions.

It is worth pointing out that the semi-arid complex is also widely developed in low-mountain part of South-Eastern Caucasus within the limits of the eastern part of Lengebiz ridge; in the southern and eastern parts of Gobustan, Absheron peninsula, as well as in the lower belt of the north-eastern slope of Greater Caucasus in interfluve area of Sumgait and Atachay. Region’s total area on south-eastern mersion of Greater Caucasus at absolute altitudes of 200 m and 600 m is approx. 6000 sq. m (Budagov, Mikailov, 1985). However, this type of landscape reaches absolute altitudes of 900-1000 m.

Of interest is the fact that semi-arid landscapes are widely developed within the limits of Jeyranchol-Ajinohur low-hill terrains to embrace altitude range of low mountains from 150-200 to 300-400 m even despite the fact that their upper bounds shift toward absolute altitudes of 500-600 m (Mikailov, Garibov,1987). Owing to the orogeomorphological structure, similar landscapes were formed in the central part of Ajinohur basin with lakeside territories from 108 m (level of Ajinohur Lake) to 140-150 m of absolute altitude, as well as in the southern slope of Hodjashen (Aharbahar) ridge with its intensive arid denudation to form badland and clayey carst.

Owing to intensive reclamation, concentration of populated localities and wide irrigation work started 3, 000 years ago, the prehistoric natural concept of semi-arid landscapes and their spatial arrangement underwent transformations into various agro-landscapes. It ought to be noted that territories of semi-arid low mountain landscapes of Azerbaijan are widely used as spring-autumn pastures and, with consideration to favorable relief and water supply there is developed agriculture and horticulture, mainly wine-growing.

Also, semi-arid landscapes span wide territories of sloping plains and low-hill terrains of noted for sharp aridity. Typical features of anthropogenic impact on semi-arid ge-complexes are, in the first turn, dependent upon a level of development and directions of agriculture. Under conditions of irrigated farming and horticulture, natural landscapes are replaced by various configurations of anthropogenic modifications.

It is worth citing that inside the semi-arid landscape type there are not territories, uninfluenced to one degree or another, to anthropogenic effect. As a result of active anthropogenic effect, the semi-arid complexes of Sadarak, Tananam, Sharur, Kengerli, Boyukduz, Julfa and coarse topography of sloping plains were transformed into varied degree of stability of agro-irrigation landscapes. To sum up, about 80% of agro-irrigation landscapes of the Nakhchivan Autonomous Republic are formed exactly on semi-arid landscape territories.

Various garden-plots embrace more than 15, 000 ha territory located on landscape units of semi-arid and dry steppes on leveled slopes, broad river valleys and sloping plains. Above 50% of cultivable areas (more than 70, 000) - stepped mountain-meadow landscapes with xerophytes are used as hayfields and semi-deserts and dry steppes as winter pastures. Owing to intensive reclamation, winter and summer pastures are on the downward path. Contributing to desertification process is the reduction of biological potential of summer and winter pastures and hayfields.

CONCLUSION

Normalization of anthropogenic effect is a principal measure aimed at preventing desertification. Note that the cattle grazing in main pastures of the region occurs 3-5 the rate. Under conditions of arid climate the intensive cattle grazing impairs the slope stability, raises degradation and creates new desertification areas. To regulate anthropogenic loading level on pastures, it is essential to operate an appropriate system in cattle grazing. Suspension of pastures helps restore the lost biological productivity. Besides, water supply of pastures and creation of artificial irrigation systems improves ecological conditions of landscape complexes. Note that unrestricted felling of trees and shrubs leads to the creation of potential centers of desertification processes. Thus, unrestricted felling of trees and shrubs lead to the following: soils fail to retain moisture, activities of surface waters are intensified and sheet flood is triggered. Also, high intensity leaching results in destruction of roots of cut grass and shrubs, so lands change into intensive desertification centers. That's why it is necessary to impose clampdown on felling trees and shrubs.

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CHANGE OF THE QUANTITY OF MICROORGANISMS IN IRRIGATED MEADOW-GRAY SOILS UNDER THE INFLUENCE OF BIOHUMUS AND ZEOLITE

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The main goal of the study is to study the dynamics of the effect of different rates of biohumus and zeolite on the amount of microorganisms under beans in irrigated meadow-gray soils. The research object is irrigated meadow-gray soils (Irragic Calsisols) of the subtropical zone, bean-mung bean (Vigna Angularis) plant. Scheme of the experiment: 1. control; 2. biohumus 5 t/ha; 3. zeolite 5 t/ha; 4. biohumus 5 t/ha + zeolite 5 t/ha; 5. biohumus 7.5 t/ha; 6. zeolite 7.5 t/ha; 7. biohumus 7.5 t/ha + zeolite 7.5 t/ha.

Biohumus and zeolite caused a significant change in the ratio of physiological groups to the total amount of microorganisms in irrigated meadow-gray soils. It was 55.3% bacteria, 19.8% spore-producing bacteria, 24.6% actinomycetes, and 0.2% microscopic fungi of the total amount of microorganisms in the 0-25 cm layer in the control option; in the biohumus 5 t/ha option: 56.4%; 20.2%; 23.2% and 0.2%, in zeolite 5 t/ha option: 62.5%; 15.9%; 21.3% and 0.2%, in biohumus 5 t/ha + zeolite 5 t/ha option; 59.7%, 18.7%; 21.4%, and 0.2%, in the biohumus 7.5 t/ha – 62.7%; 16.3%; 20.7% and 0.2%, in the zeolite 7.5 t/ha – 62.0%; 17.1%; 20.7% and 0.3%, in the biohumus 7.5 t/ha + zeolite 7.5 t/ha – 61.5%; 17.1%; 21.2% and 0.2%. The application of different doses of biohumus and zeolite alone and in combination created favorable conditions in the soil compared to the control, resulting in a decrease in the percentage of sporulating and actinomycetes from the total amount of microorganisms. Although the application of biohumus and zeolite significantly affected the number of bacteria and actinomycetes, no significant change was observed in the amount of microscopic fungi. The intensity of mineralization in irrigated grass-gray soils varied from 0.26 to 0.45 in all options. The intensity of mineralization was higher in the control.

Key words: *irrigated meadow-gray soils, biohumus and zeolite, fertilizer rate, bean plant, microorganisms*

INTRODUCTION

In modern intensive farming, the issues of increasing soil fertility and improving microbiological diversity of soil by enriching it with organic substances are becoming more and more urgent [4]. The main role in biomonitoring and biodiagnostics of soils is given to biological activity, namely, the microbial population of the soil carries out the transformation of organic matter and the formation of the humus layer, participates in the process of self-regulation of the soil, determines the fertility and ecological status of the soil [8]. A constant presence of fresh organic matter in the soil is an important condition for the vital activity of soil microorganisms and the normal development of plants. In order to transition to a more sustainable farming system, it is necessary to look at the soil as a living ecosystem, a living organism, where the process of synthesis, such as the breakdown of organic matter and the release of energy, takes place without interruption [2]. The indicators of the complex activity of enzymes and microbes in the soil can be considered a diagnostic indicator, due to which it is possible to detect negative changes in the environment at the initial stage [8]. Cultivation of land and its use under various agricultural crops affect the quantity and quality of microorganisms along with the properties of the soil. Evaluation of the functional diversity of microorganisms is one of the important indicators of soil quality [7]. Soil microorganisms are the main factors that carry out the mineralization and decomposition of organic substances of the soil with the help of the enzymes they secrete, and put them into a form that can be assimilated by plants [5].

The main goal of the work is to study the dynamics of the effect of the application of biohumus and zeolite on the amount of microorganisms in the irrigated meadow-gray soils under the bean plant cultivated in the Shirvan plain, which is characterized by a dry subtropical climate.

MATERIAL AND METHODS

The research work was carried out in 3 replicates with small bean-mung bean (Vigna Angularis) plant in irrigated meadow-gray soils (в WRB - Irragic Calsisols) at the Ujar Strong Point of the Institute of Soil Science and Arochemistry of the Ministry of Science and Education of the Republic of Azerbaijan. Scheme of the experiment: 1. control (without fertilizer) 2. biohumus 5 tons/ha; 3. zeolite 5 tons/ha; 4. biohumus 5 tons/ha + zeolite 5 tons/ha; 5. biohumus 7.5 tons/ha; 6. zeolite 7.5 tons/ha; 7. biohumus 7.5 tons/ha + zeolite 7.5 tons/ha. Soil samples for the determination of microorganisms were taken from the crop (0-25 cm) and under-crop (25-50 cm) layers during the bean plant's vegetation period (mass development, flowering and biological maturity). The total amount of bacteria on fleshy-peptone-agar (EPA), the amount of mineral nitrogen-using bacteria on starch-ammonia-agar (NAA), the amount of actinomycetes on starch-agar-agar (NAA) and the amount of microscopic fungi by planting on Capek agar (acidified) medium USSR EA. It was determined according to the methodology adopted at the Institute of Microbiology (Moscow) and was carried out in three replicates. Mathematical-statistical calculation and dispersion analysis of the received actual numbers were carried out with Microsoft Excell 2016 Anova program.

The mathematical calculation of the obtained results was carried out in the program using a standard program, their average values and standard errors were given with a probability of P=0.95.

RESULTS AND DISCUSSION

The formation of the microbial complex, their quantity and diversity directly depends on the conditions of the soil environment, soil fertility indicators, as a result, all groups of microorganisms react to any changes that occur in the soil. It is known that the amount of microorganisms in the soil is constantly changing, however, any soil cover has its own microbiota, which can maintain the current state even if the supply of these microorganisms in the soil is not provided with the energy necessary for their continuous reproduction. This is mainly determined by the characteristics of the soil and the environmental factors affecting it [8].

The application of different doses of biohumus and zeolite showed an effect on the amount of physiological groups along with the amount of microorganisms. During the research years, the amount of bacteria in the control option in the 0-25 cm layer was 1010-1157 in the spring, decreased to 962-1026 in the summer, and increased to 985-1089 in the autumn, 1225 in the biohumus 5 tons/ha option, respectively; 1090 and 1125, zeolite 5 tons/ha –1212; 1028 and 1113; biohumus 5 tons/ha + zeolite 5 tons/ha – 1411; 1282 and 1357; in biohumus 7.5 tons/ha version – 1555; 1393 and 1415; zeolite 7.5 tons/ha option – 1470; 1258 and 1325 and biohumus 7.5 tons/ha + zeolite 7.5 tons/ha – 1571; 1407 and 1410 thousand g/soil, the amount of bacteria in the subsoil layer (25-50 cm) was less than in the sown layer. The obtained results show that the amount of bacteria is higher in spring - during the initial growth period of the plant, but with the increase in temperature and decrease in humidity in summer, their amount decreased significantly, and changed in the direction of increase again in autumn. The amount of bacteria under beans with 95% probability fluctuated in the range of 989-1535 thousand in the 0-25 cm layer and 827-1416 thousand g/soil in the 25-50 cm layer. Calculations show that the sum of squares of between-group variance is 1593644, the sum of squares of within-group variance is 409572.9, and the total variance is 2003217, $F_{fac} > F_{cric}$ (36.31>26.6) for all variants, that is, there is a significant difference between all variants.

During the activity of soil microorganisms, they are affected by abiotic, biotic, anthropogenic and technogenic factors. Observations show that with the reduction of organic matter, the reduction of the totality of microorganisms occurs in a regular manner. In the initial period of decomposition of plant residues, bacteria and fungi that do not produce spores develop, then the number of bacilli and actinomycetes increases [8].

Mathematical-statistical calculation of the amount of sporulating bacteria under vegetable beans was carried out and the results were as follows: 359±94 in the control option in the 0-25 cm layer, 359±39 in the variant biohumus 5 tons/ha option, 310±34 in the variant 5 tons/ha zeolite option, in the variant biohumus 5 tons/ha + zeolite 5 tons/ha – 411±35, in the variant biohumus 7.5 tons/ha – 370±32, in the variant zeolite 7.5 tons/ha – 386±30 and biohumus 7.5 tons/ha + zeolite 7.5 tons/ha in the variant – 410±43, 211±37 in the 25-50 cm layer; 220±27; 274±24; 268±29; 248±42; 217±20 and 236±39 thousand g/soil (table). The amount of bacteria under beans with 95% probability fluctuated in the range of 264-453 thousand in the 0-25 cm layer and 175-275 thousand g/soil in the 25-50 cm layer. The results of one-factor dispersion analysis show that the sum of squares of between-group variance is 66294.44, the sum of squares of intra-group variance is 123687.6, and the total variance is 189982, Ffac>Fcric (5.00>26.6) for all variants.

The amount of actinomycetes under beans in the irrigated meadow-gray soils in the crop layer (0-25 cm) in the control in spring is 403-478, in the biohumus 5 tons/ha variant, 397-454, in the zeolite 5 tons/ha variant – 367-423, biohumus 5 tons/ha+ zeolite 5 tons/ha variant – 328-403, biohumus 7.5 tons/ha variant – 307-353, zeolite 7.5 tons/ha variant – 323-386 and biohumus 7.5 tons/ha + zeolite 7.5 tons/ha variant – 312-387, 389-478 corresponding to summer; 453-476; 434-516; 364-409; 465-513; 453-495 and 437-498, autumn – 364-423; 386-438; 361-406; 259-335; 423-478; It was 417-464 and 396-447 thousand g/soil, the amount in the sub-soil layer (25-50 cm) was comparatively less. Researchers show that the change in the amount of actinomycetes towards summer in all variants is due to the decrease in humidity [34, p.10], the relatively high activity of actinomycetes was in summer, but depression in bacteria was observed during that period [2]. Various enzymes secreted by microscopic fungi carry out mineralization of organic residues [1].

The amount of actinomycetes under beans with 95% probability fluctuated between 391-468 thousand in the 0-25 cm layer and 220-365 thousand g/soil in the 25-50 cm layer. The results of one-factor dispersion analysis show that the sum of squares of between-group variance is 37929, the sum of squares of intra-group variance is 111214, and the total variance is 149142, Ffac>Fcric (3.58>26.6) for all variants. The results of the analysis of variance show that there is a statistically significant difference between the compared options according to the mean quantity.

In irrigated meadow-gray soils, the amount of microscopic fungi under the bean plant in the spring in the 0-50 cm layer is 3.5-3.6 in the control, in the biohumus 5 tons/ha option - 4.3-4.7, in the zeolite 5 tons/ha option - 4.9-5.1, biohumus 5 tons/ha+ zeolite 5 tons/ha option – 5.0-5.6, biohumus 7.5 tons/ha option – 5.3-5.8, zeolite 7.5 tons/ha option – 6.0-6.4 and biohumus 7.5 tons/ha + zeolite 7.5 tons/ha option – 6.3-6.5, 1.8-2.3 respectively in a layer of 25-50 cm; 2.3-2.8; 2.6-2.7; 2.5-2.7; 2.5-2.8; 2.7-2.9 and 2.8-3.0; in summer – 3.1-3.5; 4.0-4.4; 4.5-4.8; 4.7-4.8; 4.5-5.2; 5.5-5.7 and 5.7-5.8; 3.1-3.5 in autumn; 4.2-4.6; 4.6-5.2; 4.8-5.3; 4.8-5.6; It changed in the range of 5.8-5.9 and 5.9-6.2 thousand g/soil.

The amount of microscopic fungi in the subsoil layer was characterized by spring and autumn maximum and summer minimum according to the crop layer, but the quantity was less compared to the crop layer [3].

The amount of microscopic fungi under beans with 95% probability fluctuated between 3.3-6.3 thousand in the 0-25 cm layer and 1.7-2.9 thousand g/soil in the 25-50 cm layer. The results of one-factor dispersion analysis show that the sum of squares of between-group variance is 44.469, the sum of squares of intra-group variance is 4.88, and the total variance is 49.349, Ffac>Fcric (85.05>26.6) for all variants. The results of the analysis of variance show that there is a statistically significant difference between the compared options according to the mean quantity.

Thus, the total amount of microorganisms in the 0-25 cm layer compared to the control is 6.6% (121 thousand) in the biohumus 5 tons/ha option, 1.6% (30 thousand) in the zeolite 5 tons/ha option, biohumus 5 tons/ha+zeolite 5 tons/ha 17.5% (319 thousand) in the option of biohumus 7.5 tons/ha – 25.1% (457 thousand), in the option of zeolite 7.5 tons/ha – 20.2 (367 thousand) and in the option of biohumus 7.5 tons/ha + zeolite 7.5 tons/ha – 27.2% (495 thousand), 10.7% (145 thousand), 11.8% (160 thousand), 23.1% (312 thousand), 25.5% (345 thousand), 26.8% (372 thousand) and 40.7% (551 thousand) and was more in the upper layers (0-25 cm) than in the lower layers (25-50 cm) (tabl).

Changes in the amount and composition of microflora along the soil profile directly depend on the amount of humus, nitrogen, phosphorus and other biogenic elements. Thus, with the decrease in the amount of humus and other elements along the profile, a decrease in the amount of microorganisms was also observed [6].

The use of biohumus and zeolite caused a significant change in the ratio of physiological groups to the total amount of microorganisms in irrigated meadow-gray soils. Bacteria 56.9-65.7%, sporulating bacteria 15.6-19.7%, actinomycetes 18.6-23.2%, and microscopic fungi 0.1-0.2% of the total amount of microorganisms in the 0-25 cm layer in the control option, 60.4-68.4% in the biohumus 5 tons/ha option, respectively; 14.7-16.8%; 16.8-22.6% and 0.1-0.3%, zeolite 5 tons/ha version 60.4-67.2%; 16.8-18.1%; 14.5-22.6% and 0.2-0.3%, 63.1-67.9% in biohumus 5 tons/ha + zeolite 5 tons/ha option; 16.1-19.2%; 15.9-17.4%, and 0.1-0.2%, biohumus 7.5 tons/ha option – 63.9-69.1%; 14.4-16.2%; 18.7-20.7% and 0.1-0.2%, zeolite 7.5 tons/ha - 61.8-70.3%; 12.8-17.6%; 18.0-20.7% and 0.1-0.3%, biohumus 7.5 tons/ha + zeolite 7.5 tons/ha – 63.2-70.3%; 12.4-17.7%.

Table

Amount of microorganisms in irrigated meadow-gray soils, per thousand gram/soil

Various	Depth, sm	Amount of microorganisms, thousand gram /dry soil				
		bacteria	bacteria with spores	actino-mycetes	microscopic fungi	amount microorganisms
Control	0-25	989-1083	264-453	391-453	3.3-3.5	1820
	25-50	827-951	175-248	220-281	1.7-2.1	1353
	0-50	963	285	337	2.7	1588
Biohumus 5 t/ha	0-25	1093-1200	321-398	407-455	4.2-4.5	1941
	25-50	966-1084	193-246	225-278	2.0-2.4	1498
	0-50	1086	290	342	3.3	1720
Zeolite 5 t/ha	0-25	1045-1191	276-344	381-454	4.6-5.0	1850
	25-50	963-1072	250-297	193-245	2.5-2.7	1513
	0-50	1068	292	319	3.7	1682
Biohumus 5 t/ha + zeolite 5 t/ha	0-25	1294-1406	376-446	327-419	4.8-5.3	2139
	25-50	1059-1201	239-298	244-286	2.4-2.6	1665
	0-50	1240	340	319	3.8	1903
Biohumus 7.5 t/ha	0-25	1386-1522	338-402	414-482	5.0-5.6	2277
	25-50	1115-1264	206-290	254-309	2.4-2.7	1722
	0-50	1322	309	365	4.0	2000
Zeolite 7.5 t/ha	0-25	1275-1428	357-416	417-470	5.6-6.0	2187
	25-50	1098-1290	197-237	255-314	2.4-2.8	1698
	0-50	1273	302	364	4.2	1943
Biohumus 7.5 t/ha + zeolite 7.5 t/ha	0-25	1390-1535	366-453	404-468	5.8-6.3	2315
	25-50	1250-1426	197-275	289-365	2.7-2.9	1904
	0-50	1401	323	382	4.4	2110

It varied between 17.2-18.8% and 0.1-0.2%. It should be noted that the single and complex application of different doses of biohumus and zeolite created favorable conditions in the soil compared to the control, resulting in a decrease in the percentage of sporulating and actinomycetes from the total amount of microorganisms.

CONCLUSION

The total amount of bacteria and microorganisms in irrigated meadow-gray soils was characterized by spring and autumn maximum and summer minimum.

The amount of spore-producing bacteria was observed to increase from the beginning to the end of vegetation.

The number of actinomycetes was higher in summer than in spring and autumn.

The amount of microscopic fungi was less in summer than in spring and autumn.

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EFFECT OF FERTILIZER RATES ON DYNAMICS OF EXCHANGEABLE POTASSIUM (K_2O) IN CHESTNUT SOILS OF MOUNTAINOUS SHIRVAN

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The main agrochemical indicators of the light-chestnut soils of the Mountainous Shirvan have been studied. According to the results, the depth of 0-25 cm of the experimental area is weakly alkaline, and the depth of 25-50 and 50-70 cm is highly alkaline. The tillage layer of the experimental area soils is carbonate, and the deep layers are medium carbonate. Because the amount of calcium carbonate at a depth of 25-50 and 50-70 cm changes between 15.50-17.30% on average. The soils of the experimental field are of medium quality. The total amount of humus in the tillage layer changes between 2.22 and 2.29%. The analysis shows that the average amount of easily hydrolyzed nitrogen at a depth of 0-25 cm varied between 52 and 74 mg per 1 kg of soil. The amount of active phosphorus was 30.5-33.3 mg/kg at a depth of 0-25 cm during 2 years, and the amount of variable potassium was 274-297 mg/kg, which gradually decreased in the lower layers. The dynamics of potassium in soil were determined in relation to the growth stages, sowing, and fertilizer rates of the "Jalilabad 19" barl*ey variety.*

Keywords: *soil, fertilizer, plant, barley, potassium*

INTRODUCTİON

Disease resistance, grain feed quality, lodging resistance, yield, and economic efficiency of the barley plant depend on the biological characteristics of the variety, as well as the degree of supply of the plant with exchangeable potassium during vegetation.

According to the literature, when the plant is not normally supplied with potassium during vegetation, that is, when there is a lack of potassium in the main phases of the plant's development, metabolism is disturbed, the strength of the stem decreases, the tendency to lodging increases and productivity decreases [Zamanov P.B., 2013, p.266].

In 2014-2015, research conducted with winter wheat in light-chestnut soils of Mountainous Shirvan, partially supplied with moisture, revealed that the amount of exchangeable potassium in the soil varies depending on the fertilizer rate and plant development phases. According to the authors, the amount of exchangeable potassium in the plow layer of the soil ranged between 315 and 356 mg/kg in the tillering stage, 239 and 285 mg/kg in the milk ripeness stage, and 221 and 233 mg/kg in the full ripeness stage depending on the fertilizer type. Thus, different changes occurred depending on the growth phases of the plant. Depending on the rates and proportions of fertilizers, the increase compared to control ranged between 22 and 44 mg/kg, 12-26 mg/kg, and 5-12 mg/kg in the tillering, milk ripeness, and full ripeness stages, respectively. The reduction of the difference compared to the control from 22-41 mg/kg to 5-12 mg/kg from the tillering stage to the full ripeness stage depending on the fertilizer rates is mainly related to the assimilation of exchangeable potassium by the above-ground biomass of the plant [Nuriyeva M.M., Hajimammadov I.M., et al., 2016, pp.304-308].

According to some authors, the amount of easily assimilated forms of the main nutrients in the soil depends on moisture, the rate and ratio of nutrients, and the technology of applying fertilizers [Nikitishen V.I., 2013, pp.18-25; Nikitishen V.I., 2012, p.486].According to the literature data, the amount of the main nutrients under the barley plant depends on the moisture of the soil, the predecessor plant, and the rate and ratio of applied fertilizers [Nikitishen V.I., 2012, p.486].

In the research conducted by the employees of the Research Institute of Crop Husbandry in the chestnut soils of Mountainous Shirvan partially supplied with moisture, the amount of exchangeable potassium in the soil decreased from 321 mg/kg to 198 mg/kg in the control variant from tillering to full ripeness. In the tillering phase, the amount of exchangeable potassium in full fertilizer rates was 11-15 mg/kg higher than in the control variant [Hajimammadov I.M., Valiyeva S.R., 2013, pp. 235-238].

MATERİALS AND METHODS

The study was conducted with the "Jalilabad-19" intensive barley variety in chestnut soils of the Gobustan Regional Experimental Station of the Research Institute of Crop Husbandry.

The main goal was to determine the effect of sowing and fertilizer rates on the accumulation of above-ground biomass product, nitrogen transport with biomass product, and productivity of the "Jalilabad-19" barley variety depending on the development phases, and to recommend effective sowing and fertilizer rates for farms. The experiments were carried out at the 3 sowing rates: 120 kg/ha, 140 kg/ha və160 kg/ha; and in 4 nutrition rates: 1. Control (without fertilizer), 2. $N_{30}P_{30}K_{30}$, 3. $N_{45}P_{45}K_{45}$, 4. $N_{60}P_{45}K_{45}$. Each section was 44-50 m^2 and trials were performed in 4 replicates.

The annual rate of phosphorus-potassium fertilizers and 30% of the annual rate of nitrogen fertilizer were given before sowing and 70% of the nitrogen fertilizer was applied in the form of feeding in early spring.

Before sowing, soil samples were taken following the methodology to determine the agrochemical parameters of the trial area without fertilizer [Dospekhov B.A., 1985, 351 p.].

RESULTS AND DİSCUSSİON

According to the results of the analysis, depending on the research years, the pH at the depth of 0-25 cm of the field was 8.28-8.31, and at the depth of 25-50 and 50-70 cm, it varied in the range of 8.46 - 8.58 and 8.60-8.68, respectively. This shows that the depth of 0-25 cm of the field is weak alkaline, and the depth of 25-50 and 50-70 cm has high alkaline property. The area is carbonated, depending on the research years, the amount of calcium carbonate varies between 4.31 and 12.96% at the depth of 0-25 and 25-50 cm, and between 15.50-17.30% at the depth of 50-70 cm, i.e. 0-25 and 25-50 cm depth is moderately carbonated, and 50-70 cm depth is highly carbonated.

The amount of total humus and total nitrogen is 2.22-2.29 and 0.156-0.159%, respectively, at the depth of 0-25 cm, and decreases naturally in the lower layers.

Supplying the plant with basic nutrients during vegetation, determination of fertilizer rates and efficiency depend on the reserve of easily assimilated forms of basic nutrients (nitrogen, phosphorus, and potassium) in the soil. Depending on the years of research in the trial area, the amount of easily hydrolyzable nitrogen at a depth of 0-25 cm varied from 52 to 74 mg per kg of soil, mobile phosphorus from 30.5 to 33.3 mg, and exchangeable potassium from 274 to 297 mg. As can be seen from the research results, the area is moderately supplied with phosphorus and poorly supplied with potassium.

Therefore, we determined the amount of exchangeable (easily assimilated) potassium (K_2O) in the plow layer (0-25 cm) depending on the sowing and fertilizer rates in the main development phases of the "Jalilabad 19" barley variety. The results of the analysis showed that the amount of exchangeable potassium in the plow layer (0-25 cm) varied depending on the fertilizer rates in the phases of plant development.

In the control variant, the three-year average amount of exchangeable potassium was 366 mg/kg at the sowing rate of 140 kg/ha in the tillering phase. This parameter in the $N_{30}P_{30}K_{30}$, $N_{45}P_{45}K_{45}$, and $N_{60}P_{45}K_{45}$ fertilizer rates amounted to 385 mg/kg, 394 mg/kg, and 392 mg/kg, respectively. The amount of exchangeable potassium in the soil was 20-26 mg/kg higher than the control, depending on the ratio of mineral fertilizer rates.

At the sowing rate of 140 kg/ha, the amount of potassium in the $N_{30}P_{30}K_{30}$ variant compared to the control decreased by 7 mg/kg in the milk ripeness phase, but the difference was relatively high in the $N_{45}P_{45}K_{45}$ and $N_{60}P_{45}K_{45}$ fertilizer rates. In the full ripeness phase, the amount of exchangeable potassium in the soil with the application of mineral fertilizers was 7-12 mg/kg higher than in the control. The minimum increase was obtained at the $N_{60}P_{45}K_{45}$ fertilizer rate of 7 mg/kg. According to the research results, when the sowing rate was increased from 120 kg/ha to 160 kg/ha, the amount of exchangeable potassium in the soil decreased (except for the full ripeness phase). The difference in tillering and milk ripeness phases was 6 and 7 mg/kg, respectively.

Table 1.

Dynamics of exchangeable potassium (K_2O) in chestnut soils of Mountainous Shirvan mg/kg (three-year average)

Trial scheme		Depth	Three-year average		
Sowing rate	Fertilizer rate		Tillering	Mılk ripeness	Full ripeness
120	Nəzarət	0-25	366	288	263
	$N_{30}P_{30}K_{30}$	0-25	385	295	268
	$N_{45}P_{45}K_{45}$	0-25	394	313	271
	$N_{60}P_{45}K_{45}$	0-25	392	311	271
140	Nəzarət	0-25	367	285	261
	$N_{30}P_{30}K_{30}$	0-25	386	290	266
	$N_{45}P_{45}K_{45}$	0-25	393	308	273
	$N_{60}P_{45}K_{45}$	0-25	390	305	268
160	Nəzarət	0-25	360	281	261
	$N_{30}P_{30}K_{30}$	0-25	386	286	268
	$N_{45}P_{45}K_{45}$	0-25	394	306	272
	$N_{60}P_{45}K_{45}$	0-25	393	302	267

Statistical analyses of the effect of fertilizer rates on the amount of exchangeable potassium were carried out in the soil in different development phases of the "Jalilabad-19" barley variety.

Table 3.

Dispersion analysis of the influence of fertilizer rates on the dynamics of exchangeable potassium (K_2O) in the soil during the development phases of the "Jalilabad 19" barley variety

İnkişaf fazaları	Factors	Df	SS	MS	F
Tillering, %	Fertilizer rate	3	4890.89	1630.30	42.307 **
	Error	32	1233.11	38.54	
	Total	35	6124.00		
Milk ripeness, %	Fertilizer rate	3	3703.19	1234.40	22.449**
	Error	32	1759.56	54.99	
	Total	35	5462.75		
Full ripeness, %	Fertilizer rate	3	536.33	178.78	19.183**
	Error	32	298.22	9.32	
	Total	35	834.56		

NS: Non-significant
*: 0.05 significant at the probability level
**: 0.01 significant at the probability level

According to the dispersion analysis (Table 3), there is a significant difference in the effect of the rate of fertilizer on the dynamics of exchangeable potassium (K_2O) in the soil in different growth phases of the plant at the 0.01 probability level. This shows that the change in the rate of fertilizer affects the amount of exchangeable potassium (K_2O) in the soil.

Table 4.

Dispersion analysis of the effect of fertilizer rates on the amount of exchangeable potassium (K2O) in the soil at different development phases according to the Duncan model

Factors	Average values							
	Tillering			Mılk ripeness		Full ripeness		
	1	2	3	1	2	1	2	3
$N_{00}P_{00}K_{00}$	364.11			284.56		261.44		
$N_{30}P_{30}K_{30}$		385.56		290.56			267.22	
$N_{60}P_{45}K_{45}$			391.67		305.78		268.78	
$N_{45}P_{45}K_{45}$			393.33		308.78			272.11

a. Average value used = 9.000
b. Alpha = 0.05

Table 4 shows the results of the dispersion analysis of the fertilizer rate effect on the amount of exchangeable potassium in the soil according to the Duncan model in different development phases of the "Jalilabad-19" barley variety. Thus, the amount of exchangeable potassium in the soil was relatively high in the $N_{45}P_{45}K_{45}$ and $N_{60}P_{45}K_{45}$ fertilizer rates in the tillering and milk ripeness phases. However, in the full ripeness phase, this indicator was relatively high in the $N_{45}P_{45}K_{45}$ variant.

CONCLUSİON

The results of field experiments and laboratory analyses revealed that the amount of exchangeable potassium in the soil depends on the rates and proportions of fertilizers. Thus, when increasing the rate of mineral fertilizers from $N_{30}P_{30}K_{30}$ to $N_{45}P_{45}K_{45}$ at the same sowing rate (120 kg/ha), the amount of exchangeable potassium in the soil was larger by 18 mg/kg, and at the sowing rates of 140 kg/ha and 160 kg/ha, it was larger by 18-20 mg/kg in the milk ripeness phase of the plant. No significant difference was observed in the full ripeness phase. When keeping the phosphorus-potassium rate constant and increasing the nitrogen rate from 45 to 60 kg/ha, the amount of exchangeable potassium in the soil decreased at different sowing rates.

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FEATURES OF IDENTIFICATION OF MINERALS USING WorldView-3 HYPERSPECTRAL IMAGES AND THE APPLICATION OF MARKOV RANDOM FIELDS

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INTRODUCTİON

Over the past few years, hyperspectral image collection systems have become very widespread. Extensive and complete spectral information is provided by hyperspectral sensors in the form of hundreds of adjacent bands. Due to the availability of rich spectral information, hyperspectral imaging systems have gained popularity in many fields, including environmental monitoring, medical imaging, defense, food technology, agriculture, Atmospheric Research, geology, and so on. As hyperspectral imaging technologies have developed, the issue of processing or classifying received hyperspectral images has also aroused great interest among researchers. As a result of the classification of hyperspectral images obtained as a result of remote sensing, it is possible to obtain extensive information about soil cover and land use. It predicts a label for each pixel in the image. Classification of hyperspectral images may also be performed out through supervised or unsupervised methods. In the case of the supervised classification, a collection of samples with known labels is used, as these samples are pre-introduced into the processing system, while the unsupervised classification does not require labeled information. The supervised classification methods usually allow to get more accurate results than unsupervised classification ones.

WorldView-3 satellite with hyperspectral characteristics and its capabilities

The Earth's surface obtaining hyperspectral image systems are capable of obtaining images in more than a hundred adjacent spectral bands. Although multispectral images are useful for differentiating the characteristics and landscape patterns of the earth, they do not allow to distinguish and interpret the materials present on the Earth. But hyperspectral drawings are considered the best tool for identifying individual materials and distinguishing them from each other. At the same time, the information obtained from the processing of hyperspectral images allows to characterize such materials. Therefore, this method can be considered a very useful tool for detecting unique objects on an image by evaluating individual pixels, in addition to showing the distribution of materials.

Hyperspectral sensors differ from multispectral sensors in their ability to identify and measure molecular absorption and have many advantages. The high spectral resolution of the hyperspectral scanner allows to detect, identify, quantify surface materials, as well as make conclusions based on biological and chemical processes.

The well-developed areas in which the results of scientific research are most often applied include geology and exploration of minerals, forestry, marine, coastal areas, inland waters and wetland soils, agriculture, ecology, urban, snow and ice, and the atmosphere. There are also numerous military applications for camouflage (masking), mapping of coastal zones and detecting mines.

Location-based signatures collected in the field for these programs and indexed in spectral libraries are essential for many analysis methods. Although image packages often include basic spectral libraries, the application of discrete libraries containing spectra of specific materials encountered in the target area greatly improves the accuracy of the interpretations generated. The spectra of vegetation are affected by such a wide range of environmental conditions that it is difficult to adequately represent this variability without accumulating field-specific field spectra.

WorldView-3 is the first commercial satellite with 16 high-resolution spectral bands collecting data in the visible-near-infrared (VNIR) and short-wave infrared (SWIR) electromagnetic spectrum (EMS) bands. This satellite is capable of acquiring 31-centimeter panchromatic, 1.24-meter VNIR, and 3.7/7.5-meter SWIR resolution images. The SWIR band is capable to collect the 14-bit resolution data.

Such 16 spectral ranges include a number of different and unique characteristics of spectral absorption, called natural signals for materials and minerals, which is of interest to many industries.

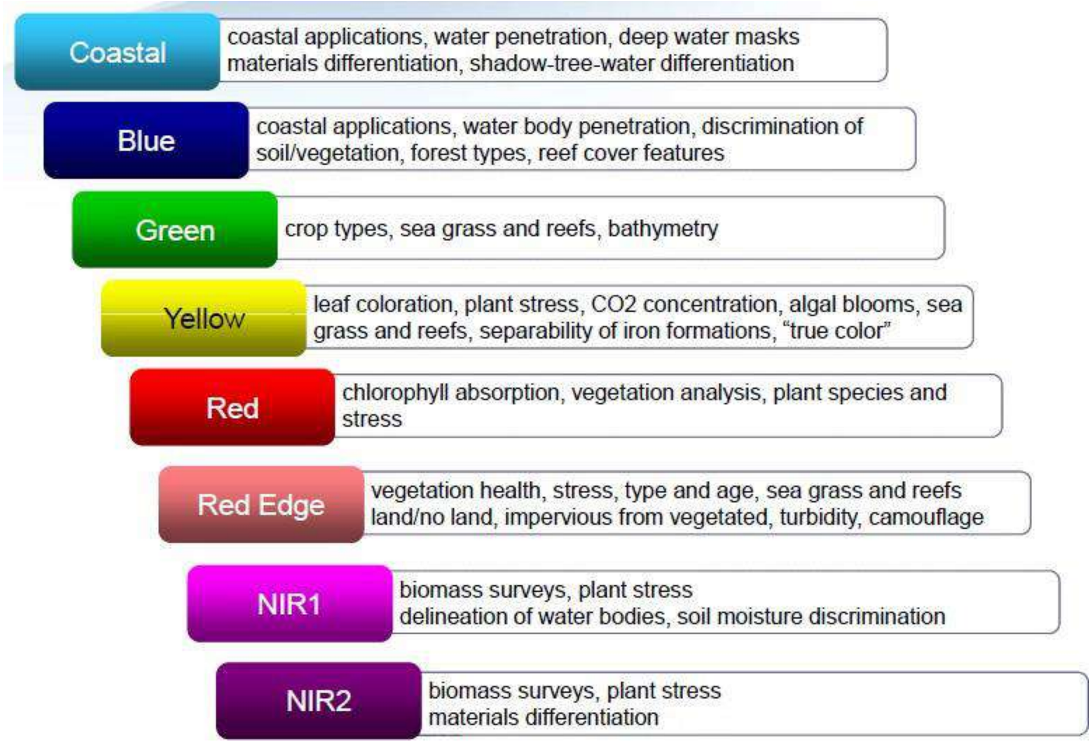
An example of this is the determination of the degree of mineralization of the soil cover. Using these spectral signals serves to improve decision-making in determining the degree of mineralization in the soil.

WorldView-3 is a Maxar imaging and monitoring the environment satellite that launched on August 13, 2014 and is still active. It's extremely similar to WorldView-2, but in a lower orbit.

Orbit Altitude	617 km
Orbit Type	Sun-synchronous
Orbit Period	97 minutes
Revisit Time	1day at 1-metre GSD resolution 4.5 days at 20° off-nadir (0.59 m GSD)
Equator Crossing Time	10:30 am Descending node

Spectral characteristics of the WorldView-3 satellite

Spektral range	**Band name**	**Spectral band**	**GSD (Ground Sample Distance)**
Panchromatic Band (1)	450-800 nm		Nadir: 0.31 m, 20^{0} off-nadir: 0.34
MS (Multispectral) Bands(8)in VNIR (Visible Near Infrared)	Costral Blue	400-450 nm	Nadir: 1.24 m, 20^{0} off-nadir: 1.38
	Blue	450-510 nm	
	Green	510-518 nm	
	Yellow	585-625 nm	
	Red	630-690 nm	
	Red edge	705-745 nm	
	Near-IR1	770-895 nm	
	Near-IR2	860-1040 nm	
Multiband (8 bands) in SWIR (Shortwave Infrared) spectral range	SWIR - 1	1195-1225 nm	Nadir: 3.70 m, 200 off-nadir: 4.10 m
	SWIR - 2	1550-1590 nm	
	SWIR - 3	1640 – 1680 nm	
	SWIR - 4	1710 - 1750 nm	
	SWIR - 5	2145 - 2185 nm	
	SWIR - 6	2185 - 2225 nm	
	SWIR - 7	2235 - 2285 nm	
	SWIR - 8	2295 -2365 nm	
CAVIS bands (12) CAVIS (Clouds, Aerosols, Vapors, Ice, & Snow)	Desert clouds	405 - 420 nm	Nadir: 0.30 m
	Aerosols-1	459 - 509 nm	
	Greens	525 - 585 nm	
	Aerosols-2	620 - 670 nm	
	Water-1	845 - 885 nm	
	Water -2	897 - 927 nm	
	Water -3	930 - 965 nm	
	NDVI-SWIR	1220 – 1252 nm	
	Cirrus	1350 - 1410 nm	
	Snow	1620 - 1680 nm	
	Aerosol-3	2105 - 2245 nm	
	Aerosol-3	2105 - 2245 nm	



Remote sensing application

In addition to spectral signatures, the calculation of vegetation and mineral indices is also an important element for determining the degree of mineralization.

The **Soil Adjusted Vegetation Index (SAVI)** is a vegetation index to minimize the effect of soil brightness by using a soil brightness correction factor. This is often used in dry regions with low vegetation.

SAVI = ((NIR - Red)/(NIR + Red + L)) * (1 + L)

NIR is pixel values in the near infrared range

Red is pixel values in the near red range

Mineral indices. To perform a deeper spectral analysis, the next step is to create mineral indices using a combination of SWIR ranges. These main categories of minerals are considered solid and reliable, as well as many remote sensing specialists are familiar with their importance from ASTER images. Indexing results can be converted to polygonal vectors for export to other mapping programs

Mineral index =(SWIR3+SWIR6)/SWIR5

For example, Alunite=3.79, Jarosite= 2.36.

The near infrared (NIR) and red range they belong to the ranges associated with these wavelengths. L quantity varies depending on the amount of green vegetation. As a rule, in areas without completely green vegetation, L=1, in areas with medium green vegetation, L=0.5, and in areas surrounded by very high vegetation, l=0, which corresponds to the NDVI method.

Contextual information about pixels is important for the analysis of remote sensing images because neighboring pixels are usually correlated.MRF theory is a widely used method for dealing with spatial correlation. The conditional chance that an image pixel is exclusively connected with its neighbors is referred to as the Markov property. Consider B-band hyperspectral imaging.

A pixel is chosen at random and its local energy is determined in the probabilistic relaxation technique. A new label is chosen for the pixel, and a new energy is calculated. If the new energy value is more than the old energy value, the pixel is labeled differently. Otherwise, a new label is likely to be issued. An picture is represented as an undirected graph in the graph cut model, with nodes representing pixels and edges reflecting neighborhood associations. The MRF model approaches this as a maximum flow issue with the goal of minimizing the energy function.

Markov random fields (MRF)

The contextual information of the pixels is important for the analysis of remote sensing images as neighboring pixels are usually correlated. MRF theory is a well-known tool to deal with spatial correlation. Markov property refers to the conditional probability of an image pixel being correlated only to its neighbors. Let us consider a B-band hyperspectral image $X = \{xi \in R\ B, i = 1, 2, \cdots, N\}$ with N pixels and xi be the feature vector of i th pixel. Let $L = \{L_i, i = 1, 2, \cdots, N\}$ be the set of image labels and $\Omega = \{L\}$ is the set of all possible label configurations. MRF model is based on the optimization of an energy function U(xi), which is a combination of two terms namely spectral (U_λ) and spatial (U_S) energies given as follows

$$U(x_i, L_i) = U_\lambda(x_i, L_i) + Us(x_i, L_i) \quad (1)$$

where $U\lambda(xi, Li)$ is the spectral energy that can be obtained from prior probability estimates $P(\cdot)$ as follows

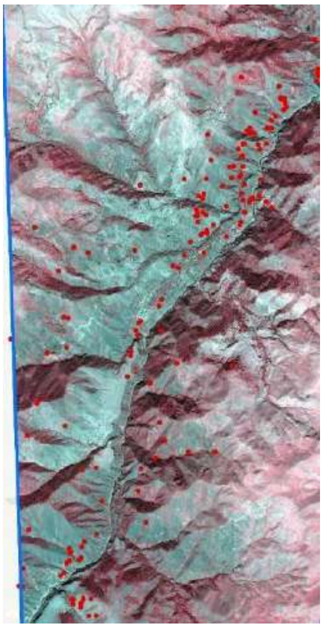
$$U_\lambda(x_i, L_i) = -\log(P(x_i|L_i)) \quad (2)$$

and spatial energy term $Us(xi, Li)$ is determined as follows

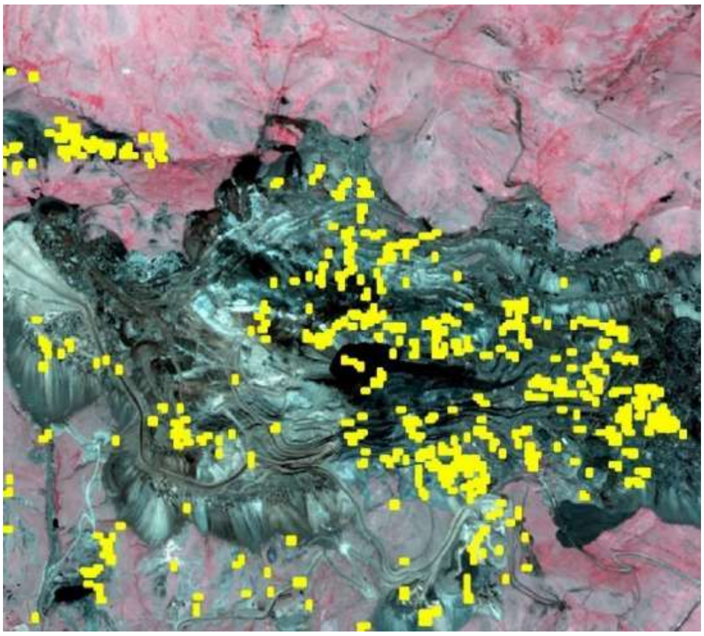
$$U_s(x_i, L_i) = -\beta \sum_{x_j \in C_i} \delta(L_i, L_j)$$

where β is a parameter that controls the contribution of spatial term, Ci represents the set of cliques for the neighborhood system of x_i, and $\delta(\bullet)$ is the Kronecker delta function.

With probabilistic relaxation approach, a pixel is randomly chosen and its local energy is computed. A new label is chosen for the pixel and new energy is determined. If new energy is greater than the original energy value, the new label is assigned to the pixel. Otherwise, the new label is assigned with some probability. In the graph cut model, the image is represented as an undirected graph with nodes representing the pixels and edges representing the neighborhood relationships. MRF model considers it as a maximum flow problem to minimize the energy function.



Detection of Alunite in the WorldView-3 SWIR bands



WorldView-3 Detection of Jarosite in the SWIR bands

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SOIL EROSION IN GANJA, AZERBAIJAN: CAUSES, EFFECTS AND MITIGATION STRATEGIES

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Soil erosion is an important and urgent environmental problem that affects agricultural productivity, ecosystem stability, and water quality. Protection of soils from erosion and the implementation of measures to combat erosion are one of the important issues of effective use of soil resources. aimed at assessing the impact on the local environment, agriculture and society and proposing mitigation strategies. The research work incorporates field observations, analysis of collected data and literature review to provide a comprehensive understanding of the erosion problem. Studies have highlighted the importance of sustainable land management practices to prevent soil erosion and ensure the long-term ecological sustainability of the region. Through a comprehensive review of the existing literature, this paper provides insights into the challenges posed by soil erosion in Ganja and recommendations for sustainable land management practices to combat soil erosion. presented and determined potential solutions to the problem. Soil erosion is divided into two parts: water and wind erosion. Both types of erosion have been determined to seriously damage agricultural production. The result of the research showed that both types of erosion occur in Ganja, but the area of Ganja city is most exposed to wind erosion due to its dry climate and relief characteristics, as a result, the area of fertile land decreases. At the same time, it has been studied that anthropogenic factors, i.e. human construction activity, the expansion of urban areas also cause the formation of the erosion process. Based on the results of the soil research conducted by the State Committee for Real Estate Issues in our country since 2017, the preparation of the erosion map of Ganja city enabled us to more accurately study the parts of the territory where erosion occurs. the factors that caused it, their influence directions were studied and proposals were made for eliminating the negative effects with successful strategies. As a result of the research, strategies such as afforestation and reforestation, terracing, contour farming, protective plowing, cover planting, anti-sediment control measures, and awareness campaigns were determined.

***Keywords**: soil erosion, fertility, sustainable land management, agriculture, reforestation*

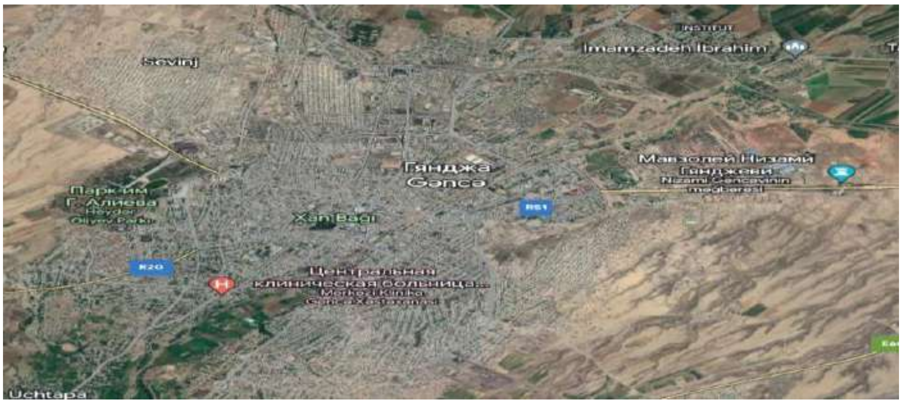
İNTRODUCTİON

Irrational use of soil fertility, water and vegetation by producers of agricultural products has led to the strengthening of the erosion process in the soil. The erosion process causes the diversity of vegetation and soil fertility. Soil erosion is a complex process related to the disintegration of the fertile layer of the soil by means of rain and wind, the separation, transport and deposition of soil particles. The process of mechanical disintegration of soil by water currents is called water erosion, and the process of disintegration and erosion by wind is called wind erosion. Both types of erosion cause serious damage to agricultural production. The main reason for the development of erosion is the improper use of the area by humans, especially the lands where natural conditions are favorable for erosion, and is caused by inadequate land management practices. the soil that has arrived is washed away and dispersed, its fertility decreases, the fields are divided into networks of fields, the useful land areas gradually become unusable, the amount of humus in the soil decreases and its composition changes, the microbiological processes in the soil weaken, the microflora of the soil is subject to change.

Depending on the natural conditions of individual regions of Azerbaijan and anthropogenic influences, the intensity and form of erosion processes have developed to different degrees. The erosion map of Ganja city was prepared based on the results of the soil research conducted by the State Committee for Real Estate Issues in 2017-2020. Soil erosion in Ganja poses a significant threat to the sustainability of agriculture, water resources and the health of the general ecosystem. to investigate the main causes, scope, methodology, and impact of climate change, showing the scale of these effects and emphasizing their negative effects on soil fertility, agricultural productivity, water quality, and increasing the risk of flooding. to develop effective strategies, provide insights for policy makers, land managers and local communities, and design potential solutions to the problem. [3;4]

MATERIAL AND METHODS

Based on the GIS of the research area, geospatial data was determined by us with the help of aerospace materials. e. 46°21′38″ N is located at the coordinate points in the coordinate system, the absolute height of the area is 422 m. (Google Earth, 2022). Climate, relief, geological structure of the area, soil conditions and vegetation cover the natural conditions that affect the development of erosion when the land is not used properly in the economy.



Map 1. Ganja View from Google Earth based on 2022 Orthophoto

Geographical position: The city of Ganja, located at an altitude of 400-450 m above sea level, is located in the west of Azerbaijan, 375 km west of the capital city of Baku, in the north-eastern foot of the Lesser Caucasus, in the Ganja-Gazakh plain in the Kura-Araz plain, on both banks of the Ganjachay river. [5]

Climate: Climate is one of the factors influencing the formation of the erosion process. The climate of the city of Ganja, Azerbaijan belongs to a semi-arid climate with hot summers and relatively mild winters. The typical climate parameters for the area are:

1. Temperature: Summers in Ganja are hot and dry, with average high temperatures (June-August) ranging from 30°C (86°F) to 35°C (95°F). Sometimes during heat waves, temperatures can exceed 40°C (104°F). In September, temperatures begin to gradually decrease, ranging from 25°C (77°F) to 30°C (86°F). October and November bring cooler weather, with average highs falling between about 15°C (59°F) and 20°C (68°F). Winter in Ganja is relatively mild compared to other regions of Azerbaijan. In winter (December to February), the average high temperature ranges from 5°C (41°F) to 8°C (46°F), while the average low temperature ranges from -2°C (28°F) to 2°C (36°F).) in spring (March–May) average temperatures range from about 10°C (50°F) to 15°C (59°F). By May, temperatures range from about 20°C (68°F) to 25°C (77°F).(meteoblue)

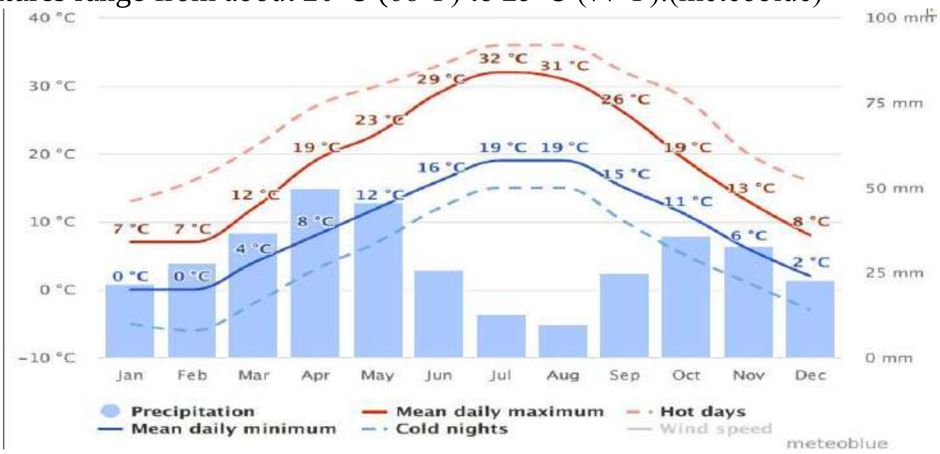


Figure 1. Average temperatures and precipitation in Ganja

The "mean daily maximum" (solid red line) shows the average daily maximum temperature for every month for Ganja. Similarly, "Minimum Average Daily Temperature" (solid blue line) shows the minimum average temperature. Warm Days and Cold Nights (The dotted red and blue lines show the average temperature on the warmest day and coldest night of each month over a 30-year period.

2. Precipitation: The graph shows that precipitation falls in Ganja mainly in spring (March-May) and autumn (September-November). Rainfall increases in autumn, October is the rainiest month. The average annual rainfall is 200-300 mm.

Table 1: Average annual temperature and precipitation in Ganja

Göstərici	Yan	Fev	Mar	Apr	May	İyn	İyl	Avq	Sen	Okt	Noy	Dek	İl
Maksimum orta, °C	6,6	6,3	9,8	16,4	22,1	27,3	30,6	29,7	25,6	19,6	13,5	9,7	18,1
Orta temperatur, °C	7	8,2	12,7	18,7	23,4	31,6	31,1	25,6	26,3	19,5	12,9	8,4	19
Minimum orta, °C	1,8	1,8	2,8	4,2	6,6	9,4	11,4	10,9	9,0	6,4	3,7	1,4	5,8
Mütləq minimum, °C	2,1	2,0	4,2	9,4	14,9	19,7	22,2	22,9	19,4	13,5	8,8	4,8	12,0
Yağıntı norması, mm	8	12	24	31	40	32	17	15	15	24	16	7	241

3. Snowfall: Due to the mild climate in Ganja, snowfall is rare but possible in December-February.

4. Humidity: The relative humidity level in Ganja in summer is higher than in winter months. Humidity varies between 25-30% on average. [1]

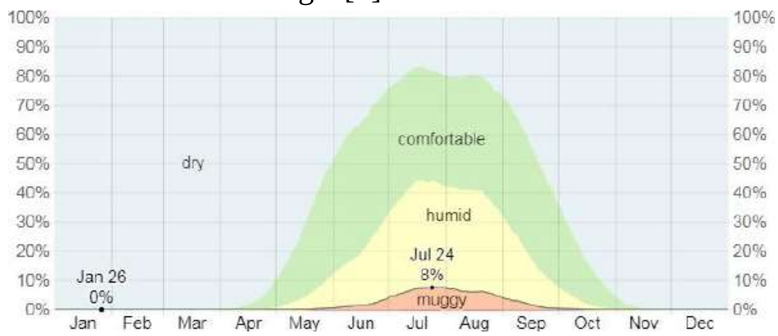


Figure 2. Average annual humidity in Ganja

5. Wind: As can be seen from the graph, the average hourly wind speed in Ganja experiences mild seasonal variation over the course of the year. The windiest part of the year lasts for 3.4 months, from June 6 to September 17, with average wind speeds greater than 6.5 miles per hour.The windiest month of the year in Ganja is July, with an average hourly wind speed of 7.7 miles per hour. [1]

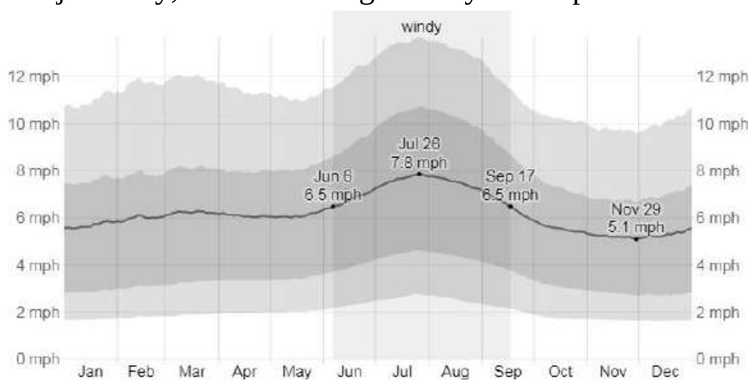


Figure 3. Average wind index in Ganja

It is important to note that these are general climate patterns and actual weather conditions may vary from year to year. For more accurate and up-to-date information, it is recommended to use local weather sources.

These studies were carried out using Google map and Google Earth (coordinates, altitude and area). Climate data reported using Meteoblue and Weatherspark (average high and low temperature, cloud cover, precipitation, tourism account).

Vegetated soils are resistant to erosion. As a result of the effect of vegetation, the soil structure improves. Its washability is increased and waterability is improved.

Since soil erosion is a gradually developing process, it is necessary to take regular measures to combat it. It refers to the complex measures of erosion control: agrotechnical, forest reclamation and hydrotechnical measures.

Agrotechnical measures include using the soil-protecting properties of annual and perennial grasses, applying soil anti-erosion cultivation rules, artificially keeping snow in the field and regulating snowmelt, and agrochemical means of increasing the fertility of eroded soils.

As forest reclamation measures, the construction of forest strips along the slope is envisaged, in other words, it involves the creation of forest plantings with various purposes (windbreak, field protection, gully strengthening, water protection, etc.).

Hydrotechnical measures are implemented as a result of the joint application of agrotechnical and forest reclamation measures. Hydrotechnical measures are applied when other anti-erosion measures are unable to prevent erosion processes. This includes the construction of hydrotechnical facilities that prevent and regulate slope flows, construction of terraces, dams, trenches, etc. is attributed. [3;4]

RESULT AND DİSCUSSİON

During the study of soil erosion in Ganja during our research, it was found that the following factors cause soil erosion in the area:

• Rainfall and Runoff - Heavy rainfall events and inadequate infiltration of water can lead to increased runoff, which erodes topsoil and carries away valuable nutrients.

• Wind erosion- Ganja's flat topography and dry climatic conditions make the region prone to wind erosion, resulting in the loss of fertile soil.

• Human causes- Deforestation and removal of vegetation: Deforestation and removal of vegetation accelerates soil erosion by directly exposing the soil surface to rain and wind.

• Unsustainable agricultural practices- Improper ploughing, overgrazing, excessive pesticide and fertilizer use and inadequate crop rotation lead to soil degradation and erosion

• Urbanization and construction—expansion of urban areas and construction activities increase soil sealing, reduce water infiltration, and promote erosion.

Photo 1.Eroded soil

We have defined the directions of soil erosion in Ganja as follows:

▪ Agriculture- As soil erosion causes a decrease in soil fertility, water holding capacity and nutrient content, agricultural productivity decreases as a result. Eroded soil particles carried by water basins and runoff accumulate in rivers and reservoirs, reducing water quality and affecting aquatic ecosystems. has an effect.

▪ Environment-Soil erosion negatively affects the diversity and abundance of plant and animal species, disturbs the ecological balance and causes the loss of biodiversity.

▪ Social impacts- Reduced agricultural productivity and increased costs of land remediation and water treatment lead to economic losses for farmers and communities.

▪ Health-Soil erosion can contribute to air and water pollution, affecting human health through contamination of food and water sources.

Conclusion

In conclusion, I would like to state that soil erosion poses a significant problem for sustainable land management and agricultural productivity in Ganja, Azerbaijan. This research work has identified the causes, effects and proposed mitigation strategies to eliminate soil erosion in the region. It is possible to reduce and minimize the effects of soil erosion in Ganja if the following strategies are followed:

♣ Conservation agriculture- Adoption of conservation practices such as contour ploughing, terracing and agroforestry will help conserve soil moisture, reduce runoff and prevent erosion.

♣ Soil management-Improving soil organic matter content, implementing cover crops, reducing tillage can increase soil structure and stability, and reduce erosion risks.

♣ Reforestation and revegetation-Intensification of afforestation and reforestation of eroded areas will increase ecological resilience by preventing soil erosion.

♣ Education and awareness- Raising public awareness through awareness campaigns can foster a culture of soil conservation and promote sustainable land management practices.

♣ Application of case studies learned from other regions, successful strategies and best practices for reducing soil erosion to Ganja, Azerbaijan can ensure its long-term ecological and socio-economic sustainability.

ACKNOWLEDGEMENT

Great thanks to Ulviyya Mammadova for motivating and supporting me to write this paper about the impact of erosion on the city of Ganja.In preparing the work aerospace materials of Google Earth, Goggle Map and several other agencies and companies were used.

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HEAVY METALS POLLUTION OF WESTERN ZONE SOILS OF THE AZERBAIJAN REPUBLIC

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Recently, the Earth has faced various global environmental problems. The main factor in the emergence of these problems is the human factor. In modern times, one of the dangerous processes in the pollution of the environment, including the soil, is the excessive accumulation of heavy metals in the biosphere, atmosphere and pedosphere. Heavy metals occupy a special place among pollutants due to the scale of pollution and the degree of impact on biological objects, including the human body.

Heavy metals have a great role in terms of physiological importance in living organisms. However, it has already been proven that their intensive distribution in the biosphere and atmosphere and their high concentration in the soil pose a great threat to biota.

There are various sources of soil contamination with heavy metals. In addition to ferrous and non-ferrous metal industry facilities, one of the sources of environmental pollution with heavy metals is automobile (vehicle) pollutants. Vehicle pollutants enter the soil and plants through the atmosphere, poisoning them in various ways.

***Key words**: Concentration, Toxic, Highway, Accumulation, Rock, Anthropogenic, irrigation*

INTRODUCTION

Actuality of Heavy Metals Pollution of Soils. Adverse biological events occur when the amount of heavy metals (Pb, Cd, Cr, Zn, Ni, Co, Cu, Sn, Hg, Mo, Be, W) exceeds the Permissible exposure limit (PEL) of heavy metals in living organisms.

Among heavy metals, especially lead, mercury, cadmium, arsenic, zinc and nickel are considered more dangerous pollutants. For example, high concentrations of lead cause changes in the reproductive, nervous, cardiovascular, immune, and endocrine systems of humans. Its toxic effect causes a change in the functionality of the kidneys, damage to the central nervous system.

These substances enter the body of biological beings (including humans) through soil → plants.

Many heavy metals are also very dangerous for living things. These metals, which get into the body in particular, are adsorbed from the liver and gastrointestinal tract and get into the blood after a few minutes (Məmmədov, 2007. 664 s/ Babayev, 2005. 299 s.). The physiological functions of the liver, kidneys, marrow, spleen and organs, which are very sensitive to the effects of heavy metals, are quickly and rapidly disrupted.

THE MAIN PURPOSE OF RESEARCH

The main purpose of the research is to study the quantity and distribution characteristics of heavy metals in selected areas along the highway of Qazakh[1] region and to determine its soil fertility parameters.

THE RESEARCH AREA AND METHODS

To achieve this goal, soil samples were taken from different layers along the soil profile to determine the amount of heavy metals at a distance of 50 meters from the hard surface of the defined highway.

The samples were analyzed in the "Azelab" LLC laboratory of the Ministry of Ecology and Natural Resources. Here, heavy metals were studied by atomic absorption spectroscopy methods.

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[1] Qazakh District is district of Azerbaijan, located in the north-west of the country.

THE RESEARCH RESULT

Extensive research works have been conducted in the world in the direction of heavy metal contamination of soils. Pollutants are getting into the soil from vehicle traffic waste primarily affect its physical, chemical and biological properties and cause changes in its parameters. As a result of soil pollution with heavy metals, along with sulfur and nitrogen oxides emitted from automobiles, the initial productivity of cultivated agricultural plants decreases by 20-40%, and heavy metals accumulated in the soil have a negative effect on the vital activity of soil biota (Zubareva etc., 2011,c. 159-164) . The share of automobile transport in the world's environmental pollution among vehicles is 85%. Car emissions make up 26.4% of total pollutants. However, in the 1970s, its share was 13%. In the last 40 years, its amount has started to increase.

It has been determined that up to 200 toxic heavy metals fall into the soil along with the gases emitted by automobile traffic and poison it. In addition, heavy metals poison plants and other organisms in the food chain.

In the study area, irrigated gray-brown soils (chestanozems)[2], dark gray-brown soils (chestanozems), common gray-brown soils (chestanozems) and subasar-meadow soils (fluvisols) were separated (Mammadov etc, 2006, 608 s) .

As a result of road construction and technogenic works around the highway, the morphological horizons of the soil are disturbed; the soil samples from the sections are taken from three layers: 0-20; 20-40 and 40-90 cm.

Accumulation of heavy metals in soils occurs naturally in various ways. First, primary and secondary rock mineral compounds, soil-insoluble oxides and hydroxides occur as a result of the penetration of organic substances and extraneous waste (pollutants) into the soil solution in the form of exchange ions.

Contamination of the soil surrounding the Qazakh[3] highway with heavy metals and the change and pollution of nutrients in the soil occur in different ways depending on natural and anthropogenic influences (Məhərrəmova, 2019. 150 s./ Məmmədov etc., 2009, 340 s.)

The distribution of emissions from vehicles is strongly influenced by meteorological and hydrometric conditions. Here, the prevailing winds blow mainly from east to west or vice versa, which causes pollutants to be carried along the highway and partly away. Relatively low rainfall prevents long-term effects of contamination.

It was determined that the pollution of the soils around the highway mainly depends on the amount of pollutants from the intensity of traffic and the throughput of the highway. During 11.5 years, an average of 2,880 grams of heavy metals (which of 40% was lead) was accumulated in each meter of the road, produced by 90,000 vehicles per day.

In recent years, rejection of using ethyl alcohol in the production of gasoline has led to a decrease in lead.

Contamination of the soil with heavy metals depends on the distance from the highway and this dependence is shown in table 1. It became clear that contamination gradually decreases and approaches the background value as you move away from the highway. It is clear from the table that the most contamination occurs in dark gray brown soils. It is true that there are differences between individual heavy metals. In general, the highest contamination in soil is copper. Chromium and zinc are observed also. The least detection was in mercury. It is true that the amount of chromium can be affected by rocks and copper by the use of various pesticides with additional copper content.

[2] Chestanozems (kastanozems, from the Russian term chestnut soils)

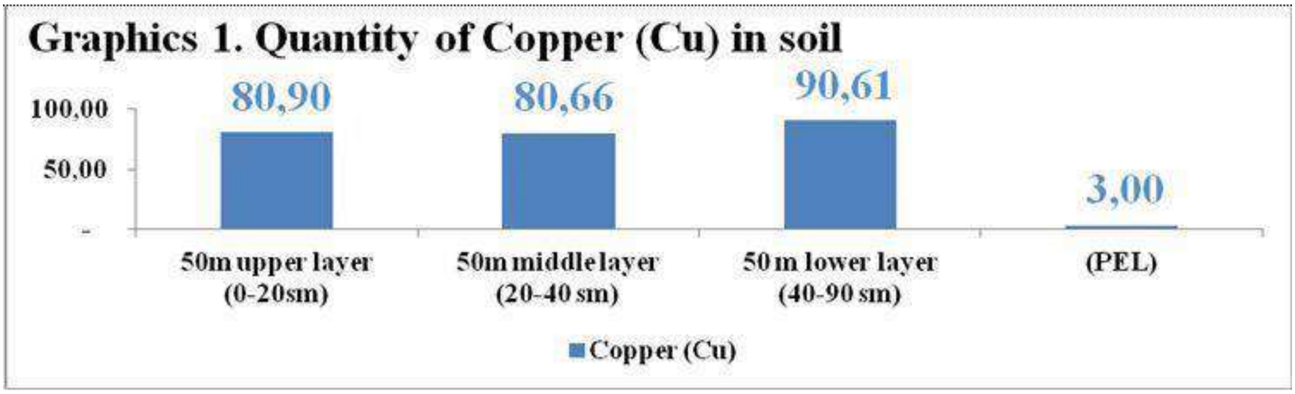
[3] Qazakh District is district of Azerbaijan, located in the north-west of the country.

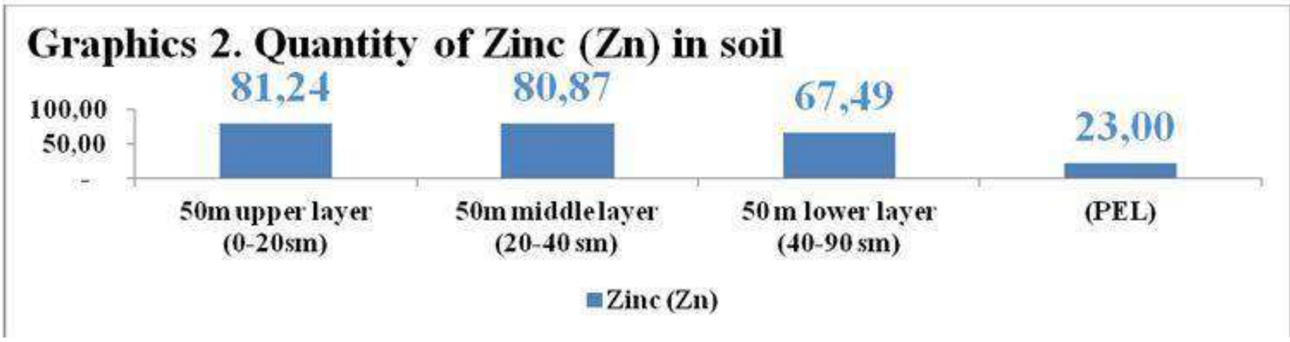
Table 1.

Vehicle Contamination of surface of irrigated gray-brown soils with heavy metals (mg/kg) in 2022

№	Indicators	50m upper layer (0-20 cm)	50m middle layer (20-40 cm)	50 m lower layer (40-90 cm)	(PEL)[4]
1	Zinc Zn	81,24	80,87	67,49	23,0
2	Cobalt Co	10,95	6,578	12,15	5,0
3	Lead Pb	7,364	4,517	< Lod[5]	32,0
4	Chromium Cr	66,93	66,80	56,61	6,0
5	Copper Cu	80,90	80,66	90,61	3,0

When studying the ecological characteristics of the vineyard soils in the plains of the western zone the total and variable amounts of heavy metals were studied too. Here, it was determined that copper at 50m upper layer (0-20 cm) was 80.90mg/kg and zinc was 81.24mg/kg in gray-brown (chestnut) soils (See Graphics 1 and 2).





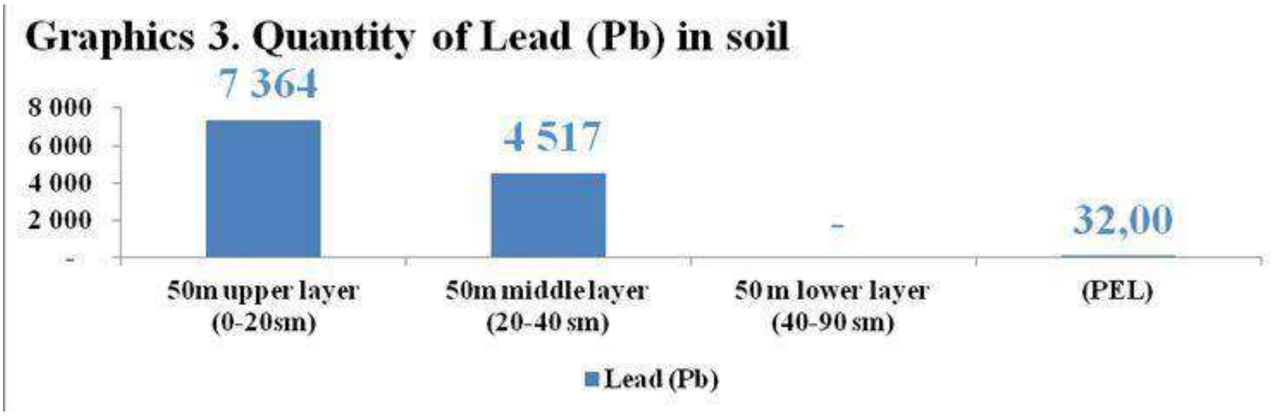
According to the study, the reason for the abundance of these metals in the soil under the vineyard was the application of mineral fertilizers and pesticides in excess of the norm to obtain a high yield.

In recent years, there has been an increase in the amount of zinc on the soil surface, which has many causes and sources; especially, friction of car tires, vulcanization of tires, and accumulation of products of various corrosion and erosion processes, use of Dialkyl and Diethyl dithiophosphate oils in engines and processes occurring in car parts. V.H. Pshenin (Hasanov, 2011, s.37-53) in his researches shows that 0.09-0.12% of the oil used in the engine is zinc. 0.05-0.1% of oils used in diesel engines is zinc. Therefore, zinc accumulates more around the highway. Currently, since zinc-plated metals are used in parts used in automobile production, the soil surface is more contaminated with zinc.

[4] Permissible exposure limit (PEL)

[5] The limit of detection (LOD)

While the amount of lead in the natural background in the soil was 0.5 mg/kg, its amount in the soil at a distance of 50m upper layer (0-20 cm)from the asphalt floor was 7,364 mg/kg, in the middle layer (20-40 cm) it was 4,517 mg/kg, and the bottom layer also decreased(See Graphics 3).



The amount of cobalt varies sharply depending on the depth of the soil in the area. So, its amount was 10.95 mg/kg in the upper layer at 50 meters (0-20 cm), 6.578 mg/kg in the middle layer (20-40 cm), and 12.15 mg/kg in the lower layer (40-90 cm) (See Graphics 4). At the same time, it is known that the amount of cobalt in soils is related to the rocks from which it is formed (Денисов etc., 2006, 312 c) . This regularity is also evident in the soils of the research area.

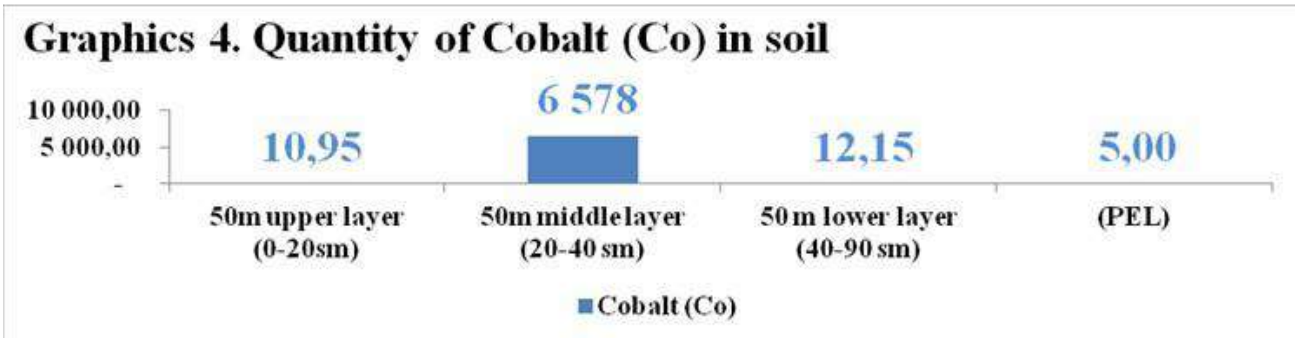
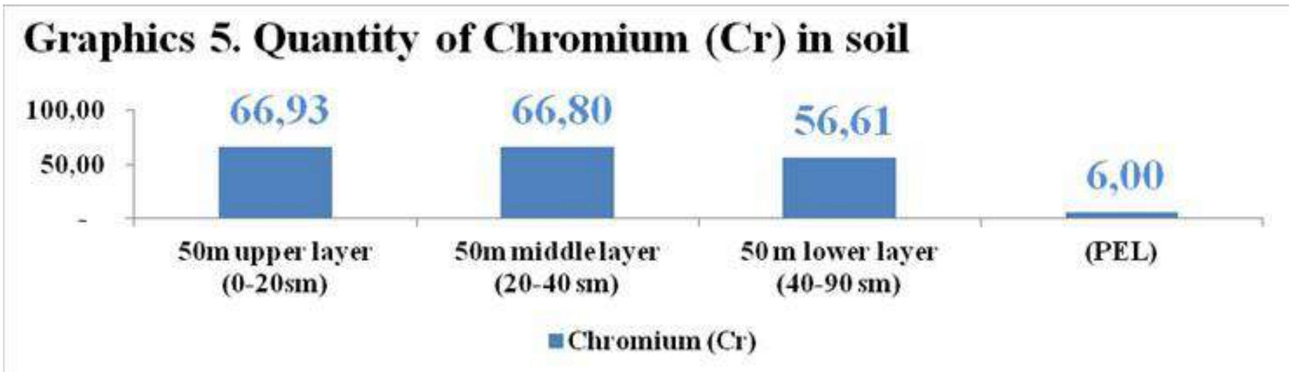


Table 1 show that the amount of chromium is higher in dark gray-brown soils. In particular, in the sample taken from the 50m upper layer (0-20 cm) of the highway, its quantity was 66.93 mg/kg, in the middle layer (20-40 cm) it was 66.80 mg/kg and in the bottom layer (40 – 90 cm) it was 56.61 mg/kg (See Graphics 5). According to many researchers, its high around the highway depends on the corrosion and friction between the parts of the cars.



CONCLUSION

It has been established that the reconstruction of the Qazakh highway in recent years has led to the intensive development of automobile transport. In particular, it has accelerated its development and intensity in the strengthening of economic relations in many neighboring countries. On average, 4-38 cars pass through the highway every minute, taking into account both directions. The arid climatic conditions of the area and the weakness of the surface flow make it possible for the car waste to remain on the soil surface or in its contents, and the heavy metals in these wastes cause poisoning of the soil, plants and various living things. The result of the research showed that mechanical, physical, chemical and physico-chemical pollution occurs mainly in the environment and soil cover with gas, liquid and solid wastes as a result of the development of automobile transport. The total amount of heavy metals in soils is naturally related to the parent rock.

In irrigated gray brown soils, the highest contamination was observed at 50 meters from highway. The amount of lead at 50m upper layer (0-20 cm) was 7.364 mg/kg and copper was 80.90 mg/kg. Similar results were obtained for cobalt, zinc and chromium. During the research, similar results were obtained in dark gray-brown and ordinary gray-brown soils. The amount of cobalt was 10.95 mg/kg at 50m upper layer (0-20 cm).

During the research, it was determined that lead and partially chromium from heavy metals accumulate mainly in the top layer of the soil profile. In ordinary gray-brown soils, lead varies between 7,364 mg/kg depending on the distance in the upper layer (at 0-20 cm), and its amount is 4,517 mg/kg at 20-40 cm depth level. A decrease in chromium is mainly observed after a depth of 45-50 cm. Zinc and copper were relatively evenly distributed along the profile. These results were also obtained on dark and irrigated gray-brown soils.

In the course of research, it was found that pollution with heavy metals also affects the composition of nutrients in the soil. Lead prevents the change of absorbable phosphorus, sulfur and potassium, depending on the amount of zinc, cobalt, and lead; it prevents nutrients from changing into an exchangeable form and causes an increase in salinity in arid conditions.

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TRANSFORMATION OF BROWN MOUNTAIN-FOREST SOILS OF THE SHAMAKHI REGION

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The article provides information about the regularity of distribution of the geographical diversity of brown mountain-forest soils in the Shamakhi region, and its changes to one degree or another as a result of the impact of human economic activities of various nature and intensity. As a result of unsystematic cutting and grazing of livestock, lowering of the upper border of the forest and destruction of other parts of the forest, depending on the slope and steepness of the slopes, different types of grass cover were formed on the site of the forests.After a certain period of time, a new type and subtype of soil begins to form under the sod-forming grass cover.

As a result of many years of anthropogenic impact on the territory of the Shamakhi region, brown mountain forest soils were transformed, and mountain black soils appeared in their place due to the replacement of forest cover with other plant formations. The modern condition of the brown mountain-forest soils distributed on different slopes of the middle mountain-forest belt of Shamakhi region, under the forest and in the areas freed from the forest (research area) was studied. Thus, as a result of erosion processes in the steppe regions, the number of surface watercourses increases, which causes an increase in ravines in this region, causing serious damage to agriculture. At the same time, the increase in surface water flows washes away the top fertile layer of the soil from the fields and, as a result, weakens the biological processes in the soil (reduces the collection and use of solar energy) and weakens the enzymatic activity.

Keywords: *transformation, forest, anthropogenic factor, humus, erosion, humidity*

INTRODUCTION

Our republic is one of the countries with limited land resources. The country has 0.22 hectares of cultivated land and 0.58 hectares of agricultural land per person. The area of pastures and meadows per person is less. From this point of view, in the development of the agrarian sector, especially animal husbandry, in meeting the population's demand for individual agricultural products, it is important to increase soil fertility, strengthen the fodder base of livestock, protect natural fodder areas, improve pastures and preserve their geobotanical richness.

The south-eastern slope of the Great Caucasus - the Shamakhi region has a very diverse soil and vegetation cover, which is due to the presence of high ridges with a highly fragmented relief, complex geological and morphological structure.

In connection with the study of the soil-vegetation cover of the Shamakhi region, the southeastern slope of the Greater Caucasus, L.L. Prilipko (1954), M.P. Babayev (2001, 2017), G.Sh. Mammadov (2007), M.Y. Khalilov (2003), B.G. Shakuri (2004), (G. Salamov, 1978) and others have conducted extensive research. The authors noted that as a result of the influence of anthropogenic factors, the soil and vegetation cover of the southeastern slope of the Greater Caucasus differs from the soil and vegetation cover of recent times (300-500 years). In many areas, the forest cover has been completely destroyed and turned into sparse bushes and steppes.

Human settlement in the study area since ancient times, anthropogenic effects have caused degradation of soil-vegetation cover here for many years and as a result, transformation of the soil cover.

MATERİAL AND METHODS

The purpose of the work: to study the modern condition of the mountain-forest brown soils in the area of the Shamakhi region, the southeastern slope of the Great Caucasus, and to study the causes of soil erosion and transformation in the forest, meadow, and pasture areas.

The task of the work: In connection with the study of the general condition of the research area (the level of cultivation of the area), it consists in developing recommendations for production to improve the fertility of the soil cover, maintain it and increase the productivity of the vegetation, as a result of phytomeliorative improvement.

Research object: The research object is the southeastern slope of the Greater Caucasus (Shamakhi region)

Research methodology: The following methods were used to carry out the re Stationary method. This method serves to study soil processes and regimes in field conditions. Search work.

Comparative - analytical method. This method allows making judgments about the composition and properties of soil samples with the application of chemical, physico-chemical, physical and other systems of analysis methods.

Comparative - geographical method. The basis of this method is the study of soils in relation to soil-cultivating factors, that is, the detection of a correlative relationship between soils, their properties and composition on the one hand, and soils and soil-cultivating factors as a whole on the other hand.

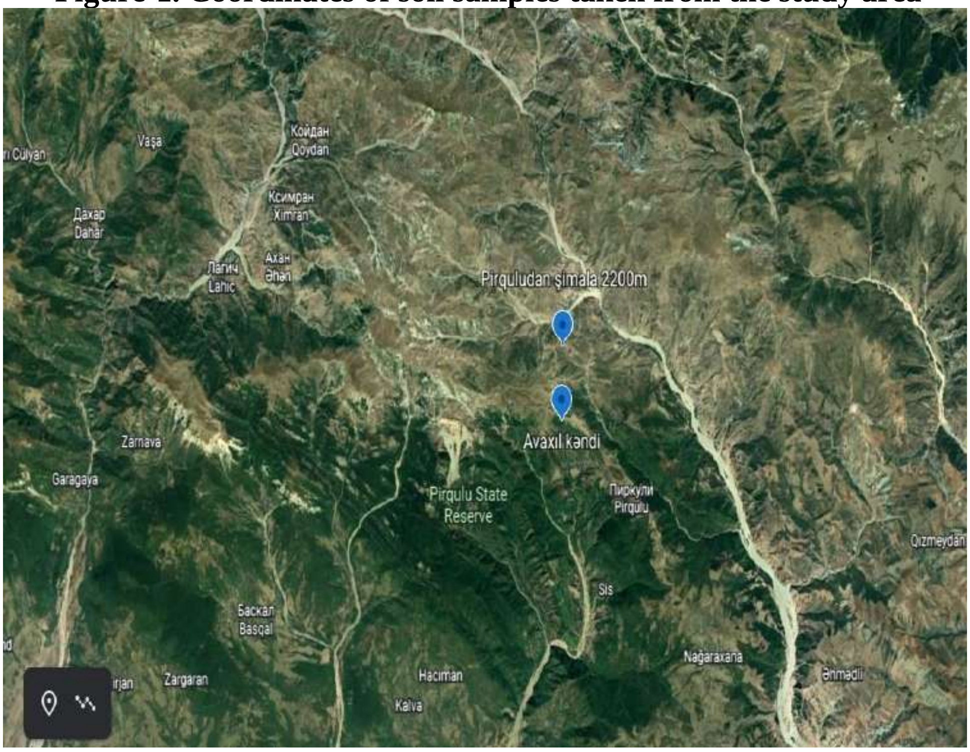
This method is more widely used in land cartography.

RESULTS AND DISCUSSION

Brown mountain-forest lands make up 416.5 thousand hectares or 4.8% of the territory of the republic, and 4.1% of the research area. It is mainly distributed in the middle and upper borders of the middle mountain-forest belt. The relief of the region is characterized by the presence of deep valleys, watersheds, cliffs and steep slopes. The climate of the middle and lower border of the middle mountain-forest belt: a mild hot climate with dry summers, and a mild hot climate with evenly distributed precipitation at the upper border.

The total annual active temperatures of the air are 2000°-3500°C, which creates favorable conditions for the development of grain crops, viticulture and horticulture. The forests of Shamakhi region are quite rich and diverse according to their typological composition. The richness of the vegetation is related to the diversity of the soil regime in mountain conditions. Forest cover consists of beech, oak, beech, beech-beech, beech-beech, oak-beech beech forests and various types of juniper, forest and thickets consisting of a mixture of blackberry with berries.

Figure-1. Coordinates of soil samples taken from the study area



In order to determine the genetic diagnosis of forest cover degradation and transformed brown mountain-forest lands (Shamakhi r. area): we carried out route studies using the "comparative geographical method" in the area of Pirgulu State Reserve and Avakhyl, Demirchilar villages of Shamakhi region.

Soil samples were taken from under the forest and transformed area between Pirgulu-Demirchilar near the village of Avakhyl with coordinates 4004814511 N, 4803412911 E and 400 48' 45" N, 480 34' 29" E and their physical and chemical properties were determined and tabulated. At the same time, against the background of anthropogenic effects, visual images of forest degradation from the above-mentioned areas were recorded.

Areas where the population is denser and more populated, and at the same time more suitable for transport, have been transformed by being exposed to anthropogenic influences. Taking into account that the humidity coefficient is 0.6-0.8, it has created the basis for the use of those areas as pastures and pastures.

Taken from the experimental sites located at the altitude of 1550 m and 1610 m above sea level with coordinates 4004814511 N, 4803412911 E and 400 48' 45" N, 480 34' 29" E - untouched forest and pasture area affected by anthropogenic influences through soil samples the modern state of soil cover has been studied.

The anthropogenically affected experimental area 2 is located in the northwest of the experimental area 1. In the same spring, this experiment area with an inclination of 22^0 was completely deprived of forest cover as a result of anthropogenic effects.The soil of this area, which was under the forest over time, is now undergoing a strong transformation and differs significantly from the physico-chemical indicators of the 1st soil section.

The physical and chemical characteristics of the soil samples taken from the research area were tabulated and compared. As can be seen from the first table, the chemical composition of the soil in the slightly disturbed forest area (filling 0.6-0.7) (section 1) is quite different from the soil of the area (section 2) where the forest was destroyed and turned into gray grass. Thus, the amount of humus in the upper (A) layer of the 1st section was 7.7%, and in the next layer (B) this figure decreased to 2.8% with a jump characteristic of brown mountain-forest soils.

The amount of total nitrogen in the humus layer is 0.540% and decreases with depth. Since this land is located under a beech-vales forest, carbonates ($CaCO3$) have been completely washed from the upper layers, despite the fact that the parent rock is carbonated. Here, carbonate is observed only in the parent rock (10.8%). 85.2% of the total elements are calcium (Ca), and 4.8% are magnesium (Mg). The pH indicator of the aqueous solution is weakly acidic (5.8) in the upper layers.

The 2nd plot of land affected by anthropogenic influence is devoid of grass. Compared to the soil under the forest, the amount of humus in the A layer is much less and is 4.8%. As it can be seen, in comparison with the 1st cut, the amount of humus here has decreased significantly. The amount of total nitrogen in layer A is 0.340. Unlike the soil under the forest (section 1), carbonation is observed in the soil along the entire profile.

The amount of carbonate residues in layer B (16.5%), and the reason why it is more than in layer C (15.8%) is related to the transition of some carbonates to layer B during the period when those lands were deforested. Therefore, the indicator of the pH of the aqueous solution has changed from a slightly acidic environment (6.8) to an alkaline environment (7.6) (table-1).

Table 1

Physico-chemical indicators of brown mountain-forest soils under slightly disturbed forest and deforested area

My cut №	The place where the cut is placed	Genetic layer	Depth, cm	Hygroscopic moisture %	Hummus, %	Total nitrogen %	$CaCO_3$	PH water solution	Absorbed bases mmol /100g to the land			Granulometric content in %	
									Ca	Mg	Cəmi	<0,001mm	<0,01mm
3	Shamakhi-Avakhil h=1550m Coordinate system $40^0 48^1 45^{11}$ N, $48^0 34^1 29^{11}$ E,	A_O	0-3	Meşə döşənəyi									
		AU	3-18	6,61	7,7	0,540	yox	5,8	29,1	4,9	34,0	24,50	54,60
		Bca	18-37	5,07	2,8	0,234	yox	7,1	23,0	4,5	27,5	27,10	51,20
		Cca	37-85	5,08	0,8	0,074	10,8	7,5	19,3	3,7	20,3	29,60	41,20
4	Shamakhi-Demircilers Deserted h=1610 m Coordinate system $40^0 47^1 19^{11}$ N, $48^0 34^1 11^{11}$ E,	AU	0-19	7,4	4,8	0,340	yox	6,8	26,0	4,0	30,0	28,50	50,52
		Bca	19-45	5,7	2,1	0,210	16,5	7,6	22,0	5,5	27,5	25,10	46,10
		Cca	45-72	6,3	0,7	0,061	15,8	7,5	18,0	6,2	24,2	21,50	40,60

Figure – 2.Comparative characteristics of the humus indicator of steppe brown mountain-forest soils

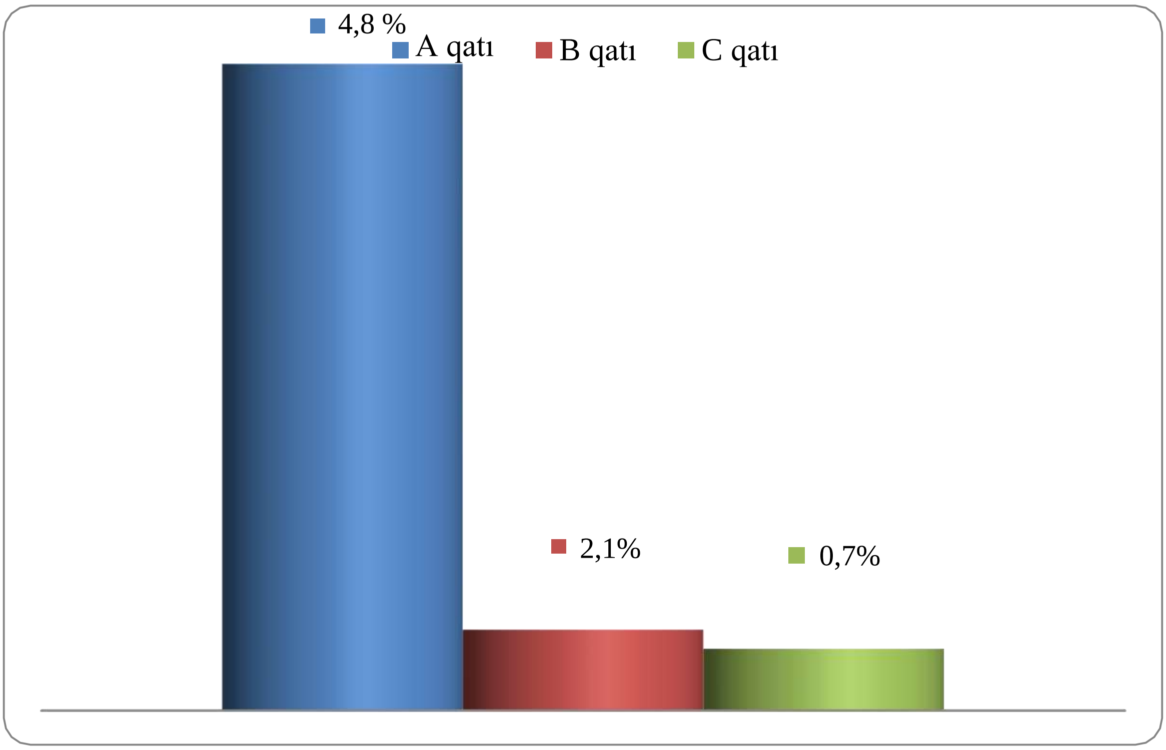
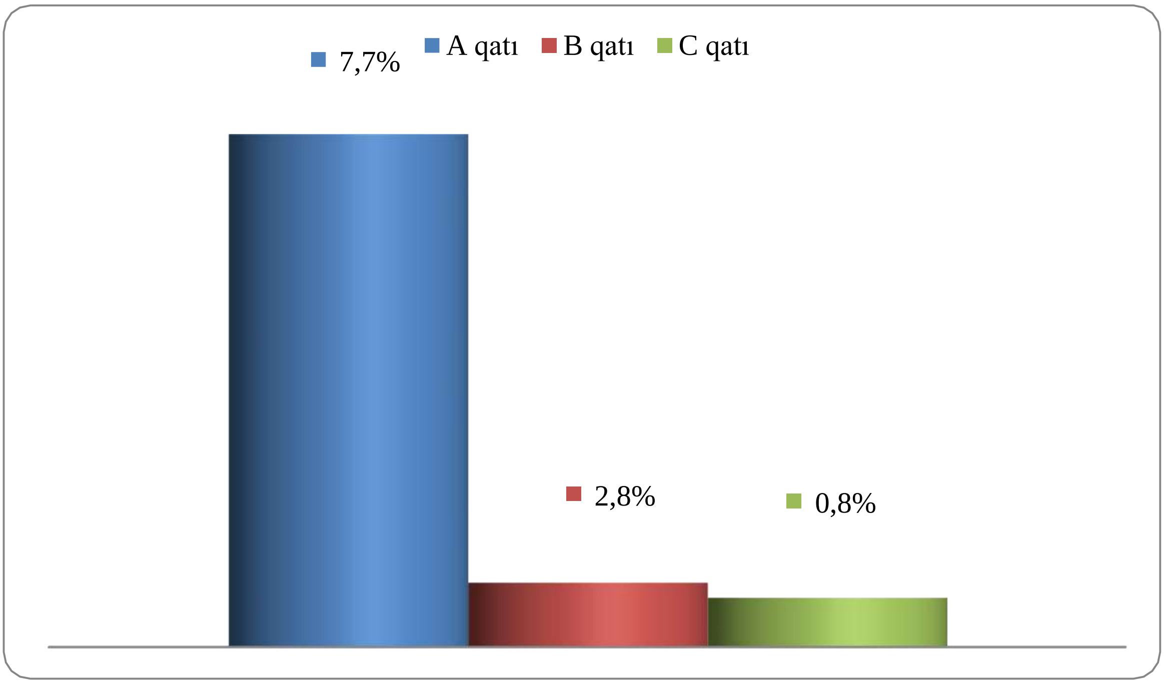


Figure - 3. Comparative characteristics of the humus indicator of brown mountain-forest soils washed from carbonate



On the slopes that have been exposed to various degrees of erosion and deforested, grass, gray-grass groups are located 1500-1800 m above sea level, although there is no meadow zone, they are currently used as summer pastures is done. At the time, most of these areas were used for agricultural crops (mainly grain), and then they were "discarded" due to the process of erosion. During the summer-summer-autumn period, due to excessive grazing of cattle in these areas, the erosion process intensifies, ravines, avalanches, landslides, and landslides increase. If cattle grazing in such areas is continued as it is now, after a while it will also become unfit for grazing.

CONCLUSİON

1. The current condition of the brown mountain-forest soils distributed in the middle and upper zones of the middle mountain-forest belt of Shamakhi region, under the forest and in the areas freed from the forest (research area) was studied. As a result of the influence of anthropogenic factors, the forest cover has been completely destroyed because it is suitable for transport, despite the partial increase in humidity in the steppe areas 2350 meters north-west of the forest-covered area. Some physico-chemical indicators of the soil in the steppe areas (humus, total nitrogen, moisture, porosity, etc.) are significantly different from the samples taken from under the forest. Therefore, because of the erosion processes in the steppe areas, the amount of surface water flows increases and causes the increase of gullies in the area, causing serious damage to agriculture. At the same time, the increase in surface water flows washes away the top fertile layer of the soil from the fields and, as a result, weakens the biological processes in the soil (reduces the collection and use of solar energy) and weakens the enzymatic activity.
2. In order to increase productivity in the eroded grayish brown mountain-forest soils of the southeastern slope of the Greater Caucasus, it is possible to use semi-drought-resistant perennial khasha and alfalfa plants from the leguminous family, which are partly resistant to drought and have spindle roots. Azotobacteria, living symbiotically in the roots of khasha and alfalfa plants, also increase the fertility of the soil due to the absorption of free nitrogen ($N2$) from the air. In the northwestern part of Shamakhi region, at an altitude of 1,500-1,600 m above sea level, on the steep slopes, which have been exposed to strong erosion and are in danger of being completely destroyed in the future, against the background of grass vegetation l-black grazing It should be prohibited, it is possible to grow forests using common pine, Crimean pine (provided not to interfere with existing shrub species).

Acknowledgements
Thank you

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THE EFFECTS OF TOBACCO PRODUCTION WASTE ON MICROBIAL BIOMASS CARBON AND BASAL RESPIRATION OF MAIZE RHIZOSPHERE

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Farmers prefer the precise regulation of nutrient amounts in the soil through the use of inorganic fertilizers, as they are convenient, require less time and labor compared to organic sources. Inorganic fertilizers provide immediate effects on yield, unlike organic sources that take time to decompose and release nutrients. Consequently, the intensive agricultural practices in Anatolian soils lead to a decline in soil fertility due to the loss of organic matter. This decline in soil fertility is often accompanied by a reduction in organic matter, soil structure deterioration, decreased water infiltration, soil compaction, increased erodibility, and leaching, resulting in decreased nutrient holding capacity and a less favorable environment for microbial activities. To preserve or restore soil fertility, the common approach is to incorporate organic matter, preferably in a stabilized form that can yield beneficial effects.

This study aimed to investigate the impact of tobacco production waste on microbial biomass C and basal respiration in clay loam soil and maize plant rhizosphere (Zea mays indandata) soil under greenhouse conditions. The tobacco production waste was thoroughly mixed with the soil at a rate equivalent to 50 g kg-1 based on air-dried weight. The experimental design followed a randomized plot setup in the greenhouse, with replications. The soil moisture content was maintained at approximately 60% of the maximum water holding capacity by daily weighing of the pots. Changes in microbial biomass C and basal respiration were assessed in soil and rhizosphere samples, as well as root-free soil, collected at 15, 30, 45, 60, 75, and 90 days after the commencement of the experiment. The results indicated that the addition of tobacco production waste to the soil significantly increased microbial biomass C and basal respiration compared to the control ($P<0.01$) throughout all the experimental periods. Furthermore, the rhizosphere soil exhibited higher microbial biomass C and basal respiration than the root-free soil following the application of tobacco production waste ($P<0.01$).

Key words: *Tobacco production waste, Soil, Rhizosphere, microbial biomass C, basal respiration*

INTRODUCTION

Intensive land use in Anatolia results in the loss of soil organic matter, leading to decreased soil fertility and productivity (Kızılkaya, 2004). To preserve and restore soil fertility, the common approach is to incorporate organic matter that is sufficiently stabilized to yield beneficial effects. As a result, the application of various organic wastes to soils has become increasingly common, promoting soil organic matter accumulation, as well as improvements in soil carbon and nitrogen contents and enhanced biological activity (Gallardo-Lara and Nogales, 1987; Vigil et al., 1991; Mathur et al., 1993).

Plants play a crucial role in influencing carbon turnover and organic matter content in soils. They contribute to the soil's microbial characteristics through litter deposition and rhizosphere exudation, while also stimulating the turnover of existing soil carbon through interactions with rhizosphere microorganisms (Waldrop et al., 2000; Kourtev et al., 2003; Chen et al., 2006). Despite the importance of these plant-microbe interactions, there is a limited number of studies examining root exudation, microbial rhizosphere community composition, and enzyme activities (Grierson and Adams, 2000; Kourtev et al., 2003).

Microbial activity is a key factor in regulating soil fertility and is central to numerous ecological functions (Nannipieri et al. 1990). It is closely linked to soil structure, fertility, and the transformation of organic matter (Ladd et. al., 1996). Several microbiological parameters have been employed to assess soil productivity in agricultural ecosystems, and various methods exist for studying microorganisms and their activities at the microhabitat level (Vekemans et al., 1989). The microbiological properties of agricultural soils have been investigated in relation to site and soil factors, with certain characteristics such as respiratory activity, and microbial biomass serving as bio-indicators for soil quality and health (Rogers and Li, 1985).

Microbial biomass, although comprising only a small proportion of total soil carbon and soil mass, is a vital component of soil organic matter (Smith and Paul, 1990). It actively participates in the biogeochemical cycles of essential nutrients (carbon, nitrogen, phosphorus, sulfur) and associated energy flows (Meli et al., 2002; Kızılkaya et al., 2004). Basal soil respiration, which reflects the physiological condition of the soil ecosystem, provides valuable information regarding energy utilization by microorganisms and the efficiency of organic carbon degradation (Wardle and Ghani, 1992).

In this study, we conducted a greenhouse experiment to simulate field conditions of organic matter management using tobacco production waste in soil. The tobacco production waste was carefully processed to eliminate any potential particle size effects. Our primary objectives were to assess the impact of tobacco production waste on microbial biomass and basal soil respiration in the maize rhizosphere and root-free soil.

MATERIAL AND METHODS

Material

Surface soil (0-20 cm) was taken from Bafra, Samsun, Turkey The soil used in this experiment is a Typic Udipsamment and contained 20.60 % clay, 18.36 % silt, and 61.04 % sand. Soil texture can accordingly be classified as sandy clay loam (SCL). The pH in water was 8.1, the oxidizable organic matter content was 1.68 %, and the soil C:N ratio was 13.9. The site is located in the Black Sea Region, Northern Turkey (Latitude, 41^{0}21'N; longitude, 36^{0}15'W). The climate is semi humid, (R_f = 47.21) with temperatures ranging from 6.6 ^{0}C in February to 23 ^{0}C in August. The annual mean temperature is 14.2 ^{0}C and annual mean precipitation is 670 mm. Tobacco plants are commonly grown in the Eastern and Middle Black Sea Region of Turkey. Therefore, there is much tobacco production waste in this region. These tobacco production waste were taken from the industry of tobacco production in this region. Tobacco production waste were dried and sieved into less than 0.50 mm. The properties of the tobacco production waste was expressed on a moist-free basis and analyzed by standard procedures, given in Ryan et al. (2001).

Experimental procedure

The soil samples were first air-dried in a laboratory and then passed through 0-2 mm screens for sieving. Subsequently, 500 g of the air-dried soil was placed in cylindrical plastic containers with a capacity of 600 ml. The tobacco production waste was thoroughly mixed with the soil at a rate equivalent to 5% based on the air-dried weight. Following the soil amendment, five maize (*Zea mays indendata*) seeds were planted in each container. To maintain optimal moisture conditions, the soil moisture content was adjusted to 60% of the water holding capacity, and the containers were incubated in a greenhouse for a duration of 90 days, with consistent moisture levels throughout the experiment.

The containers with maize plants were considered as the rhizosphere, while the remaining containers without plants served as the root-free soil (non-rhizosphere). Sampling for microbial biomass carbon and basal respiration analyses was conducted at 15, 30, 45, 60, 75, and 90 days after the start of the experiment. During soil sampling, the maize plants were carefully extracted from the soil, and the soil adhering to the roots was designated as the rhizosphere. Simultaneously, root-free soil samples were collected from the non-planting containers at the same depth. As a control, soil without the addition of tobacco production waste was included.

A randomized complete plot design with three replicates per treatment and soil type was employed. The experiment consisted of four treatments:

(i) Control for soil: No tobacco production waste addition or plant seeds

(ii) + 50 g kg^{-1} tobacco production waste: Tobacco production waste addition without plant seeds

(iii) Control for rhizosphere: No tobacco production waste addition, but with plant seeds

(iv) + 50 g kg^{-1} tobacco production waste: Tobacco production waste addition with plant seeds

Microbial biomass carbon was determined using the substrate-induced respiration method described by Anderson and Domsch (1978). Basal soil respiration was measured according to the procedure outlined by Anderson (1982).

RESULTS AND DISCUSSION

The analysis results of the tobacco production waste revealed significant characteristics for its potential use as an organic amendment. The organic matter content was determined to be 66.21%, indicating a substantial presence of decomposable plant and microbial residues. Furthermore, the C/N ratio, an important indicator of nutrient availability and microbial activity, was measured at 20, suggesting a balanced carbon-to-nitrogen ratio suitable for efficient decomposition and nutrient cycling. The nitrogen content was found to be 1.97%, highlighting its potential as a nitrogen source for soil fertility enhancement. Additionally, the presence of P_2O_5 at 0.45% and K_2O at 4.71% signifies the tobacco production waste's capacity to contribute phosphorus and potassium, essential macronutrients for plant growth. These results indicate that the tobacco production waste possesses favorable characteristics that can positively impact soil fertility and nutrient availability when utilized as an organic amendment.

The effects of tobacco production waste treatments on Microbial biomass carbon and Basal soil respiration in rhizosphere and root free soils are presented in Table 1 and 2.

Significant variations in microbial biomass carbon and basal soil respiration were evident between samples with and without plant roots, as shown in Table 3. Upon the addition of tobacco production waste, a marked and rapid increase in microbial biomass carbon and basal soil respiration was observed in the waste-amended soils. This initial increase was followed by a progressive rise in microbial biomass carbon and basal soil respiration in the rhizosphere where tobacco production waste had been applied. By the conclusion of the experiment, the levels of microbial biomass carbon and basal soil respiration measured in the tobacco production waste-treated soils differed significantly from those observed in the control soils.

Table 1.

Microbial biomass carbon in rhizosphere and root free soils (μg CO_2-C g^{-1} dry soil). Standard error in parenthesis.

Incubation	Rhizosphere soil				Root free soil			
Days	Control		TOW		Control		TOW	
15 days	2,7	(0,43)	7,5	(0,98)	2,5	(0,16)	7,8	(0,85)
30 days	3,6	(0,11)	10,3	(0,16)	2,8	(0,16)	9,6	(0,19)
45 days	4,5	(0,09)	14,7	(0,36)	2,9	(0,61)	10,5	(0,74)
60 days	5,5	(0,35)	16,2	(0,82)	3,0	(0,48)	11,4	(0,29)
75 days	7,1	(0,14)	18,4	(1,27)	3,1	(0,22)	12,7	(0,29)
90 days	9,6	(0,70)	18,3	(0,53)	2,5	(0,16)	13,2	(0,80

Table 2.

Basal soil respiration in rhizosphere and root free soils (μg CO_2 g^{-1} dry soil). Standard error in parenthesis.

Incubation	Rhizosphere soil				Root free soil			
Days	Control		TOW		Control		TOW	
15 days	27.5	(4.40)	29.1	(3.83)	17.3	(1.66)	52.9	(3.89)
30 days	40.1	(1.22)	116.1	(1.84)	28.6	(1.80)	108.6	(2.14)
45 days	44.4	(0.91)	144.9	(3.89)	18.8	(4.29)	74.1	(5.74)
60 days	38.3	(2.95)	161.8	(8.19)	28.4	(6.13)	113.2	(2.90)
75 days	49.9	(5.81)	134.7	(8.84)	30.3	(4.93)	129.7	(2.90)
90 days	101.7	(7.44)	194.8	(5.62)	33.4	(2.33)	140.0	(8.51)

Table 3.

Results of ANOVA for Microbial biomass carbon and Basal soil respiration

Variables	Basal soil respiration		Microbial biomass carbon	
	F-value	$LSD_{\alpha=0.01}$	F-value	$LSD_{\alpha=0.01}$
Plant root (Pr)	73.210***	8.516	1272.261***	0.200
Incubation days (Id)	67.507***	14.749	981.591***	0.347
Pr x Id	5.060***	20.859	117.093***	0.490

The application of tobacco production waste had a significant impact on the levels of microbial biomass carbon and basal soil respiration, particularly in the rhizosphere, when compared to both the control treatment and root-free soils. Table 1 and 2 clearly demonstrate that microbial biomass carbon and basal soil respiration in the rhizosphere were consistently higher than in the control treatment and root-free soils at all sampling time points and with tobacco production waste treatments. This observation can be attributed to the organic material supplied by plant roots and their exudates (Martin 1983, Toal et al., 2000; Brimecombe et al., 2001; Kourtev et al., 2003; Bais et al., 2004). The supply of organic material from plant roots plays a critical role in supporting soil microbial communities, whose growth is often limited by carbon availability. The type and quantity of nutrients released by plant roots directly impact microbial biomass and activity. Plant litter and root exudates serve as the primary sources of carbon input to the soil system. Root exudates, which include carbohydrates, amino acids, organic acids, lipids, hormones, vitamins, and enzymes, stimulate soil microbiological activity. It is widely recognized that root-derived organic carbon, originating from root exudates, promotes the growth of microorganisms and enhances microbial activity in the rhizosphere. Previous studies (Martin 1983, Toal et al., 2000; Brimecombe et al., 2001; Kourtev et al., 2003; Bais et al., 2004) have reported similar findings, emphasizing the positive effects of root exudates on microbial biomass and activity in the rhizosphere. Consistent with these findings, our study also revealed greater microbial biomass carbon and basal soil respiration in soils amended with tobacco production waste under plant roots compared to root-free soils. The presence of tobacco production waste in the rhizosphere led to increased microbial biomass carbon and basal soil respiration after 90 days, contributing to the higher levels observed in the root-free soil as well.

These results further support the notion that the addition of tobacco production waste stimulates microbial biomass and activity in the soil, particularly in the rhizosphere. The organic compounds present in the waste serve as a valuable carbon source for microorganisms, ultimately enhancing soil fertility and nutrient cycling processes. The utilization of tobacco production waste in agricultural practices can, therefore, be considered a beneficial approach for improving soil health and promoting sustainable waste management strategies.

CONCLUSION

The obtained data demonstrates a strong association between tobacco production waste and key microbiological characteristics, including microbial biomass carbon and basal soil respiration. Our findings suggest that the incorporation of tobacco production waste into the soil stimulates microbial biomass carbon and basal soil respiration in both the rhizosphere and root-free soil. This stimulation can be attributed to the introduction of organic compounds through tobacco production waste, which promotes microbial growth. Organic materials, such as root exudates and degraded organic waste, are crucial carbon sources for microorganisms. The utilization of tobacco production waste presents an opportunity to enhance organic matter levels and improve soil fertility in agricultural lands.

Moreover, our results indicate that tobacco production waste has a more pronounced impact on microbial biomass carbon and basal soil respiration in the rhizosphere compared to the root-free soil. This observation suggests that the presence of plant roots amplifies the effects of tobacco production waste on microbial activity. Thus, the incorporation of tobacco production waste into the soil during the conducted greenhouse experiment significantly governs microbial biomass carbon and basal soil respiration.

Additionally, this practice demonstrates potential as an effective waste recycling method, offering a solution to waste disposal issues. By repurposing tobacco production waste in soil management, we can simultaneously enhance soil fertility and contribute to waste management strategies.

In conclusion, our study highlights the positive influence of tobacco production waste on microbiological parameters, emphasizing its potential as an organic amendment for agricultural soils. The incorporation of tobacco production waste can enrich organic matter levels, improve soil fertility, and exhibit a stronger impact on microbial activity in the rhizosphere. These findings support the adoption of tobacco production waste utilization as an environmentally sustainable practice for enhancing soil health and addressing waste management challenges.

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ENHANCING VERMICOMPOSTING EFFICIENCY AND ASSESSING CD ACCUMULATION USING EISENIA FOETIDA IN SEWAGE SLUDGE-AMENDED FEED MIXTURES

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Vermicomposting plays a crucial role in integrated waste management strategies. In this study, the potential of the epigeic earthworm Eisenia foetida was investigated for transforming anaerobically digested sewage sludge (SS) when combined with hazelnut husk (HH) and cow manure (CM) in varying proportions under laboratory conditions. The research aimed to determine the optimal medium for earthworm growth and reproduction, analyze heavy metal concentrations in different feed mixtures before and after vermicomposting, and explore the accumulation of Cd in earthworms inhabiting sewage sludge with different feed mixtures. The number and biomass of earthworms, as well as the heavy metal contents in the feed mixtures and earthworms, were monitored periodically throughout the vermicomposting period. The findings revealed that the highest earthworm biomass was achieved in the feed mixture comprising 20% SS, 40% CM, and 40% HH. Meanwhile, the greatest number of earthworms was observed in the feed mixture consisting of 30% SS, 35% CM, and 35% HH. Over time, the Cd concentration in all feed mixtures decreased, indicating the potential of vermicomposting to mitigate Cd levels. Furthermore, the Cd content in the feed mixtures was lower than that of the initial mixtures. The analysis of earthworms demonstrated significant bioaccumulation of heavy metals in their body tissues. Moreover, the proportion of SS in the feed mixtures positively influenced the Cd content in earthworm bodies. These findings highlight the potential of earthworms to accumulate heavy metals, emphasizing the need for caution when utilizing vermicompost derived from SS with higher SS proportions. In summary, this study demonstrates that vermicomposting, using E. foetida, effectively transforms anaerobically digested sewage sludge when combined with HH and CM. It provides insights into the optimal feed mixture compositions for earthworm growth and reproduction, showcases the reduction of heavy metal concentrations during vermicomposting, and underscores the bioaccumulation of Cd in earthworm tissues. These findings contribute to our understanding of the potential applications of vermicomposting in waste management and sustainable soil restoration practices.

Key words: *Vermicomposting, Eisenia foetida, sewage sludge, feed mixtures, heavy metal accumulation, earthworm biomass, Cd.*

INTRODUCTION

It is widely recognized that earthworms play a significant role in the transformation of organic wastes into a stabilized humus-like product known as vermicompost. Compared to the original materials, vermicompost is characterized by increased decomposition, humification, and enhanced microbial activity, making it more fragmented, porous, and biologically active (Edwards, 1988; Garg and Kaushik, 2005; Kızılkaya, 2008). Numerous studies have reported the use of earthworms in waste management, organic matter stabilization, soil detoxification, and vermicompost production (Kaushik and Garg, 2003; Garg and Kaushik, 2005; Gupta and Garg, 2008). Specifically, the epigeic species of earthworms have demonstrated the ability to significantly accelerate the composting process, resulting in the production of high-quality compost compared to traditional composting methods (Ndegwa and Thompson, 2001).

The process of utilizing earthworms in sludge management, known as vermistabilization, has gained attention (Neuhauser et al., 1988). Vermistabilization facilitates the conversion of important plant nutrients such as nitrogen (N), phosphorus (P), and potassium (K) into more soluble forms through microbial activity, thereby enhancing their availability to plants (Ndegwa and Thompson, 2001; Kızılkaya and Hepşen, 2004, 2007). Vermicompost, the end product of this process, is highly regarded due to its stability, uniformity, aesthetic appeal, reduced contaminant levels, and its value as a superior growth medium for plants (Aranda et al., 1999).

Sewage sludge, which remains after wastewater treatment, is rich in nutrients (N, P, K, etc.), essential trace elements, and organic matter. It has been recognized as a cost-effective alternative to commercial fertilizers, as it improves soil physicochemical properties and plant nutrient status. However, the presence of potentially toxic metals, both non-essential and essential trace elements, has raised concerns regarding environmental health (Mench et al., 1994; McBride, 1995; Kizilkaya and Bayrakli, 2005). To mitigate these risks, sewage sludge with high concentrations of potentially toxic metals must undergo stabilization and/or composting processes to reduce the levels of these contaminants. Composting and/or stabilization of sewage sludge not only helps avoid inhibitory effects on plant growth but also facilitates the handling of dewatered sewage sludge cake when mixed with soil. Moreover, these processes minimize risks to the environment and public health, particularly in relation to epidemiological aspects and odors (Katayama et al., 1987).

In recent years, earthworms have been extensively used for the decomposition of sewage sludge and other organic wastes to produce vermicomposts (Jain et al., 2003). Certain earthworm species have shown the ability to accumulate heavy metals, making vermicomposting technology effective in mitigating the toxicity of industrial and municipal waste (Saxena et al., 1998; Gupta et al., 2005). This low-cost and straightforward technique can facilitate the removal of toxic metals and the breakdown of complex chemicals into non-toxic forms (Jain and Singh, 2004). Accumulating evidence suggests that earthworms can accumulate heavy metals from polluted soils and other media (Ireland, 1983; Goats and Edwards, 1988; Rhett et al., 1988; Neuhauser et al., 1985; Edwards, 1996; Kızılkaya, 2004, 2005). The red wigglers, scientifically known as Eisenia fetida, are among the most commonly used earthworm species for vermicomposting. These worms exhibit rapid growth, can consume various organic materials as feed, possess a wide temperature tolerance range, and are capable of accumulating heavy metals in vermicomposted sewage sludge (Hartenstein, 1983; Saxena et al., 1998; Edwards and Bater, 1992).

This study aimed to vermicompost sewage sludge using hazelnut husk and cow manure. The utilization of this approach offers several advantages: (a) it can handle a wide range of sewage sludge vermicompost quantities, from very low to high, (b) it is a cost-effective and straightforward method suitable for both small and large-scale applications, and (c) the vermicasts produced have a readily available market as soil enhancers (Abbasi and Ramasamy, 1999; Ismail, 1997). Vermicasts are believed to contain various components that improve soil quality when applied (Kumar, 1994). They are also thought to contain enzymes and hormones that stimulate plant growth while suppressing pathogens (Abbasi and Ramasamy, 1999; Szczeck, 1999; Gupta et al., 2005). Hence, the main objectives of this study were: (i) to determine the optimal proportion of sewage sludge, hazelnut husk, and cow manure for sustainable growth of E. fetida, (ii) to analyze the cadmium (Cd) content in the vermicomposted mixtures before and after the process, and (iii) to measure the Cd accumulation in the earthworm tissues.

MATERIAL AND METHODS

Organic wastes and earthworm: The study utilized sewage sludge (SS) obtained from the Ankara Wastewater Treatment Plants in Türkiye, hazelnut husk (HH) collected from hazelnut trees in the Eastern Black Sea Region, and cow manure (CM) mixed with bedding and feed refusals from cows in Tokat, Türkiye. The organic wastes were digested and air-dried, sieved to less than 0.5 mm, and stored in polyethylene bags at 5°C until used. Cd contents of materials are given in Table 1.

Table 1.

Heavy metal concentrations ($\mu g.g^{-1}$) in SS, HH and CM used in this study

	SS	HH	CM
Cd	10,34	1,37	3,29

Experimental design: ***The experiment followed a randomized complete plot design with five replicates per treatment. Eleven different treatments were used, involving different mixtures of sewage sludge, hazelnut husk, and cow manure as specified in Table 2.***

Table 2.

Composition of treatments used for experimentation

Mixture number	Mixture Description	SS (g)	SS (%)	HH (g)	HH (%)	CM (g)	CM (%)
1	0% SS + 50% HH + 50% CM	0	0	250	50	250	50
2	10% SS + 45% HH + 45% CM	50	10	225	45	225	45
3	20% SS + 40% HH + 40% CM	100	20	200	40	200	40
4	30% SS + 35% HH + 35% CM	150	30	175	35	175	35
5	40% SS + 30% HH + 30% CM	200	40	150	30	150	30
6	50% SS + 25% HH + 25% CM	250	50	125	25	125	25
7	60% SS + 20% HH + 20% CM	300	60	100	20	100	20
8	70% SS + 15% HH + 15% CM	350	70	75	15	75	15
9	80% SS + 10% HH + 10% CM	400	80	50	10	50	10
10	90% SS + 5% HH + 5% CM	450	90	25	5	25	5
11	100% SS + 0% HH + 0% CM	500	100	0	0	0	0

For each treatment, 500 g of the dry weight of the organic waste mixture was placed in a 1-L cylindrical plastic container. Three clitellated earthworms of the species Eisenia fetida, weighing between 0.6 and 0.7 g each, were added to the mixed material. The moisture content of the mixture was adjusted to 50% of the soil water holding capacity by adding distilled water during the conditioning period. After conditioning, the moisture content was maintained at 70% throughout the vermicomposting period. The containers were kept in darkness at a temperature of 25°C ± 0.5°C, which provides optimal conditions for the growth and reproduction of E. fetida. Samples of the vermicompost were collected every 15 days during the 90-day vermicomposting period. The samples were stored in plastic vials at 4°C until analysis. The number and biomass gain of the earthworms were recorded during each vermicomposting period.

Cd contents in vermicompost and in earthworms body : The Cd content in the vermicomposts was determined using AAS after digesting the samples with a mixture of Aqua Regia-HNO_3 and HCI. For the analysis of Cd content in the earthworms, the dried earthworms were digested in nitric acid, and the Cd concentration was measured using flame AAS.

Bioaccumulation Factors : Bioaccumulation factors (BAFs) for Cd were calculated based on the Cd concentrations in the earthworm tissues and substrate materials using the formula BAF= Cbiota/Csubstrate, where Cbiota is the Cd concentration in the earthworm and Csubstrate is the Cd concentration in the substrate used for the vermicomposting experiment.

Statistical analysis: Statistical analysis was performed using SPSS 11.0 software. Two-way analysis of variance (ANOVA) was conducted, considering the factors of mixture ratio and vermicomposting period. The means were compared using the LSD test, and significance levels were denoted by asterisks (*, **, ***).

RESULTS AND DISCUSSION

Earthworm production and reproduction

Figure 1 and 2 show the values obtained from the experiments for production and reproduction in *Eisenia foetida* in different feed mixtures. Increasing proportion of SS in the feed mixtures caused the decrease in survival and growth of *E.foetida* (Figures 1 and 2). Mortality was observed in feed mixtures containing 60% or more SS throughout the vermicomposting period, suggesting that higher SS concentrations were significantly toxic to the production and reproduction of E. foetida. This toxicity may be attributed to the elevated levels of NH_4-N in anaerobically digested SS.

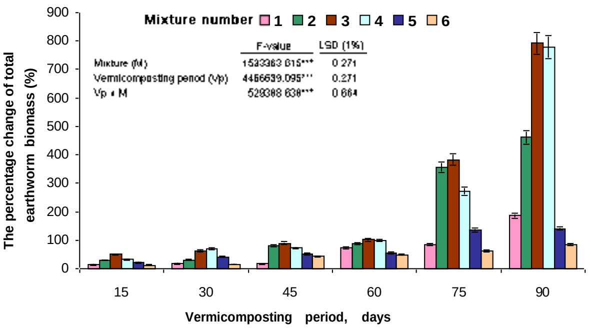

Figure 1. The percentage change of total earthworm biomass in experimental units obtaining in different feed mixtures (n=5).

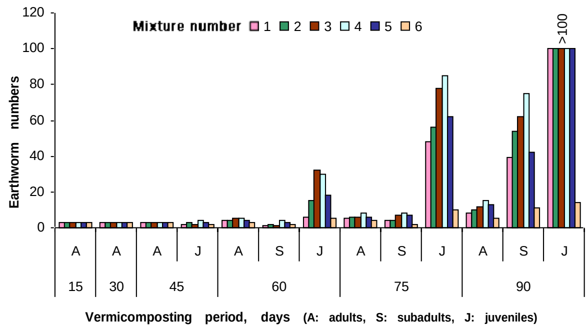

Figure 2. Population dynamics of earthworm E.feotida in experimental units in different feed mixtures (n=5).

The observed mortality in E. foetida when exposed to paper-pulp mill sludge by Elvira et al. (1997) supports the notion that degradation processes leading to changes in environmental characteristics can affect worm survival. Similarly, Masciandaro et al. (2002) reported similar results for vermicomposting of anaerobic and aerobic sludges using E. foetida, where feeds with higher proportions of anaerobic sludge were not suitable for the worms. Additionally, Harstenstein and Mitchell (1978) found that anaerobically digested sludge was acutely toxic to E. foetida, but this toxicity disappeared after aging the sludge for two months in thin layers exposed to air.

Organic wastes containing high levels of ammonia (>500 µg/g) or large amounts of inorganic salts were indicated by Edwards (1988) to be toxic to E. foetida. Harstenstein and Mitchell (1978) suggested that various sludge treatments with heavy metal salts at specific concentrations were not toxic to E. foetida over a six-week period, except for copper (Cu) at 2500 µg/g and zinc (Zn) at 10000 µg/g, which exhibited toxicity. Figure 1 presents the percentage changes of total earthworm biomass production by E. foetida in different feed mixtures over the vermicomposting period. Significant differences in the total earthworm biomass were observed among all feed mixtures, and the percentage change in biomass was consistent across all vermicomposting periods. Feed mixture no. 3 (20% SS + 40% CM + 40% HH) yielded the highest worm masses, while the lowest was recorded in the 50% SS + 25% CM + 25% HH feed mixture (no. 6) at a significance level of $P<0.001$. Moreover, an increase in the percentage of SS in the feed mixtures resulted in a decrease in the number of E. foetida. Feed mixtures no. 3 and 4 exhibited higher net number gains by E. foetida compared to other mixtures. The maximum earthworm biomass and number were generally observed on the 75th or 90th day across all feed mixtures. The population dynamics within the feed mixtures appeared to be cyclical, with periods of high and low adult numbers at different sampling times. These cyclical shifts in populations are depicted in Figure 2. Overall, the results highlight the negative impact of higher proportions of SS in feed mixtures on the survival, growth, and reproduction of E. foetida. The findings suggest that the toxicity of SS, particularly due to NH_4-N concentrations in anaerobically digested SS, can affect earthworm populations during vermicomposting.

Cd contents in vermicompost

Heavy metals, including cadmium (Cd), can be present in sewage sludge (SS) derived from various sources. The concentration of heavy metals in vermicompost, particularly Cd, needs to be determined before its application to soils. Table 3 shows the Cd status in different mixtures of SS, horse manure (HH), and cow manure (CM) before vermicomposting (Table 3).

Table 3.

Cd concentrations ($\mu g.g^{-1}$) in feed mixture before vermicomposting.

	Mixture number					
	1	2	3	4	5	6
Cd	2,33	3,13	3,93	4,73	5,53	6,34

The initial Cd contents in SS were higher compared to HH and CM, resulting in higher Cd concentrations in the feed mixtures containing SS. Figure 3 illustrates the Cd concentrations in the final vermicompost compared to the initial feed mixtures. Cd concentrations decreased from feed mixtures no. 1 to 6, with feed mixtures no. 4-6 containing higher proportions of SS. The Cd content in the vermicompost decreased over time during the vermicomposting process (Figure 3 and Table 4).

Table 4.

Results of ANOVA (* *P*<0.001)**

	Mixture (M)		Vermicomposting period (VP)		M x VP	
	F-value	LSD	*F*-value	LSD	*F*-value	LSD
Metals in vermicompost	11854,068***	0,021	5271,295***	0,021	86,898**	0,052
Cd in Earthworm body	14797,186***	0,036	2502,279***	0,036	34,193**	0,088
Bioaccumulation factor	5323,754***	0,015	9396,826***	0,015	591,053**	0,038

Table 4 presents the results of the analysis of variance (ANOVA), indicating significant differences in Cd contents among the feed mixtures at different vermicomposting periods (Figure 3 and Table 4). Figure 4 demonstrates the chemical analysis of vermicomposted samples and shows a substantial reduction in Cd concentrations for all feed mixtures. The reduction ranged from 36.6% to 81.8% for Cd. The decrease in Cd content increased with the duration of vermicomposting, likely due to the activity of earthworms and the accumulation of Cd in their tissues. Previous studies have also observed the accumulation of heavy metals, including Cd, in earthworm tissues during vermicomposting (Hartenstein and Hartenstein, 1981; Garg and Kaushik, 2005).

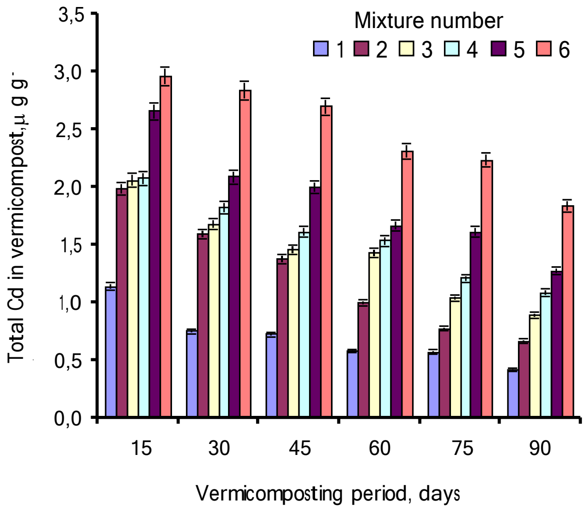

Figure 3. Changes in Cd concentrations (µg/g) from different feed mixtures associated during vermicomposting process.

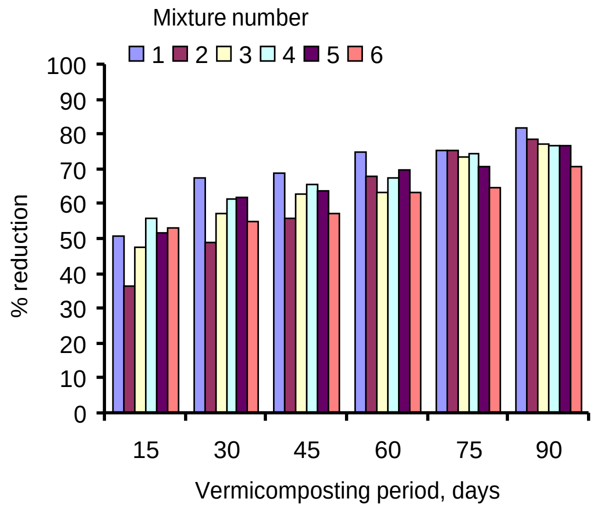

Figure 4. % reduction of Cd of different feed mixtures with time during vermicomposting process

Heavy metals in earthworm body

The earthworms E. foetida collected at the end of the experiment from different feed mixtures exhibited significant concentrations of Cd in their bodies (Figure 5). Statistical analysis confirmed the differences in Cd contents among the feed mixtures (Table 4). Figure 5 illustrates that the concentrations of heavy metals, including Cd, in earthworm body tissues decreased over time during the vermicomposting process. The feed mixture no. 6 (50% SS + 25% HH + 25% CM) had significantly higher Cd content in earthworm bodies compared to other feed mixtures (P<0.01). The Cd content in earthworms was directly related to the Cd concentrations in the feed mixtures, indicating a direct uptake of Cd from the feed material.

The bioaccumulation of high concentrations of metals in earthworm tissues has been well-documented in previous studies (Hsu et al., 2006; Kızılkaya, 2004, Suthar, 2008). Earthworms can serve as useful biological indicators of contamination due to their ability to accumulate certain contaminants consistently. The results of this study supported the hypothesis that the proportion of SS in the feed mixtures plays a significant role in the accumulation of heavy metals in earthworm tissues. Earthworms collected from vermibeds with higher proportions of SS showed higher concentrations of heavy metals, including Cd, in their tissues (Hsu et al., 2006; Kızılkaya, 2004, Suthar, 2008, Lukkari et al., 2006).

Among the studied heavy metals, Zn and Cu exhibited greater concentrations in the tissues of inhabiting earthworms. This could be attributed to the metabolic requirements of earthworms for these metals. It has been observed that earthworms regulate Zn and Cu concentrations in their tissues, whereas Cd concentrations decrease with increasing Cd concentration in the substrate. Previous studies have also reported the accumulation of heavy metals, including Cd, in earthworm tissues during vermicomposting Ireland, 1983; Carter et al., 1983; Graff, 1982).

Bioaccumulation factors (BAFs)

The bioaccumulation factors (BAFs) for Cd in the earthworm E. foetida body tissues during the 90-day vermicomposting period are shown in Figure 5. The BAF values varied among the different feed mixtures, as indicated in Table 4. When the BAFs were calculated relative to the total Cd concentrations in the different feed mixtures, they were found to be lower than 3 for Cd. Furthermore, the results demonstrated that the BAF values increased with higher proportions of SS in the feed mixtures (Figure 6).

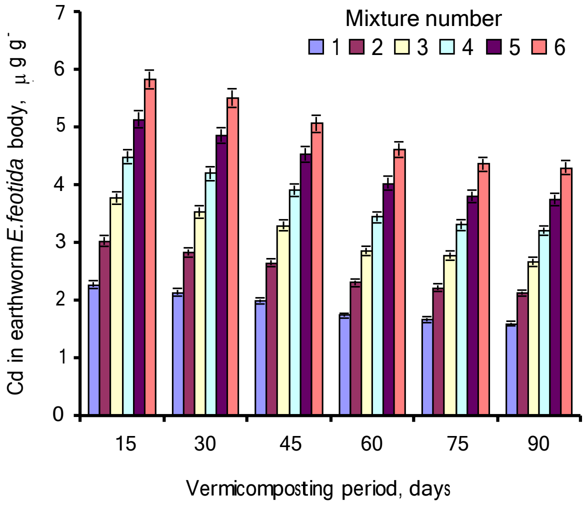

Figure 5. Changes in Cd contents in earthworm E.feotida body during vermicomposting process.

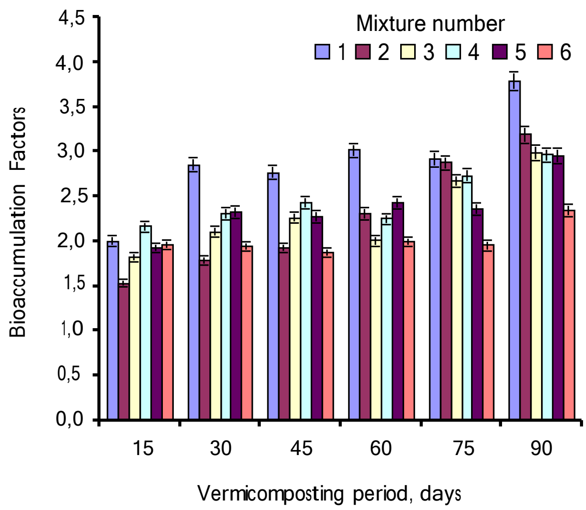

Figure 6. Bioaccumulation factors of Cd accumulated in earthworm *Eisenia feotida* body in feed with different mixtures.

Figure 6 presents the relationship between BAF and the proportion of SS in the feed mixtures. Recent studies have suggested that the accumulation of metals in earthworms, particularly Cd, Cu, and Zn, is primarily attributed to the binding of metals by metallothioneins (Kagi and Kojima, 1987). However, the BAF ranges observed in this study were higher than those reported in earlier studies (Dia et al., 2004; Hsu et al., 2006; Suthar and Singh, 2008; Kızılkaya, 2004; 2005). The disparity in BAF values between the present study and previous research may be attributed to differences in Cd contamination levels, exposure duration, or the species of earthworms used (Morgan and Morgan, 1992). Different earthworm species can exhibit substantial variations in tissue Cd contents due to differences in food selectivity and metabolic physiology (Hopkin, 1989; Ireland, 1983). Earthworms also possess species-specific mechanisms for accumulation and regulation of metals, particularly trace metals like Cu and Zn (Ireland, 1983). It is worth noting that the exposure duration could be a significant factor contributing to the observed differences in BAF values. In this study, the exposure duration was relatively longer (i.e., 90 days) compared to previous investigations (Suthar and Singh, 2008; Kızılkaya, 2004). Some previous studies have reported wide ranges of BAF values for metals in earthworms, suggesting that vermicomposting could pose risks if applied to stabilize SS without proper management of the inoculated worms (References 4 and 6). If not properly managed, there is a considerable risk of transferring toxicants through earthworms to organisms at different trophic levels (Kızılkaya, 2005).

CONCLUSION

In conclusion, the results of this study suggest that vermicomposting can be a viable alternative technology for the management of primary sewage sludge (SS) when mixed with horse manure (HM) and cow manure (CM). The vermicomposting process led to a reduction in the concentration of heavy metals in the sludge. Feed mixtures containing 20% to 30% SS, along with higher proportions of HM and CM, showed the highest increase in earthworm numbers and biomass production rates, as well as the greatest decrease in Cd concentrations during the vermicomposting period. This indicates the capability of the earthworm species E. foetida to accumulate Cd in their body tissues.

However, it should be noted that feed mixtures with higher proportions of SS (≥60%) resulted in greater levels of bioconcentrated metals in earthworm tissues, leading to high mortality rates. Therefore, caution should be exercised when using high proportions of SS in vermicomposting. Nevertheless, when appropriate quantities of primary SS (20-30%) were added to HM and CM, the resulting mixture could be effectively used as a raw material for vermicomposting.

The study also revealed that earthworm biomass production and reproduction performance were excellent in bedding materials with lower proportions of distillery sludge (feed mixtures no. 3 and 4). The numbers and biomass production rates of earthworms were significantly influenced by the proportion of SS in their feed mixtures.

Based on these findings, it can be inferred that SS mixed with HM and CM has the potential to be utilized as an efficient soil conditioner for sustainable land restoration practices when processed by the epigeic earthworm species E. foetida. Furthermore, the application of SS-based vermicompost as a soil conditioner in agricultural fields is not expected to have any adverse effects. In summary, vermicomposting offers a promising solution for the environmentally acceptable disposal of SS, with the added benefits of reducing heavy metal concentrations and enhancing soil fertility when appropriately managed. Further research and field trials are recommended to validate the findings and optimize the vermicomposting process for different soil and waste composition scenarios.

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CORRECTION OF IONIZING RADIATION-INDUCED CHANGES IN PLANTS BY POMEGRANATE EXTRACTS

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As a result of studies, drugs obtained from pomegranate peel, septa and leaves have been proven to reduce the level of lipid peroxidation in Allium cepa cells as a result of treatment of the seeds with these extracts before radiation.

Treatment with extracts before irradiation weakens the formation process of MDA. The radioprotective effect of these compounds is of great importance in the studied topic, because MDA, formed during the oxidation of unsaturated fatty acids contained in many food products, has the ability to form mutagenic nitrosamines in the presence of nitrites, nitrates and carbon.

Key words: *gamma irradiation, Pomegranate, LP (lipid peroxidation), MDA (malondialdehyde).*

INTRODUCTION

In the work carried out in the direction of protecting plants from radiation, priority is given to the study of radioprotectors, substances that accelerate the development of the body, normalize metabolism and eliminate genetic changes. When the salts of metals such as iron, nickel, cobalt, sodium, potassium, strontium are introduced into the body, it is known that they have a therapeutic effect as well as a preventive effect. In addition to these, it is appropriate to conduct research in the direction of studying the immune-stimulating and genoprotective properties of extracts obtained from plants. Representing the relationship between DNA molecules, between protein molecules, as well as between DNA and protein molecules, according to the hypothesis of the authors of, which are formed in vivo with the participation of various metabolites that are constantly present in cells, and are a trigger that determines cell aging mediated the inevitable accumulation of DNA damage during aging.

The study of the patterns of genetic instability in plants is of great fundamental and applied importance, in particular, for predicting the long-term consequences of irradiation of various plant species in order to preserve their gene pool. It is also possible to use plants with known characteristics of genomic instability as test systems for assessing the genetic consequences of radionuclide contamination and other stress factors, monitoring natural ecosystems over large areas in areas of environmental disasters; environmental risk assessments; obtaining new forms in the selection[2,8,10].

Thus, the theory of aging of genomic instability in combination with the intensity of the appearance of free radicals suggests that proper coverage of the components of the antioxidant defense system in cells can maintain the functional state of the DNA molecule and the stability of transmission of physiological information established by hereditary information by regulating the rate and direction of the redox potential. Taking into account the known data on the primary reactions underlying the physiological aging process, as well as the results of our comprehensive study, we can formulate some conclusions about the mechanism of radioprotective action extract of Pomegranate, which, as it turned out, is diverse and composes from closely interlocking functional paths.

MATERIAL AND METHODS.

Irradiation of the onion seeds *Allium cepa* was performed on “Issledovatel” apparatus (^{60}Co) at dose rate 0.02 Gy/s and “Rhuxund-20000” apparatus (^{60}Co) at dose rate 0.5-1 Gy/min. Control and irradiated seeds were couched on the wet filter paper in the Petri dishes at 24ºC. Analysis of the lipid peroxidation (LP) rate by the procedure of registration of the malondialdehyde (MDA) quantitative content in plant leaves through colour reaction with thiobarbituric acid by change of the optical density of the stained complex on СФ-26 at 532 nm. Intensity of the lipid peroxidation in plant leaves was evaluated by accumulation of MDA oxidation products in tissues which was measured by colour reaction with thiobarbituric acid [2,8,9]. For that purpose, 0.3 mL of the buffer (Tris NaCl HCl) was added to the test tube with 0.3 g weight of the plant material, homogenized, and then 2 mL of 0.5% thiobarbituric acid (TBA) in 20% trichlor acetic acid (TCA) was added, and incubation was performed during 30 min. on boiling water bath with subsequent filtration. Then filtrate was transferred to the cuvette, and optical density was measured on СФ-26 spectrophotometer at 532 nm wave length. Environment with reagents was used for control.

The fruits, bark and leaves of Pomegranate peel, leaves and partitions contain various biologically active substances - alkaloids, proteins, essential oils, vitamins, dyes (plant pigments) [2].

Pomegranate peel, leaves and partitions extract was obtained from of the plant Pomegranate. The plant mass was ground. 20 g of Pomegranate peel, leaves and partitions were poured into 150 ml of ethyl alcohol and boiled for 2 hours in a Soxhlet apparatus. The resulting extract was filtered and evaporated in a water bath until a dry residue formed.

We obtained rutin from the peel, leaves and partitions Pomegranate, which is a widespread plant and is characterized by a particularly high (up to 10-15%) content of this substance. To obtain vitamins, Pomegranate peel, leaves and partitions were extracted with 70% alcohol. Extraction was carried out at a temperature of 70-80° C. Then the precipitate was washed with water with dichloroethane.

Pomegranate leaves extract was obtained from green leavs. The leavs were ground and washed with pentane or hexane to remove oils. Then it was boiled for 5 hours in isopropyl alcohol. The resulting liquid extract was evaporated under vacuum on a rotary evaporator to obtain a dark brown dry extract.

In the study of radioprotective properties, various concentrations of plant extracts of 0,1(μg / ml;%), 0.01(μg / ml;%), 0,001 (μg / ml;%) were used.

To study the process of lipid peroxidation (POL), we used the method of recording the quantitative content of malondialdehyde (MDA) in plant leaves by color reaction with thiobarbituric acid by changing the optical density of the colored complex. The measurement was carried out on an SF-26 spectrophotometer at 532 nm. The intensity of lipid peroxidation in plant leaves was estimated by the accumulation in the tissues of the MDA oxidation product, determined by the color reaction with thiobarbituric acid (3). For this purpose, 0.3 ml of buffer (Tris NaCl HCl) was added to a 0.3 g sample of plant material in a test tube, homogenized, and 2 ml of 0.5% thiobarbituric acid (TBA) in 20% trichloroacetic acid (TCA) was added.), incubated for 30 min in a boiling water bath, filtered. Then, the filtrate was transferred to a cuvette and the optical density was determined on an SF-26 spectrophotometer at a wavelength of 532 nm. The control was a medium with reagents.

The concentration of MDA was calculated by the formula:

$C = D / EL$,

where C- is the concentration of MDA, μm, D- is the optical density, E- is the molar extinction coefficient (1.56 x 108 sm-1M-1), L -is the thickness of the solution layer in the cuvette (1 sm).

The amount of MDA was calculated in μM per 1 g of wet weight of plant material.

RESULTS AND DISCUSSION

The impossibility of isolating the genetic apparatus of organisms from various environmental stress factors, such as ionizing radiation, predetermined the need for additional stimulation of the biological capabilities of organisms, allowing them to adapt to the action of these components of the biosphere. This can be achieved with the regulation of the resistance of organisms, biologically active compounds. It is known that protectors exert their effect by correcting the processes of cellular metabolism, stimulating or suppressing them [1,9]. MDA resulting from chain reaction of peroxidation by free radicals of polyunsaturated fatty acids is not only the indicator of free radicals rate (FR) and peroxide processes, but it also easily reacts with macromolecules. Lipid peroxidation process is induced by free radical oxygen forms which form unstable lipid hydroperoxides able to spontaneous decomposition through attacking of polyunsaturated fatty acid chains. However in this dose range, in the mode without processing, it increased 2-fold; and with processing - only to 1.5 times as an average. Another unique feature of Pomogranate peel, leaf and partitions treatment impact was increase of their action at higher doses. Thus,at 1 Gy, decrease of MDA ranged from 88% to 95%, and at 15 Gy it was much lower: 60% to 72% [Tabl.]. Thus, it was shown that treatment of seeds with Pomogranate peel, leaf and partitions extracts before irradiation led to reduced MDA concentration in plant tissues obtained from irritated seeds. First of all, considering the aging mechanism from the standpoint of its relationship with the reliability of the functioning of repair systems, it can be argued that one of the ways of radioprotective regulation of this mutation process caused by physiological aging is its effect on the activity of individual stages of DNA repair. So, it was shown that pre-irradiation of seed treatment with peel, leaf and partitions extracts caused a decrease in the concentration of MDA in plant tissues obtained from irradiated seeds.

Radioprotective action of this compounds under the studied subject seems to be of significant importance, because MDA forming during unsaturated fatty acids' per oxidation, contained in many food products moreover has the ability to form mutagenic nitrosamines in the presence of nitrites, nitrates, and carbon compounds.

It was revealed that the treatment of seeds with pomegranate peel, partitions and leaves extracts before irradiation caused a weakening of the effect of lipid peroxidation, as evidenced by a decrease in the concentration of malondialdehyde in plant tissues obtained from treated seeds. The decrease in the content of this compound due to the action of plant extracts indicates their antioxidant properties. This indicates that a decrease in the development of radiation-induced instability of the genome may be associated with the antioxidant activity of the natural radioprotectors of pomegranate peel, partitions and leaves extracts used.

Table.

Effect of gamma radiation on leaves obtained from Allium cepa L. seeds, pomegranate peel extract, pomegranate leaves extract and partitions extract on malondialdehyde (MDA) levels (0.001%)

Variants	Dos, Gy					
	0	1	2.5	5	10	15
Control	0.50±0.01 (0.45-0.51)	0.62±0.01 (0.58-0.63)	0.73±0.01 (0.70-0.75)	0.92±0.01 (0.90-0.92)	0.92±0.02 (0.87-0.93)	1.23±0.01 (1.12-1.24)
Extract of Pomogranate Peel	0.52±0.01 (0.44-0.52)	0.50±0.01 (0.47-0.51)	0.59±0.01 (0.52-0.60)	0.78±0.02 (0.65-0.80)	0.84±0.00 (0.81-0.85)	0.80±0.01 (0.74-0.80)
P	<0.001	<0.001	<0.001	<0.001	<0.001	–
Extract of Pomogranate leaves	0.50±0.01 (0.46-0.51)	0.51±0.01 (0.47-0.53)	0.63±0.00 (0.62-0.64)	0.69±0.00 (0.65-0.69)	0.81±0.01 (0.78-0.80)	0.84±0.01 (0.82-0.85)
P	<0.05	<0.001	<0.001	<0.001	<0.001	–
Extract of Pomogranate partitions	0.51±0.01 (0.44-0.52)	0.53±0.00 (0.49-0.55)	0.66±0.02 (0.49-0.66)	0.66±0.01 (0.60-0.69)	0.76±0.02 (0.66-0.77)	0.80±0.01 (0.76-0.81)
P	<0.05	<0.001	<0.001	<0.001	<0.001	–

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BIOGEOCENOSIS - AN ELEMENTARY STRUCTURAL COMPONENT OF THE BIOSPHERE

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The biosphere, according to the figurative expression of V.R.Vernadsky, is the planetary shell of the Earth. The biosphere, as a planetary phenomenon, is based on the transformation of matter-energy and information cations by living matter in a long evolutionary time. The evolution of the biosphere is closely connected with the evolution of the forms of living matter and the complication of their biogeochemical functions. The elementary structural unit of the biosphere is biogeocenosis. Biogeocenosis, as a natural-historical body, is the fate of a homogeneous topographic microclimatic, biocenotic, soil, hydrological and geochemical relationship.

Biogeocenosis includes a certain community of organisms, soil, soil and ground water and the lower layers of the troposphere. If we take into account that each biogeocenosis is formed in different environmental conditions, then it is natural that each of them has its own cycle of substances and a certain nature of solar energy flows, the functions of which are the creation of bioproducts.

In this article, in a generalized form, on a methodological basis, fundamental research in the field of soil science, ecology and soil biology is covered, which are applied to all types of soils with their natural habitats, natural and cultivated biotopes. First of all, this refers to the problem of the energy of soil formation and agro-energy. As a component of the biosphere, the soil and its constituent elements are interconnected by a common energy flow. In natural ecosystems, biomass energy is accumulated in humic substances, determining soil fertility. In agroecosystems, a significant part of the energy is alienated in the form of plant and animal mass, which leads to a violation of the established biogeochemical cycles.

The soils of Azerbaijan are distributed in various geographical areas with arid, humid and semi-humid environmental conditions. The study of the nature of soil formation in these regions showed the formation of very specific morphogenetic soil profiles. On the one hand, these studies confirm the basic principle of vertical zoning of soils, and on the other hand, the diverse biological activity of living organisms as a biological factor in soil formation. Therefore, characteristic complexes of soil invertebrates and microorganisms can be used in soil diagnostics as biological tests. Finally, it should be noted that each farm must individually develop model programs for the intensive development of specific sectors (for example, tea growing) of agricultural production. In this regard, model options for soil fertility, environmental assessment and monitoring of soils in the Lankaran region are being successfully developed.

Keywords*: biogeocenosis, soil, biosphere, energy*

INTRODUCTION

The soil, which is a product of the interaction of living organisms and rocks, creates a characteristic area of a large concentration of living matter and the energy associated with it.

The complexity and heterogeneity of the soil environment creates a wide variety of conditions for a variety of functional groups: aerobes and anaerobes, consumers of organic and mineral compounds.

In the natural state, each individual ecosystem (biogeocenosis) is a self-regulating mechanism and represents a certain level of interaction and organization of living matter and inanimate matter. Ecosystems "organisms-soil" perform the most important functions in the biosphere, this is a continuous ongoing process of biogenic accumulation, transformation and redistribution of solar energy, maintaining the cycle of chemical (biophilic) elements in nature, i.e. carried out due to the formation of trophic bonds.

The reliability of the functioning of individual links of biogeocenosis, the achievement of its equilibrium (stationary) state is determined by the level and stable activity of soil organisms.

Therefore, when studying biogeocenoses, as open systems capable of self-regulation for a long time, special attention should be paid to soil research. Proceeding from this, it should be noted that the basis of highly productive agriculture and specific methods of farming is a deep knowledge of the characteristics of the soil cover of the studied region of the zone, economy, as well as taking into account the environmental situation and soil and climatic conditions of the territory. Accounting, assessment, all-round conservation and improvement of soils must be considered as an obligatory part of zonal, regional, local farming systems.

The soil cover is the subject of many-sided human activity, the object of his labor and the means of production. The soil cover is a planetary receiver of wastes of various composition. In soils, the destruction of many organic and organo-mineral wastes is completed. Unlike fresh water sources, flora and fauna, the soil cover does not self-renew itself after destruction.

At the same time, unlike non-renewable resources (oil, gas, coal, ores), the correct use of soils in agriculture is not accompanied by their destruction. On the contrary, agronomically correct tillage in agriculture and forestry not only preserves, but also improves, increases their productivity, which is expressed in the growing biomass of the necessary agricultural crops.

Soils with rational use in agriculture and their cultivation acquire new, qualitative properties.

The soil cover and especially the humus shell serve as a planetary accumulator and distributor of energy, which is transformed into the creation of secondary (animal) products and is spent on intrasoil elementary processes.

Farming requires deep scientific substantiation of the thoroughness of the agrotechnical, ameliorative handling of "living means of production." That is why one of the most important problems of mankind is the effective use of the land fund, its preservation as a component of the biosphere.

OBJECTS AND RESEARCH METHODOLOGY

In this article, in a generalized form, on a methodological basis, fundamental research in the field of soil science, ecology and soil biology is covered, which are applied to all types of soils with their natural habitats, natural and cultivated biotopes. First of all, this refers to the problem of the energy of soil formation and agro-energy. As a component of the biosphere, the soil and its constituent elements are interconnected by a common energy flow. In natural ecosystems, biomass energy is accumulated in humic substances, determining soil fertility. In agroecosystems, a significant part of the energy is alienated in the form of plant and animal mass, which leads to a violation of the established biogeochemical cycles.

Therefore, it is advisable to study these processes on an energy basis, which will allow a comparative assessment of the transformation of energy between natural and cultural ecosystems [1,2].

Soil organisms, being active participants in the transformation of organic residues and humus formation, are an important energy block in the trophic structure of pedobiotes [7]. Since various types of soils are common in characteristic geographic areas, the study of environmental conditions, the formation of their morphogenetic profiles is important [8].

In this context, the environmental assessment of soils in terms of their fertility and ability to produce crops of plant biomass is becoming essential. In other words, using complex ecological, geographical and biological indicators, a completely new, innovative method of scoring soils is being implemented [4]. The result of these studies is the compilation of functional models of soil fertility and energy transformation for specific soil types under various crops [6,7].

THE DISCUSSION OF THE RESULTS

The soil, being a component of the biosphere, is a special form of natural resources. At the same time, knowledge and protection of the soil cover is the basis of productive agriculture. However, the main basis for highly productive agriculture and specific farming practices is a deep knowledge of the characteristics of the soil cover of the region under study, as well as a correct assessment of environmental conditions.

The soils of Azerbaijan are distributed in various geographical areas with arid, humid and semi-humid environmental conditions. The study of the nature of soil formation in these regions showed the formation of very specific morphogenetic soil profiles. On the one hand, these studies confirm the basic principle of vertical zoning of soils, and on the other hand, the diverse biological activity of living organisms as a biological factor in soil formation. Therefore, characteristic complexes of soil invertebrates and microorganisms can be used in soil diagnostics as biological tests.

Soil animals are a good bioindicator of saline soils, as well as some anthropogenic changes in technogenic landscapes. The rational use of the soil cover and its resources contributes to the conservation of soil fertility, the accumulation of energy reserves and biophilic elements in ecosystems, as well as its stable functioning. This natural principle should be actively implemented in the practice of agricultural production.

It should be especially noted that agriculture is a peculiar and complex kind of biological industry, in which the main means of production is living matter: plants, microorganisms, animals and soils. Therefore, agriculture requires deep scientific validity, proper agrotechnical, reclamation and mechanical handling of living soil.

High bioproductivity of plants is possible only under the condition of optimal ecological conformity of the environment and organisms. The correct use of natural resources is possible only with strictly scientific quantitative and qualitative accounting of soils, i.e. maintaining a land cadastre, which includes a set of necessary information about the natural, economic and legal status of lands.

The land cadastre serves the purposes of organizing the efficient use of land and its protection, placement and specialization of agricultural production. Among the main forms of quantitative and qualitative accounting of soils are various materials of large-scale soil research: soil maps, cartograms. This should include the agro-production grouping (according to the commonality of agronomic, the proximity of environmental conditions, fertility levels, etc.) and the grading (comparative assessment of soils by their productivity) of soils.

Each natural and economic region needs to develop its own long-term development program in relation to local environmental conditions. Such development programs should have not only large state, but also individual farms. Fundamental research has been carried out in Azerbaijan in the field of cadastre and grading of soils [3,4].

Finally, it should be noted that each farm must individually develop model programs for the intensive development of specific sectors (for example, tea growing) of agricultural production. In this regard, model options for soil fertility, environmental assessment and monitoring of soils in the Lankaran region are being successfully developed [5,6].

CONCLUSIONS

1. The significance of biogeocenosis as an elementary, structural component of the biosphere in the global energy transformation and biogeochemical circulation of substances is theoretically analyzed.

2. The methodological foundations of fundamental research in the field of soil science, ecology and soil biology are considered.

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INFLUENCE OF ORGANIC-MINERAL COMPLEXES ON THE DEVELOPMENT OF AGROCENOSES ON THE BACKGROUND OF MINERAL FERTILIZERS

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Increasing the production of agricultural products has created a foundation for the development of the industry related to agriculture. For the implementation of works in this direction, our Republic has favorable soil and climate conditions and great internal possibilities.

Protection and improvement of fertility and its physical, chemical, biological indicators should always be in focus, along with crop production, in conditions of intensive use of land in agriculture. In terms of providing plants with air, water and nutrients, soil fertility has important agroecological importance.

Increasing the productivity of agricultural crops in the republic is always relevant as an unchanging priority. In addition, the availability of environmentally friendly products on a global scale is a very important issue from both the health and food safety point of view. The mentioned factors coincide with the requirements of the time, the achievement of high productivity with the application of organic-mineral fertilizers obtained from natural resources.

In this regard, the research work carried out by researchers conducting research in the fields of geology, technology, chemistry, argochemistry and botany was devoted to studying the mineralogical and chemical properties of various raw materials and waste products available in Azerbaijan, obtaining organic-mineral complexes from them and studying their effects on the cultivation of agricultural plants. has been done.

There are various raw materials and wastes in our country, which have both reserves and rich mineralogical and chemical properties. For this reason, it is possible to use these resources as fertilizers in various directions, mainly in agriculture, in the direction of preserving soil fertility and increasing crop production. Although these resources have a high application potential, their use has not been resolved. [2]

It is relevant and important to satisfy the biological characteristics of plants and fertilization requirements, to determine the level of soil nutrient supply and to apply recommended fertilizer rates.

The article is devoted to the investigation of mineralogical and chemical characteristics of combustible shale, plant residues and wastes from sewage treatment, and at the same time, to the preparation of organic-mineral complexes using their various proportions and to the study of their effects in the cultivation of agricultural plants.

In the conducted complex research studies, it has been confirmed that raw materials and wastes that have not been used so far have the necessary properties as organic-mineral fertilizers, and that they have a better effect on the development and productivity of agrocenoses cultivated with traditional fertilizers.

Keywords: *organic-mineral complex, plant residue, fertility, yield, chemical composition, mineralogical composition.*

THE OBJECT AND METHODOLOGY OF THE RESEARCH

In our country, there are various raw materials and wastes, rich in both reserves and rich mineralogical and chemical properties. Examples of these resources include combustible shale, plant residues that become waste after harvesting, as well as excess active waste obtained after biological treatment of wastewater [3].

Let's consider some chemical and mineralogical characteristics of the mentioned raw materials. In the Absheron Peninsula, Shamakhi-Gobustan, Guba and Ismayilli regions of our republic, deposits and manifestations of igneous shale, which are considered useful raw material resources, are widespread. it is rich in boron, manganese, lithium, vanadium, nickel and other elements. [3]

Currently, the cotton plant is cultivated in the southern and subtropical regions of our republic. Calculations show that the amount of plant residues actually turned into waste after harvesting the cotton crop in one farmer's field is estimated to be more than thousands of tons. [1]. In various domestic and foreign literature materials, along with research results on the benefits of alternative fuel-raw materials resources of shale as fertilizer, information about their possible use in this direction is found. [4;5]

Due to its chemical and mineralogical composition, combustible shales can be used as raw materials in various directions, including in agriculture, to increase soil fertility.

In order to prepare organic and mineral complexes, the igneous shales of Guzdak and Cengi River, as well as the sodium salt of naphthenic acids, were used.

Table 1

Geochemical comparison of igneous shales of Azerbaijan and foreign countries

Countries	Organic matter, %	Sulfur, %	Ash, %	Heat generation, mC/kq
Azerbaijan	15,0-31,0	0,4-1,2	65,0-85,0	6,0-12,0
Foreign countries	12,0-28,0	0,7-6,0	51,0-79,0	4,0-10,5

The chemical, mineralogical, agrochemical composition of the samples was studied and it was found that the amount of metal and non-metal oxides varied between 0.12-54.93%. According to mineralogical composition, 10% montmorillonite, 12% hematite, 2% pyrite were determined.

The acidity (pH) of the prepared organic-mineral complexes varied from 4.61 to 8.55, it has medium acid and weak alkaline properties. Burnt and unburned Guzdak shale is carbonate-free. The content of calcium carbonate in Goychay igneous shale and volcanic ash varied between 2.07-4.22%.

The amount of organic carbon in the prepared organic-mineral complexes is 0.552-2.259%, total humus is 0.97-4.32%, total nitrogen is 0.069-0.313%, active phosphorus is 3.3-23.4mg/kg, and exchangeable potassium is 159.0-2004mg/kg.

However, in regions where cotton is cultivated, although their plant residues are used individually by the population as a type of household fuel, in most cases, their residues hinder the movement of tractor mechanisms as waste, and complete cleaning from cultivated fields requires additional costs. For this reason, by remaining in the soil, plant residues play a role in causing agrotechnical complications in the process of its cultivation in the next year.

At present, modern technologies are used in the world, as well as in our republic, to neutralize waste water after treatment. During the removal of waste residues, it causes the formation of a large layer of sludge.

Since this sludge fraction is in a semi-liquid phase, its transportation causes additional difficulties. And dumping this mass of sludge into the environment creates ecological problems.

Mineralogical and chemical characteristics of combustible shales, plant residues (cotton straw) and surplus waste products. To date, organic-mineral complexes have been mineralogically and chemically analyzed, and the concentrations of the components in them have been analyzed for the purpose of obtaining organic-mineral complexes from combustible shale, cotton straw, and excess waste, which are not widely used in obtaining energy resources, agricultural or construction materials of various profiles.

Material and methods - In the research work, samples of combustible shale from Gobustan region, excess waste obtained as a result of wastewater treatment in Sumgayit water-canal

Department, and cotton straw samples were collected from the farm belonging to Azadkend municipality of Saatli region, mineralogical and geochemical analyzes were carried out in analytical devices and equipment.

Results and their discussion - The main concentrations that attract attention in terms of mineralogical diversity in the studied raw materials and surplus waste are clay minerals in shales, especially illite (20%) and montmorillonite (25%), phosphorus compounds in cotton straw Fe(H2PO3)3 (20%) , FePO4 (3%), and calcite (28%), montmorillonite (10%), etc. in excess waste. is related to

It is known from the conducted scientific research that natural bentonite mineral (clay) enriches the soil with additional nutrients, improves its physical and chemical properties and increases the productivity of agricultural plants. The most important ecological problem is the "nitrate" problem, the transition of solidified phosphorus compounds to assimilated forms, and the loss of nutrients from mineral fertilizers as a result of atmospheric sediments and washing with irrigation water [6].

When the nitrogen fertilizers (NH4NO3) given to the soil are hot and dry, ammonia (NO3) escapes into the air in the form of gas, and nitrate (NO3) is washed into the lower layers of the soil by atmospheric sediments and irrigation water and pollutes the underground water by mixing with groundwater. In order to avoid this problem, by using natural adsorbents, the damage caused by "nitrate", which is a universal problem, to human health has been prevented.

In order to prevent the loss of nutrients in mineral fertilizers, natural bentonite clay, which has high adsorption properties, was used. Bentonite clay contains 75.6% montmoriolinite, which has a strong water retention property. The use of bentonite mineral under the water-demanding grape plant is of particular importance.

In addition, 21% organic matter was determined in combustible shale, 95% in cotton straw, and 67% in excess waste. As you can see, although the mineral part of cotton straw is weak, its richness in organic matter determines its superiority.

Taking into account the mineralogical and chemical properties of the mentioned raw materials and household waste products, a mineral-organic complex was prepared by us and tested in the cultivation of cotton and grape plants. The experiments were carried out under the cotton plant (BO-440 white gold cotton variety) in the grass-grey soils of the Mugan-Salyan zone (in the territory of the Azadkend municipality of the Saatli region) and the "Madrasah" grape variety in the mountain-brown soils of Mountanous-Shirvan (Muganli village of the Shamakhi region). Taking soil samples from the experiment area in advance, absorbed ammonia nitrogen, nitrate nitrogen, exchangeable potassium, mobile phosphorus, pH of soil-water suspension, total humus amount were studied according to the relevant methodology. As a result of the agrochemical analyzes of grass-gray and mountain-brown soils during the conducted research, it was found that these soils have an alkaline soil environment and are well supplied with general forms of nutrients. However, the forms of nutrients that can be assimilated by plants are poorly provided. For this reason, it is important to apply organic and mineral fertilizers to obtain good yields from these soils.

In general, field researches were conducted in accordance with accepted agronomic practices. During the research, phenological observations were made on the plants according to the options applied, and the effect of organic mineral complexes on the growth and development of the plant was studied. It was found that compared to the control option, the organic mineral complex had a noticeable positive effect on the growth and development of the plant. Compared to the control variant in the bushing, flowering and full maturity stages, in all three options related to the applied organic-mineral complex, plant height, number of branches and cones were superior. In comparison, the Fon + complex variant attracted more attention from the point of view of height and productivity. The research results show that since the grass-grey soils used for testing are heavy granular soils, the application of organic and mineral complexes had a positive effect on their structure to some extent.

Table 2

Chemical and mineralogical composition of Guzdak, Cengichay shale (burnt). Chemical composition of samples - in %.

The name of the instance	Na_2O	MgO	Al_2O_3	SiO_2	SO_3	P_2O_5	K_2O	CaO	TiO_2	MnO	Fe_2O_3	Cl^-	YTİ
Guzdak shale (burnt)	2,29	1,64	16,03	61,50	1,35	0,01	3,77	0,31	0,91	0,19	3,33	0,65	7,80
Cengichay shale (burnt)	1,54	2,48	13,31	46,28	3,38	0,13	2,78	7,35	0,68	0,05	5,39	0,02	16,24

The name of the instance	Ba	Zr	Rb	Cu	Cr	Mo	Sr	Zn	Ni	Br	Ga	Nb
Guzdak shale (burnt)	0,0591	0,0198	0,0189	0,0196	0,0178	0,0189	0,0101	0,0101	0,0085	0,0038	0,0030	0,0024
Cengichay shale (burnt)	0,0196	0,0158	0,0112	0,0197	0,0094	0,0101	0,0396	0,0392	0,0179	0,0011	0,0007	0,0009

Mineralogical composition of the samples in %

The name of the instance	SiO_2 (α - quartz)	Albit	FeS_2 (pirit)	Magnesium calcite	Calcite	İllite	Caolinit	Fe_2O_3 (hematit)	Montmorillonite	Klinptilolite
Guzdak shale (burnt)	39	16	-	-	-	12	-	5	23	5
Cengichay shale (burnt)	20	5	-	-	20	21	3	3	28	-

Combustible shale, rich in mineral substances, was used in the preparation of the organic mineral complex. The innovations shown in the literature, which we use (in %) of montmorillonite in the composition of igneous shale, can also be applied to the prepared mineral complexes. That is, the prevention of the loss of nutrients, the transfer of solidified phosphorus compounds to absorbed forms, and at the same time the improvement of the soil's water retention properties are of great importance.

CONCLUSION

For the first time, mineralogical and chemical properties of combustible shale, cotton straw and excess waste as natural raw materials and waste were investigated, and organic-mineral complexes were obtained from their various ratios.

The application of organic-mineral complex to heavy gravel grass-grey soils, which have a soil-alkaline environment and are well provided with general forms of nutrients, but poorly provided with forms that can be assimilated by plants, had a positive effect on the development of cotton plants.

From the lysimeter research conducted under the vineyards in the mountain-brown soils of Mountainous Shirvan, it was found that 7.3% of nitrogen, 0.88% of phosphorus, and 5.49% of potassium were leached from the mineral fertilizers given in the N100P100K120 norm, in the case that the fertilizers were applied 1:2 with the complex as 0.40; 1.06; 0.82%, except nitrogen, potassium 0.22%, phosphorus fertilizer (1.17%) in 1:5 leaching decreased.

The increase in the amount of phosphorus in the lysimeter waters was due to the transition of solidified phosphorus compounds to assimilated forms, which is of great importance both ecologically and experimentally.

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STUDY OF THE SALT COMPOSITION OF THE TARTARCHAY WATER

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The article deals with the changes in salt composition of the Tartarchay water (near the Barda district). River waters perform a great job in the migration of chemical elements and having the highest speed of movement among natural waters. They wash and decompose rocks and soil, mixing suspended and dissolved substances.Thus, the study of salts dissolved in river waters used for various purposes is carried out in the field of salinization of soils, irrigation of agricultural crops, use of river waters as drinking water, construction of hydraulic structures, etc. of great scientific and practical importance.The salt composition of river waters differs sharply from each other due to the variety of formation conditions.

The water samples of the Tartarchay have been taken and dry residue, salt ion, the environment content and other indicators have been studied to learn a composition of the river waters in here.

It is seen from the analysis results that the salt quantity was 0.870 g/l in the water of the Tartarchay. CO_3 ion hasn't been followed in these waters, but the other ions change depending on rivers. A quantity of Cl -ion in the river water was 0.224 g/l. The middle Jurassic sedimentaries newly spreaded in the volcanogen facies of the Tartarchay basin. Cracking of the rocks is explained by over feeding of river with underground water. Here, an amount of SO_4^{-2} ion was 0.214 g/l, but a quantity of HCO_3^- ion was 0.288 g/l. An amount of $Na+K^1$ was superior compared to Ca^{+2} and Mg^{+2} among cations. Its amount was 0.078 g/l in the composition of the investigated river water. An environment of the water was 7.82 and it has a alkaline character.

Key words: *Ions, Mineralization, River, Salt quantity,Salinization Water quality*

INTRODUCTION

The Little Caucasus province particularly differs from other regions with its unique geographical position, relief and climate characters. The relief complexity of the relief has led to the formation of dry, cold winter and mountain-tundra climate types. The following regularity prevails in distribution of the atmospheric precipitations in the Little Caucasus as in all mountainous countries: the least precipitation falls in the foothills, an amount of precipitations also rises with the increase of the sea level. The reasons of these diversity are the following: physical and geographical situation, morphometry, the content of dissolved substances entering the river by tributaries, general anthropogenic loading, etc. An annual quantity of the atmospheric precipitations changes from 300-400 mm to 600 mm in the Little Caucasus. Such diversity of the precipitation quantity is related to the relief comlexity, air masses coming from different direction.

The hydrographic network of the Little Caucasus province developed to a different degree depending on climate, relief, geological structure, surface sloping, vegetation and other ecological factors. The river network developed well in the middle-mountainous stripe occupying the heights of 1000-2500 m, but it developed weakly below and above the heights.

The Tartarchay – a total length of the river is 200 km, an area of the basin is 2650 km^2. The Tartarchay is the right tributary of the Kur river with the highest wateriness. The river flows from the zone of 4 regions - Kalbajar, Aghdara, Barda and Tartar. 14% of the flow is formed from rain, 28% from snow and 58% from underground water. The snow water forms floods in the river in spring and summer seasons. The flood begins from March and continues till June, July (100-120 days). The water becomes diminished in August-September months. The rains of October-November months form little floods in the river again (12).

The fact that the demand for river waters is increasing day by day shows how important the study of the chemical composition of waters is in modern times.The study of the chemical composition of river waters in Azerbaijan began in 1938. The chemical composition of the rivers were studied by O.A. Alyokin (3), S.Sh.Rustamov, R.M.Gashgay (10) and others.

The chemical flow of the rivers it depends on the environment in which it is formed. Geological-geomorphological conditions play an important role in the formation of chemical flow. The lithological composition of the rocks is chemical in the middle and upper reaches has a significant effect on the formation of the flow. The filtered water dissolves the salts in the rock, changes its density, stickiness, mineralization and salt composition.

The quality of irrigation waters differs in various regions, countries and locations based on how the groundwater has been extracted. The quality and composition of the irrigation water may affect plant development, soil structure and the irrigation system itself. Irrigation water quality indicators are completely different from drinking water criteria.The degree of salinization of soils is determined by the amount of salts that can easily dissolve in the water with which they come into contact. Salinity is one of the water parameters that is more related to the quality of irrigation water. Assessment of the quality of river waters by salt content has always been the focus of attention of researchers (1, 5, 6, 7, 8, 9).

In groundwater generally have higher levels of dissolved salts (minerals) than surface water. This is because the mineral rocks that surround the groundwater break down and dissolve in the water, forming the source of dissolved salts in the water. This is because the mineral rocks surrounding the groundwater are broken down and dissolved in the water. Irrigation water can vary greatly in quality depending on the type and amount of dissolved salts.

It is known that the chemical composition of the groundwater and surface waters of any plain area is closely related to the chemical composition of the sediments of the mountainous part covering this area to some extent. Thus, one of the reasons for salinization of the lands in the plain part of the Republic is that the sediments in the mountainous areas surrounding these plains are rich in various salts.

The ratio of the quantities of salt flow of the rivers of the Lesser Caucasus is 9 times smaller than that of the rivers of the Greater Caucasus (2). This can be explained by the widespread distribution of volcanic rocks resistant to washing in the territory of the Lesser Caucasus. It should be noted that large prices for total salt flow are observed mainly in transit rivers. For example, the total salt flow of Okhchuchay is more than that of Tartarchay, with the area of its basin in the Madagiz settlement (2460 km^2) 3.6 times, and the annual average flow volume is 2 times smaller. This can be explained by the increase in the concentration of dissolved salts due to wastewater discharged from the territory of Armenia to Okhchuchay.

METHOD AND MATERIALS

Comparative stationary method was used in the research work. In accordance with the scientific-theoretical and methodological characteristics of the problems posed in 2022, experimental studies were carried out in field, cameral and laboratory conditions. The sample taken from the Tartar river (Barda city) by the "batometer-bottle" method was collected from the middle part of the place where the water does not stagnate and flows in the fastest way.

Their dry residue, CO_3, hydrocarbonate, chlorine, sulfate, calcium, magnesium, Na^1+K^1 ion and pH were determined by the accepted methods(4)

ANALYSIS OF RESULTS

It is of particular importance to look at the recent changes in the modern state of irrigation waters of the area (salt and ion content) and study them on the basis of new approaches. All irrigation water contains dissolved mineral salts with the concentration. 90-95% of the dissolved substances in river waters fall on the main ions, which are divided into cations and anions. Major cations normally include Na^+, K^+, Ca^{2+} and Mg^{2+}. Major anions normally include CO_3^{2-}, HCO_3^-, Cl^- and also SO_4^{2-} .Cation and anion combine in a certain proportion to form the salt content of rivers.

A chemical composition of the Tartarchay, Khachinchay and Injachay waters changes along their flow. So, a chemical compositioin of waters is hydrocalcareous-calcic-magnesium at the foothill zone, but it is hydrocalcareous-sulphate-sodium, sodium-calcic, hydrocalcareous-sulphate in their low flow. The mineraliration rate of waters accordingly changes (a from 0.24 g/l to 2.27 g/l) in the direction of the rivers flow. A slight change is observed along the flow in the Kur river [6]

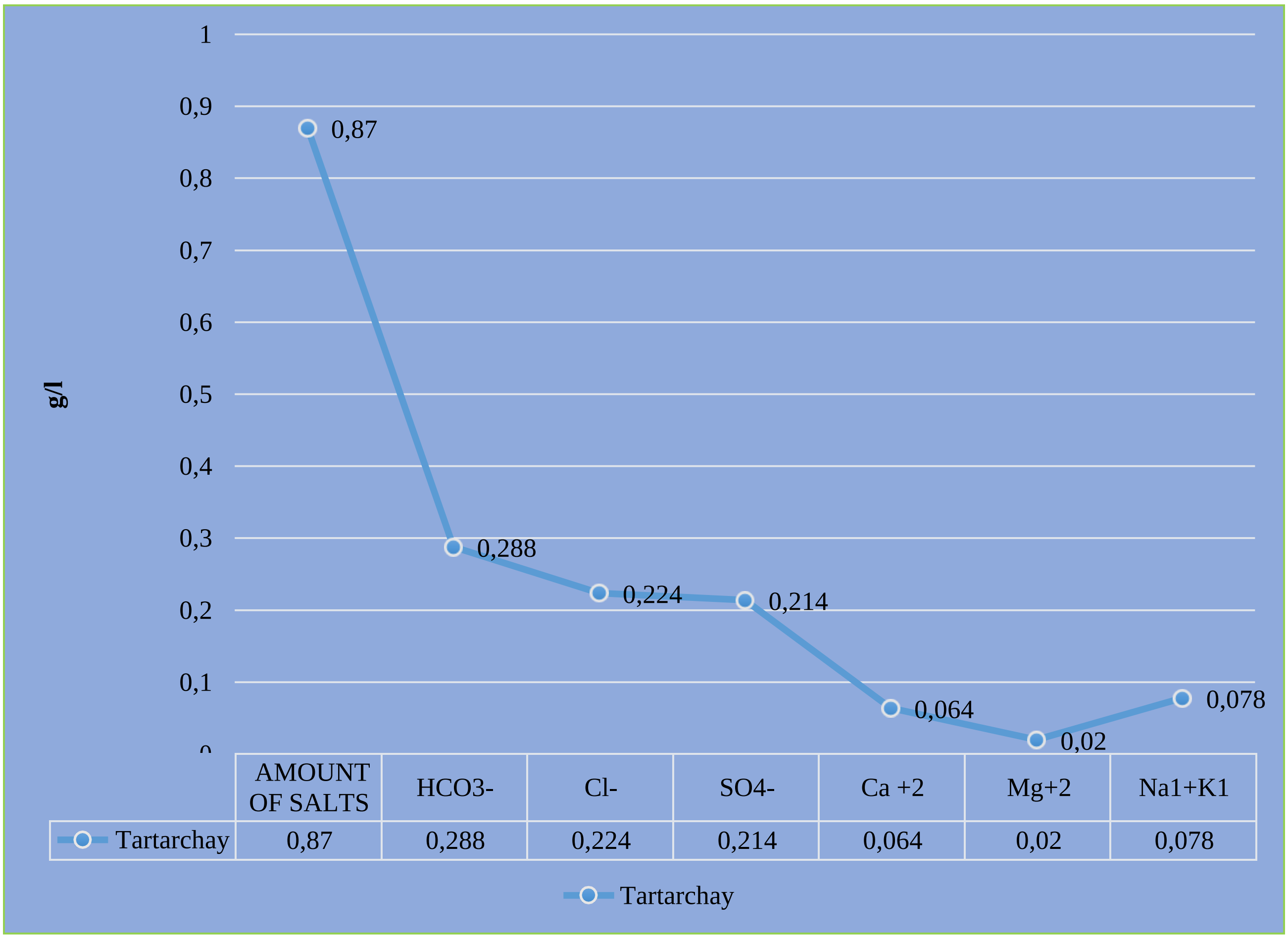
All natural waters are divided into 3 classes (hydrocarbonate, sulfate, chloride) according to the predominance of anions (Alekin, 1970).

M.A.Abduyev's research (2) shows that the river waters of the Lesser Caucasus belong to the hydrocarbonated class as a whole. İt is seem in our researchs, too. (HCO_3>SO_4>Cl)

It is seen from the analysis results that the salt quantity was 0.870 g/l in the water of the Tartarchay. CO_3 ion hasn't been followed in these waters, but the other ions change depending on rivers.

Here, an amount of SO_4^{-2} ion was 0.214 g/l, but a quantity of HCO_3- ion was 0.288 g/l. A quantity of Cl -ion in the river water was 0.224 g/l (Picture 1).

The middle Jurassic sedimentaries newly spreaded in the volcanogen facies of the Tartarchay basin. Cracking of the rocks is explained by over feeding of river with underground water. An amount of Na^1+K^1 was superior compared to Ca^{+2} and Mg^{+2} among cations. Its amount was 0.078 g/l in the composition of the investigated river water. ($Na^1+K^1>Ca^{+2}>Mg^{+2}$)



Picture1. Salt composition of Tartarchay river (g/l)

The pH of the irrigation water has a great influence on the solubility of mineral salts. In general, water for irrigation should have a pH between 5.0 and 7.0. Water with pH below 7.0 is termed "acidic" and water with pH above 7.0 is termed "basic"; pH 7.0 is "neutral". Here, an environment of the water was a alkaline character.

The role of the bringing cones of rivers in the formation of the surface of the area where we are conducting research is great. The cones cover a large area in the plain and are of great importance in the placement of various agricultural crops. For example, the Tartar river's bring cone is made up of four bring cones of different ages, occupying a larger area. The youngest of them descends towards the Kura River, occupying a large area on the plain, and passes into the plain formed by older alluvial-proluvial sediments of the middle and upper quaternary periods. The remaining three parts of the bring cones are narrowed towards the foothills. Wide swampy areas were formed between the bring cones of the Tartar and Khachin rivers. Ravine, gobu and other erosional relief forms have developed on the relatively high-altitude cones[11]

CONCLUSION

From the results of analysis of Tartarchay waters, it is known that the mineralization of the waters here is weak (0,870g/l). It is seen from the analysis results that the salt quantity was 0.870 g/l in the water of the Tartarchay.. A quantity of Cl -ion in the river water was 0.224 g/l. Here, an amount of SO_4^{-2} ion was 0.214 g/l, but a quantity of HCO_3^- ion was 0.288 g/l. An amount of $Na+K^1$ was superior compared to Ca^{+2} and Mg^{+2} among cations.. An environment of the water was 7.82 and it has a alkaline character.

From the results of river water analysis, it is known that there is no danger for the development of agriculture in these lands.

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THE ROLE OF ABIOTIC AND BIOTIC FACTORS IN THE FORMATION OF MOUNTAIN GRAY-BROWN SOILS

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Gray-brown soils were identified for the first time by the Russian scientist A. N. Rozanov in the east of the Caucasus and included in the systematics as an independent soil type. Previously, these soils were combined with brown soils and shown as one soil type, but as shown below, the genesis, physical and chemical properties of these soils differ significantly from each other. Gray-brown soils are defined as the transition between the gray soils of semi-deserts and dry steppes, and the brown soils of arid forests and bushes. The article provides a comparative analysis of the similarities and differences between the gray-brown soils of the Aleppo and Homs plains of the Syrian Republic with a Mediterranean climate type in the Middle East and the gray-brown soils of the southeastern slope of the Greater Caucasus (Shamakhi region) and the Russian Federation (Republic of Dagestan).

Although the vegetation period is very different, both regions have specific characteristics with certain suitable natural conditions in the formation and development of these soils. So, taking into account that the distances of the gray-brown soils formed here between the Republic of Dagestan of the Russian Federation and the Aleppo and Homs plains located in the northwest of Syria in the Middle East are thousands of kilometers in the geographical latitude and longitude directions, the genetic characteristics are similar (subtropical and Holocene soils of tropical regions,) regularity is that these areas are subjected to appropriate evolutionary processes.

Keywords: *damping coefficient, forest, anthropogenic factor, humus, erosion, humidity*

INTRODUCTION

In the formation of different types of soil cover, among abiotic factors, climatic elements have a very large role and play a leading role. Climate elements include underground and surface air of the soil cover, water of the surface cover and underground water, solar radiation, amount of precipitation, wind, etc. includes. The effect of these elements on the development of the soil can be direct - it is expressed by moistening, heating and cooling of the soil, and indirectly, the climate of the soil affects the life of soil organisms.

Initially, the most important elements of climate in soil formation are precipitation and the flow of radiant energy (heat and light) from the sun. In some places, uneven periodic rainfall also creates an unfavorable soil water regime, characterized by alternating dry periods with wet periods.

The local climate in general and the soil in particular play a major role in soil formation. Soil climate affects soil properties (humus content, temperature, humidity, aeration conditions, etc.) in a certain way and, in turn, depends on soil, vegetation growing on it, relief elements.

The second element of climate important in soil formation is soil temperature. Soil temperature affects the rate of chemical and biological processes occurring in the soil. The temperature conditions of the area and the duration of the vegetation period determine the duration of intensive seasonal soil formation. At negative temperatures, soil formation continues extremely weakly, if not completely stopped. Humus formation is also very weak at low temperatures. The periodic effect of positive and negative temperatures is accompanied by freezing and thawing of the soil. Due to the crystallization of water in the pores of the soil, there are cracks and brittle separations in the form of an eternally frozen structure. Wind can affect soil formation and cause deflation. At the soil surface, when the wind speed is >5 m/s, small soil particles are blown away, medium-sized particles move suddenly, and larger ones roll along the surface. Wind promotes the exchange of atmospheric and soil air, increases evaporation of water from the surface of the earth - soil.

MATERİAL AND METHODS

The purpose of the work: to study the modern condition of the mountain-forest brown soils in the area of the Shamakhi region, the southeastern slope of the Great Caucasus, and to study the causes of soil erosion and transformation in the forest, meadow, and pasture areas.

The task of the work: In connection with the study of the general condition of the research area (the level of cultivation of the area), it consists in developing recommendations for production to improve the fertility of the soil cover, maintain it and increase the productivity of the vegetation, as a result of phytomeliorative improvement.

Research object: The research object is the southeastern slope of the Greater Caucasus (Shamakhi region)

Research methodology: The following methods were used to carry out the re Stationary method. This method serves to study soil processes and regimes in field conditions. Search work.

Comparative - analytical method. This method allows making judgments about the composition and properties of soil samples with the application of chemical, physico-chemical, physical and other systems of analysis methods.

Comparative - geographical method. The basis of this method is the study of soils in relation to soil-cultivating factors, that is, the detection of a correlative relationship between soils, their properties and composition on the one hand, and soils and soil-cultivating factors as a whole on the other hand.

This method is more widely used in land cartography.

RESULTS AND DISCUSSION

Gray-brown soils are formed in variable-moist climate conditions, but they differ in the presence of less annual precipitation and more arid climate conditions than brown soils. It is known that the climate of each geographical region is formed under the influence of a number of factors. The geographical location of the area occupies an important place among the existing factors. Both on the earth's surface and in the atmosphere, different degrees of accumulation of radiation, its consumption, indicators of heat balance, in general, the nature of the climate depends on the geographical location. Geographical position also determines the location of the area in the system of planetary and regional circulation of the atmosphere.

Along with the climate, relief and other factors have a great influence on soil formation. Relief is involved in the process of land development as micro-relief, meso-relief and macro-relief forms.

Vegetation consists mainly of short thorny shrubs, tall white grasses, and other drought-resistant cereals (wild winter oats, red oats, alfalfa species, cowpeas, etc.) and legumes. Irrigation of the soil is one of the prerequisites for obtaining a high yield from these soils. Plains and foothills are widely used as winter pastures (mainly cattle and sheep).

The gray-brown soils of Syria are mainly characterized by a very short and relatively humid cold period of the year, and a hot and long dry summer of the year, with temperatures above 10 °C totaling 4000–4200 °C, against the background of an arid subtropical climate type. , formed on carbonate rocks under xerophytic herbaceous and sparse shrub vegetation. annual precipitation is 300-600 mm, and the amount of evaporation is 1200-1500 mm. That is, the amount of evaporation is about 3-4 times more than precipitation. So, the humidity coefficient in the area is equal to 0.30-0.40 units.

Although the temperatures above 10°C are only 3500–3700°C in the northern latitude borders of the subtropical climate, it is distinguished by low precipitation and evaporation. The aridity of the climate on the southeastern slope of the Great Caucasus (Humidity Coefficient 0.3-0.4) determines the active mineralization of the remains of the organic world. Therefore, gray-brown soils are characterized by low humus content.

In the Russian Federation (Republic of Dagestan), mountain gray-brown (chestnut) soils develop in a subarid climate characterized by hot, dry summers and cold winters with little snow cover. D.I. According to Shashko [38], the temperature of these areas varies between 20-25°C in July and -3°C to -6°C in January. The average annual temperature is 8-10°C. The sum of active temperatures (> 10°C) is 3300–3500°. The amount of annual precipitation is 300-400 mm. Evaporation is greatly exceeded by precipitation. So, the humidity coefficient in the area is equal to 0.33-0.55 units.

Some climatic indicators of the dry desert zone, where mountain gray-brown (chestnut) soils are spread in Syria, Russia, Azerbaijan and the Federation

Provinces	precipitation, in annual mm	t>10°C total	More than t >10°C of the days	Humidity coefficient
Syria, Homs	400-600	4000-4200	230-240	0,30-0,40
Shamakhi	350-500	3500–3800	200-210	0,32-0,42
of Dagestan ~~sout-heast~~	350-400	3300-3500	180-190	0,33-0,55

As can be seen from the table, despite the relatively high annual rainfall (400-600 mm) in the territory of Syria compared to the territory of the Republic of Dagestan of the Russian Federation, a dry desert climate zone has formed in these areas. This is due to the fact that the vegetation period is longer in those areas than in the Republic of Dagestan, and the total temperature above 10°C is higher. The very low humidity coefficient (0.30-0.40) in the province of Aleppo, Syria, created conditions for the formation of thorny bushes and tall grasses as a result of the lack of moisture needed for woody plants.

CONCLUSİON

In our research studies, we have compared the similar and different abiotic and biotic factors in the formation and distribution of the mountain gray-brown soils in the Aleppo-Homs region, which is located on the foothills in the northwest of the Syrian Republic, and the mountain gray-brown soils in the southeast of the Republic of Dagestan, which are closer due to their natural conditions. we analyzed the similar and different aspects of those lands by comparing their aspects. If we take a look at the relief, the mountain gray-brown soil areas located in the north-west of Syria can rise up to 1000 meters high. However, in the Republic of Dagestan, it is found in the foothills (300-500 meters). As for climate elements, although the vegetation period of the gray-brown soils spread in Syria is longer than that of the Republic of Dagestan, the amount of precipitation and total temperature above 10°C in those areas is greater than in Syria. It is clear from the analysis that against the background of abiotic factors, the high rainfall and temperature in the territory of Syria, the short vegetation period in the Republic of Dagestan and the relatively high humidity coefficient compensate for the influence of similar climate elements and lead to the formation of the same type of soil. Although these similar areas are located at a distance of 1155 km from each other.

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THE EFFECT OF LIME APPLICATION ON SOIL REACTION AND AVAILABLE MICRONUTRIENTS CONTENT OF SANDY LOAM TEXTURE SOIL

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In this study carried out in İzmir Ödemiş Türkiye conditions, the effects of different doses of lime application on soil reaction, available Fe, Cu, Zn and Mn content of sandy loam texture soil were investigated. For this purpose, 45 soil samples were taken in 3 different sampling periods from experimental field and analyzed in the Laboratories of Ege University Faculty of Agriculture Soil Science and Plant Nutrition Department. In the study, lime doses were control, ¼ optimal dose (1.66 t ha^{-1}), ½ optimal dose (3.31 t ha^{-1}), optimal dose (6.63 t ha^{-1}) and 2 × optimal dose (13.30 t ha^{-1}). At the end of the trial (3rd sampling period), the highest soil reaction was observed in 2 × optimal dose of lime application. Soil reaction in the control application was 4.80, while it was 5.99 in this application. Lime applications have reduced the availability of available micronutrients.
Keywords: *Lime, Micro nutrients, Soil, Soil reaction,*

INTRODUCTION

Soil reaction is effective on plant growth and thus on the yield of cultivated plants. It is recommended that the soil reaction should be at least above 5 so that Al and Mn do not have a toxic effect, and the increase in soil reaction reduces the availability of micronutrients and P (Blume et al., 2010). In a study conducted in Pakistan, annual hay yield increased from 877 kg to 2120 kg per hectare with liming applications on highly acid-reactive soils (pH=3.3-3.8) (Neale et al., 1997). In a study conducted with a single dose of lime applied to different soils under laboratory conditions, it was observed that there were significant decreases in the available P content of the soils (Badalucco et al., 1992). Lime-pH relationship has been taken into account in many studies and publications on the determination of soil lime requirement, other soil properties have been completely or partially neglected (Uchida and Hue, 2000; Fageria and Baligar 2008; Kamprath, 2010). In a study conducted under potted conditions, wood ash, chicken manure and lime were used to raise the soil pH. It was determined that lime and ash applications increased the soil pH the most. In addition, it has been observed that lime applications have positive effects on soil aggregate stability and field capacity (Çalış and Şeker, 2018).

MATERIAL AND METHODS

The trial area is located in the Ege Region, east of İzmir Ödemiş, Türkiye (38°13'51.20"N; 28° 1'13.70"E). The trial area has a sandy loam texture (Table 1). The cation exchange capacity of the soil in which the study was carried out is 7.73 me/100 grams.

Table 1.
Particle size distribution of the trial area soil.

Sand (%)	Silt (%)	Clay (%)	Texture
72.4	12.0	15.6	Sandy loam

The lime requirement of the soil sample taken from the area where the experiment will be established was determined according to Kacar (2009) in the laboratory of Ege University Faculty of Agriculture, Department of Soil Science and Plant Nutrition. For this purpose, 400 g soil sample was taken and the pH was measured by preparing saturation paste with pure water. Soil pH was measured at each stage by gradually adding $CaCO_3$ to the soil (Table 2).

Table 2.

Effect of added $CaCO_3$ on soil reaction.

Added $CaCO_3$ (g) amount	Cumulative $CaCO_3$ (g) amount	Soil pH
		5,09 Start
0,13	0,13	5,90
0,05	0,18	6,01
0,07	0,25	6,11
0,10	0,35	6,28
0,13	0,48	6,41
0,08	0,56	6,56
0,09	0,65	6,65
0,09	0,74	6,67
0,11	0,85	6,70
0,11	0,96	6,74
0,10	1,06	6,77

* amount of soil 400 g

After it was understood that the increase in soil reaction stopped with the gradual addition of $CaCO_3$ to the soil and the curve followed a horizontal line, a decision was made on the dose to be applied. This dose was accepted as the optimal dose. Twice, half, and quarter of the optimal dose constituted other administration issues (Table 3).

Table 3.

Application doses.

Dose	$CaCO_3$ g m^{-2}	t ha^{-1}
Kontrol	-	-
¼ Optimal doz	165,6	1,66
½ Optimal doz	331,3	3,31
Optimal doz	662,5	6,63
2×Optimal doz	1325,0	13,30

In the study, liming material with the trade name Omya Calciprill 110 was used. The material in question consists of 91% $CaCO_3$ and 2% $MgCO_3$ with a size of 2-6 mm. The field experiment was established according to the randomized plot design with 3 replications.

The liming material was applied to the plots on 08.03.2020 to mix into the soil depth of 20 cm. The first sampling was done on 10.03.2020, the second sampling on 17.04.2020 and the third sampling on 08.05.2020.

Soil samples taken were made ready for physical and chemical analyzes after they were air-dried in the laboratory and passed through a 2 mm sieve (US Soil Survey Staff, 1951).

Lime ($CaCO_3$): Determined by Scheibler calcimeter (Schlichting and Blume, 1966).

pH: In saturated soil paste, measurement was made with a glass electrode pH-meter (Jackson, 1967).

Available Fe, Cu, Zn, Mn: It was determined by shaking and filtering 20 g soil sample with 40 ml of DTPA and reading in Atomic Absorption Spectrophotometer (Lindsay and Norvell, 1978, Jones, 2001).

RESULTS AND DISCUSSION

Within the scope of the project studies, increases were observed in the soil reaction with the lime applied to the soil (Table 4). Lime applications caused statistically significant differences in soil reaction and the highest soil reaction was observed at the optimal dose in the first period soil sampling. When the time dependent soil reaction is examined, it is seen that there is a decreasing trend in the control application. This situation is thought to be caused by precipitation. In other applications, first a decrease and then an increase is observed.

Table 4.

The effect of lime applications on soil reaction.

Dose	Sampling periods								
	I			II			III		
Control	4,95±0,40	b	A	4,87±0,11	b	A	4,80±0,26	b	A	
¼	5,52±0,77	ab	A	5,32±0,38	ab	A	5,87±0,29	a	A	
½	5,70±0,75	ab	A	5,20±0,75	ab	A	5,64±0,44	ab	A	
1/1	6,44±0,08	a	A	5,80±0,65	ab	A	5,87±0,45	a	A	
2/1	6,42±0,03	a	A	5,95±0,44	a	A	5,99±0,37	a	A	
		**			*			*-		
Vertical lowercase letters indicate applications, horizontal uppercase letters show the difference between periods **Tukey P≤0,01 * Tukey P≤0,05										

With lime applications, there was a decrease in the available Fe content of the soil in parallel with the dose increase (Table 5). However, these decreases were not found to be statistically significant. Soil available Fe was affected by at least ¼ optimal dose.

Table 5.

The effect of lime applications on the available Fe content of soil (mg kg^{-1}).

Dose	Sampling periods									
	I			II			III			
Control	92,47±11,10	a	A	90,06±14,90	a	A	92,14±8,96	a	A	
¼	81,75±18,39	a	A	75,81±4,95	a	A	89,99±13,59	a	A	
½	89,55±7,99	a	A	81,53±4,87	a	A	84,29±12,94	a	A	
1/1	87,47±16,25	a	A	84,42±12,30	a	A	80,44±9,04	a	A	
2/1	84,55±8,56	a	A	80,31±23,00	a	A	72,62±14,38	a	A	
Vertical lowercase letters indicate applications, horizontal uppercase letters show the difference between periods **Tukey P≤0,01 * Tukey P≤0,05										

In the study, available Cu was not affected much by lime applications (Table 6). On the other hand, available Cu showed statistical differences between the periods according to the application subjects.

Table 6.

The effect of lime applications on the available Cu content of soil (mg kg^{-1}).

Dose	Sampling periods									
	I			II			III			
Control	1,14±0,21	a	A	0,89±0,27	a	AB	0,70±0,01	a	B	**
¼	1,01±0,08	a	A	0,79±0,02	a	AB	0,73±0,03	a	B	*
½	1,17±0,10	a	A	0,86±0,02	a	B	0,63±0,05	a	B	**
1/1	1,10±0,17	a	A	0,79±0,06	a	B	0,66±0,12	a	B	**
2/1	1,04±0,09	a	A	0,74±0,06	a	AB	0,65±0,11	a	B	**
Vertical lowercase letters indicate applications, horizontal uppercase letters show the difference between periods **Tukey P≤0,01 * Tukey P≤0,05										

In the study, available Zn was statistically affected by lime applications in the first two sampling periods (Table 7). At the same time, statistical differences occurred according to the periods in the control, ½ optimal dose and optimal dose applications. In general, the available Zn content in the soil decreased with lime applications.

Table 7.

The effect of lime applications on the available Zn content of soil (mg kg^{-1}).

Dose	Sampling periods									
	I			II			III			
Control	7,81±2,68	a	A	7,90±1,93	a	A	4,89±0,58	a	B	*
¼	5,04±0,58	b	A	5,64±1,45	ab	A	4,51±0,16	a	A	
½	7,62±1,86	a	A	5,63±0,99	ab	AB	4,17±0,38	a	B	**
1/1	7,20±1,33	ab	A	5,69±1,13	ab	AB	4,37±0,31	a	B	*
2/1	5,52±0,70	ab	A	5,05±0,90	b	A	3,76±0,49	a	A	
		*			*					
Vertical lowercase letters indicate applications, horizontal uppercase letters show the difference between periods **Tukey P≤0,01 * Tukey P≤0,05										

Both the applications and the lime applications on the basis of the period did not have a statistical effect on the receivable Mn (Table 8)

Table 8.

The effect of lime applications on the Mn content of soil (mg kg^{-1}).

Dose	Sampling periods									
	I			II			III			
Control	15,94±3,85	a	A	16,39±7,23	a	A	16,13±4,61	a	A	
¼	15,51±7,04	a	A	13,96±4,23	a	A	13,18±1,82	a	A	
½	18,38±3,81	a	A	13,60±2,46	a	A	12,81±3,46	a	A	
1/1	17,70±5,49	a	A	13,35±3,20	a	A	10,35±0,66	a	A	
2/1	17,79±6,94	a	A	15,32±9,89	a	A	8,22±1,24	a	A	
Vertical lowercase letters indicate applications, horizontal uppercase letters show the difference between periods **Tukey P≤0,01 * Tukey P≤0,05										

Many studies have shown that as the lime content in the soil increases, the availability of micronutrients decreases (Shuman, 1986; Moreira et. al., 2017; Ongun et. al., 2020). It is seen that the findings obtained from the study are similar to other studies in this respect. However, it has been observed that sometimes liming and N application increase the availability of micronutrients in the soil (Malhi et. al., 1998).

CONCLUSION

In this study carried out in Türkiye İzmir Ödemiş conditions, the effects of different doses of lime application on soil reaction, available Ca, P, Fe, Cu, Zn and Mn content of soil were investigated. For this purpose, a total of 45 soil samples were taken in 3 different sampling periods from sandy loam texture soil and analyzed at Ege University Faculty of Agriculture, Department of Soil Science and Plant Nutrition Laboratories.

Looking at the results, it was seen that the soil reaction increased with increasing lime dosage applications, but this effect decreased over time. In recent samples, it is seen that the gap between ¼ optimal dose and 2×optimal dose has closed.

In the study, although lime applications have a negative effect on the availability of micronutrients, this effect is not at very high levels. The most obvious negative effect was seen in the available Cu content of the soil. ¼ optimal dose was the application that least affected the availability of micronutrients.

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EVALUATION OF BIOLOGICAL INDICATORS OF IRRIGATED YELLOW-GLEYİC SOILS SUİTABLE FOR VEGETABLES IN CROP ROTATİON

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Research object yellow-gleyic soils (Gleyic Livosols), the five-field vegetable-beans crop rotation: 1. tomato; 2. maize for white head cabbage+silage; 3. head onion; 4. vegetable bean; 5. vegetable bean and permanent plants: a whitehead cabbage, tomato, maize, head onion and vegetable-bean. The potential (ferments activity, ammonification and nitrification ability, biogenness) and actual activity (shattering intensity of the linen located in the soil profile and CO_2 decomposed from soil) have been learnt in dynamics. The biological indicators were defined and biodiagnostics was given under the growing plants on the crop rotations and constant tillage in the irrigative yellow-gleyic soils for definition of the biological indicators change in what direction inside the same soil type. The soils biodiagnostics was reflected on the basis of the soil biological parameters under the growing plants on the five-field vegetable-bean crop rotation and constant tillage in the irrigative yellow-gleyic soils. Using of the virgin land, sowing fertilizing, applying of the agrotechnical measures under the agricultural plants were a reason for appearance of the biological activity change in a different form. Biodiagnostics of the yellow-gleyic soils shows a change of the biological parameters under the plants in a different direction. The catalaza ferment activity, nitrification process intensity and microflora quantity were higher in yellow-gleyic soil type, the rest indicators changed depending on soil type character. A change of the biological parameters in which direction can be clearly seen from the comparison of the cultured soils with the virgin versions. Integral index biological state soils (IIBSS) was calculated for the complex biological parameters. IIBSS vibrated by 70-100% on the crop rotation, 53-77% on the constant tillage. The ecological-biological state of the integral parameter was calculated for definition of the change of the different biological parameter in what direction depending on using direction of the soils.

Key words: *irrigated yellow-gleyic soils, biological activity, crop rotation, permanent plants, vegetable plants, evaluatıon of bıologıcal.*

INTRODUCTION

Soil is an inseparable part of biosphere and it fulfils the global ecological problems, provides biosphere stability and life availability on the land. Soil texture refers to the relative proportion of the three soil separates; sand, silt and clay in a soil mass [3]. It generally affects an array of physical, chemical and biological properties and processes in soils. Several effects are mostly indirect, that is, texture influences property that directly affects plant growth [4]. Soil quality indicators are physical, chemical, and biological properties, processes, and characteristics that can be measured and interpreted to monitor patterns and changes in the soil [4]. Soil organisms are a key factor for soil development and in turn depend on soils as a habitat [5]. The soil population consists of organisms that have a wide range of activities and which possess a great diversity of enzyme systems. In the absence of microorganisms, higher life forms would never have evolved and could not now be sustained [10]. Microbes play a vital role in biogeochemical cycles [6]. Soil microorganisms are actively involved in soil biochemical processes, including organic matter decomposition, nutrient mineralization and cycling [8]. Therefore, the issues of improving the environmental situation in modern agricultural landscapes, maintenance, and reproduction in soil fertility and increase crop productivity is being acquired special urgency. One of the most promising measures in improving soil fertility is organic farming: crop rotation, the introduction of legumes in crop rotation, perennial legumes and legume-grass mixtures, the intensification and maximum use of associative and symbiotic nitrogen fixation, the use of green manure and non-market part of the harvest for fertilizer, the use of organic fertilizers, crop adaptive highly productive varieties and hybrids that are resistant to pests and diseases, a moderate use of mineral fertilizers and pesticides, coupled with differentiated minimum tillage [13]. Some scientists show that the soils cultural level regulate biological especially microbiological process to considerable extent, change microflora quantity by a quality and a quantity and increase microorganisms' quantity in agrocenosis [17, 18].

The practical and theoretical importance is great in using of the different type of soils under agricultural plants, in definition of the soil fertility formation objective laws, in study of the influence of the plants growing characters on soil peculiarities. As a result of the crop rotation application there is an enough material about soil ecological condition, physical, chemical and biological characters improvement at present. Growing of the plants in crop rotation and constant tillage effects on soil fermentative activity to an important degree. The ferments activity in the soils under the same plants is higher in crop rotation than in constant tillage [2, 16]. The ferments activity in the soils where leguminous plants (pea, lucerne) are grown is higher than grain-like, an influence remains in the last years, that's why a main agroecological measure is an application of the crop rotation in order to regulate ferments activity. A root system of lucerne possesses an ability to enrich the soil with phosphataza ferment a as result the lucerne hag got an ability to ensure inself with phosphorus [14, 16]. The soils under the plants which are predecessors of the leguminous plants possess high biochemical activity, the mobile forms of nitrogen and phosphorus aren't gathered [2] as a result of mineralization of the plants organic remnants in the soil. The root secretion depends on root diversity and root remnant biomass by a quality. The ferments activity depends on plant development phase and grown in plant rizosphere, the ferments activity is high in the plant active development phase [10].

MATERİAL AND METHODS

Irrigated yellow-gleyic soils (Irragric Gleyic Luvisols) of the moderately humid subtropical zone are formed under the influence of the seasonally wet climate with excessive moistening in the spring and autumn and with insufficient moistening in the summer. The crop rotation of five-field vegetable-beans was tested in yellow-gleyic soils of the Lankaran Zonal Experimental Station. The humus content in the upper horizons is 2.5– 5.0%, and the soil reaction is slightly acid (pH H2O 5.5–6.5; the pHKCl is 5.0–5.5). AUaI-tillage-humus layer density is 27-30 cm, colour is dark greyish-chaff, yellowish-brown and structure is heaplike-nutlike, plant residues are met and granulometric structure is loamy. AUaII-undertillage layer density is 20-35cm, it harden, structure isn't clear and heap-like nutlike, granulometric structure is mainly clayey, there are little and large plant roots. B-transitional horizon thickness is 40-60 cm, colour is filthy-yellow and bluish-rusty, hardened granulometric structure is light and heavy loamy, spots by manganie and ferrum origin are met. C-horizon-maternal rock consists of different mechanical structural gleyey layers complex. The sandy, gravel-clayey horizons, buried ancient soils are characteristic for morphological profile of majority of the irrigative gleyey-yellow soils. The humus quantity is 2,5-5,0% on upper layer, 1,0-2,0% on low layers, C:N ratio is 7-11 on upper layers, 5-7 on low layers, in the irrigative gleyey-yellow soils, and it shows good provision of the soil with nitrogen Ch.a. : Cf.a. ratio is 0,8-1,2, silty degree is 40-58%, waterresistant aggregates are >0,25 mm-45-70%, absorption capacity is 25-30 mg/ekv, Ca:Mg-2-5 and a total quantity of ferrrum is-7-12%. The soils environment is acid (water solution is 5,5-6,5, salt solution is 5,0-5,5). These soils are mainly without carbonate, on low layers carbonates are met in a form of shell consisting of sea deposits.

The following crop rotation systems were used. On the irrigated yellow-soils, a five field vegetable-beans crop rotation. The five-field vegetable crop rotation scheme is applied in yellow-gleyic soils: 1. Tomato ($N_{120}P_{90}K_{60}$); 2. white head cabbage ($N_{120}P_{90}K_{90}$) + corn for silage ($N_{120}P_{90}K_{90}$); 3. head onion ($N_{90}P_{120}K_{120}$); 4. vegetable bean ($N_{60}P_{90}K_{60}$); 5. vegetable bean ($N_{60}P_{90}K_{60}$). In order to define the changes occuring in the soils under plants in the crop rotation vegetable plants of the same name have been used and a white head cabbage, tomato, corn for silage, head onion and vegetable-bean have been in the same area for five years. The phenological observations over the growing plants at the vegetation period (March-October months).

The CO_2 emission from the soils was determined in the field according to the method suggested by Makarov, and the intensity of the cellulose decomposition was determined according to the method of Vostrov and Petrova. In the laboratory, we studied the enzymatic activity according to Khaziev, the nitrification intensity according to Bolotina and Abramova, the ammonification intensity according to the method proposed by Tepper with coauthors. The standard environment was used for definition of taxonomical group of microorganisms: ammonifiers assimilating the organic forms of nitrogen were determined on meat-peptony-agar (mpa), bacteria assimilating the mineral forms of nitrogen were determined on the starch-ammonia agaric (saa), the total number of actinomycetes was determined on starch- agar - agar (saa), the total number of fungi was determined on malt agar (czapek's agar medium) dilution of 1:1000. All microbiological analyses were performed in three replications and the average number of microorganisms was calculated at 1.0 g absolutely dry soil. All experiments were conducted under aseptic condition. The statistical processing of the data was performed by the routine methods to ensure a 95% significance level [16].

At present, there are no universal methods for the appreciation of the biological activity of soils, and the use of some particular characteristics is insufficient for this purpose. An integral index of the bioecological status is recommended in [9]. For its calculation, the highest value of each characteristic in the studied soils is taken as 100%, and the same characteristic in the remaining soils is expressed in percent of the maximum value: $B_1= (B_x/B_{max}). 100$, (1) where B_1 is the relative value of the studied characteristic and Bx and Bmax are its actual and maximum absolute values, respectively. The relative values of many characteristics can be summed up, whereas their absolute values cannot be summed up because of the different measurement units: $B_m = (B_1 + B_2 + B_3 + \dots + Bn)/N$, (2) where B_m is the mean relative value of the number of characteristics, and N is the number of characteristics. The integral characteristic of the soil biological status is calculated similarly to Eq. (1): IBSS = $(B_m/B_{max}). 100$, (3) where B_m and B_{max} are the mean and maximum relative values of all the characteristics.

RESULTS AND DISCUSSION

A main carbon source in soil is saccharose. Invertase ferment hydrolyses saccharose, till glucose and fructose. Fructofuranozidase from carbohydrolases is studied more. Overturn of carbohydrates by ferments forms a main chain of carbon circulation, they don't collect in soil because of fast exposing of them to chemical and biochemical overturns.

Invertase Activity. The changes in the invertase activity of different soil types of Azerbaijan with respect to the season, the water and temperature conditions, the plant cover, and the chemical composition and physicochemical properties of the soils have been comprehensively studied [18]. The corresponding values of for invertase activity the yellow-gleyic soils are 8.3–15.4 and 6.7–13.2 mg of glucose/g of soil per day.

Urease Activity. The urease activity in the soils of Azerbaijan has been studied sufficiently well (Mamedzade 2005, Orujova 2004).

In the upper 50 cm, it varies within 2.2–3.9 and 2.0–3.5 mg of NH3/g of soil per day in the irrigated yellow-gleyic soils. The lowest urease activity is typical of the yellow-gleyic soils.

Phosphatase Activity. Contrary to the invertase and urease activities, the dependence of the phosphatase activity on the cultivated crops and ecological factors is less pronounced. The mean phosphatase activity in the plow and subplow horizons of the irrigated yellow-gleyic soils in the crop rotations and under the permanent crops varies within 5–2.4 and 0.6–1.5 mg of P2O5/10 g of soil per h. The phosphatase activity in the irrigated yellow-gleyic soils was higher.

Catalase Activity. The catalase activity determines the soil fertility and is an important diagnostic characteristic of the biological activity. It was studied in the irrigated gray-brown soils under crop rotation [16] and under permanent olive trees, in the irrigated meadow-sierozemic soils [7], and in the irrigated yellow-gleyic soils [13, 18]. In the irrigated gray-brown soils under crop rotation and upon permanent crop growing, the catalase activity in the upper 50 cm varies in the yellow-gleyic soils, within 2.5–6.1 and 1.6–4.7 cm3 of O2/g of soil per min. The lowest catalase activity is observed in the yellow-gleyic soils. The catalase activity may be inhibited by the acidity of the yellow-gleyic soils.

Dehydrogenase Activity. Dehydrogenase catalyzes the reaction of hydrogen detachment in various organic substances carbohydrates, organic acids, amino acids, spirits, etc.). The dehydrogenase activity was studied in the irrigated gray-brown soils [13, 14]. According to our data, it varies within for the yellow-gleyic soils, 7.9–15.5 and 5.8–8.9 mg of triphenylformazan/10 g of soil per day. The dehydrogenase activity in the irrigated soils changes with respect to the soil type and the biological characteristics of the cultivated crops. The highest dehydrogenase activity is typical of the yellow-gleyic soils, which is probably favored by the anaerobic conditions in these soils. Investigations performed under different pedoclimatic conditions indicate that the activity of enzymes under vegetable crops in rotation systems is generally higher than that upon permanent crop crowing [18]. Our study shows that the activity of hydrolytic enzymes is more stable as compared to oxidation– reduction enzymes and is mainly dictated by the growth of the crops. The oxidation–reduction processes are more dynamic and sensitive to changes in the environmental conditions.

Biogenic features of irrigated soils. The activity of microorganisms in soils is related to the formation and mineralization of soil humus and inactivation of substances released from plants and inhibiting substances entering the soils with applied chemicals. The living activity of microorganisms affects the properties of the soil air and gas exchange processes. Investigations performed under different pedoclimatic conditions indicate that the crops exert different effects on the composition and number of microorganisms [14, 18]. The analysis of the soil microflora includes the determination of the total number of microorganisms in the soil and the populations of particular physiological groups. It is also important to determine the total biological activity diagnosed by the amount of carbonic acid released from the soil and the soil capacity for accumulation of nitrates and cellulose decomposition. In the irrigated yellow-gleyic soils used in rotation systems with different crops, the numbers of microorganisms in the upper 50 cm of the soil profiles varies within the following values: 1643–2101 thousand CFU/g of dry soil for bacteria,, 248–300 thousand CFU/g of dry soil for spore-forming bacteria, 511–547 thousand CFU/g of dry soil for actinomycetes, and 23–52 thousand CFU/g of dry soil for microscopic fungi. In the yellow-gleyic soils under monocultures, the amount of microorganisms is the lowest than crop rotation. These data attest to the low effect of the soil type on the rhizosphere microflora and to the considerable effect of the cultivated crops on the number and composition of the soil microbial community.

Nitrification capacity. Soil ammonifiers, nitrifiers, and denitrifiers play an important role in the transformation of nitrogen compounds. The intensity of the nitrate accumulation under crops due to the activity of nitrifying bacteria has been studied by many authors [14, 16, 18]. It has been shown that the intensity of the nitrification in gray-brown soils during the growing season changes in dependence on the biological specificity of the crops, the soil water and temperature regimes, and the applied agrotechnologies [18]. In the upper 50 cm of the irrigated yellow-gleyic soils in crop rotation and permanent cultural, the nitrification intensity varies within 13.1–33.7 and 8.1– 19.8 mg of N-NO3/kg of soil per 14 days. The mineralization of nitrogen compounds in the yellow-gleyic soils was relatively low.

Ammonification capacity. The ammonification processes under cultivated crops have been studied by many scientists [1]. The activity of ammonifying bacteria in the upper 50 cm of irrigated yellow-gleyic soils in rotations and under permanent crops, the corresponding values are 88.1–131.7 and 80.6–121.4 mg of N-NH3/kg of soil per 14 days, respectively. The ammonification intensity is the highest upon crop rotations.

The intensity of the CO_2 emission from the soil. The emission of carbon dioxide from soils is due to root res-piration, the living activity of microorganisms (bacteria, fungi, algae, and protozoa), and physicochemical and chemical soil processes [11]. Many papers are devoted to the CO_2 emission from soils under different crops [7, 18]. The CO_2 emission from the irrigated yellow-gleyic soils in rotations, it varies within 4.0–8.1 kg of CO_2/ha per h, while, under permanent crops, the intensity of the CO_2 emission is somewhat lower.

The intensity of the cellulose decomposition. Linen tissue placed into soil is gradually decomposed under the impact of microorganisms, including cellulose-decomposing bacteria. Cellulose is decomposed to monomers (glucose) by different enzymes. The biological activity of the soil may be judged from the intensity of linen tissue decomposition and from the accumulation of amino acids. The intensity of cellulose decomposition in soils has been studied by many authors [10]. In the irrigated yellow-gleyic soils under six-field crop rotations and permanent cultural, the intensity of the cellulose decomposition varies within 11.1–34.4 and 14.1–28.5%, respectively.

The analytical data show that the activity of the biochemical processes varies widely with respect to the biological specificity and the phase of development of the crops, the ecological state of the soil, and the soil type. It is somewhat higher in the irrigated soils used in crop rotations than under the permanent crops. In the irrigated yellow-gleyic soils, the biological activity is the highest under bean (haricots) and the lowest under garlic and onions. Under the other crops, the soil biological activity is intermediate. The data on the different indices of the biological activity of the studied soils are summarized in the table. This approach makes it possible to integrate several biological characteristics [9]. Changes in the soil fertility can be judged from the IBSS values. An integral characteristic of the bioecological status of the studied soils used in crop rotation systems and for permanent crop growing has been determined on the basis of the particular characteristics of their biological activity. Earlier, the same work was done for the virgin gray-brown and meadow-sierozemic soils of arid subtropical regions, the meadow-forest alluvial soils of semiarid subtropical regions, and the yellow-gleyic soils of humid subtropical regions [18]. In the yellow-gleyic soils, the IBSS varies within 70–100% in the rotation system and within 53–77% under the permanent crops with the highest values under haricots and the lowest values under onions. Thus, the changes in the IBSS values depend on the character of the soil management.

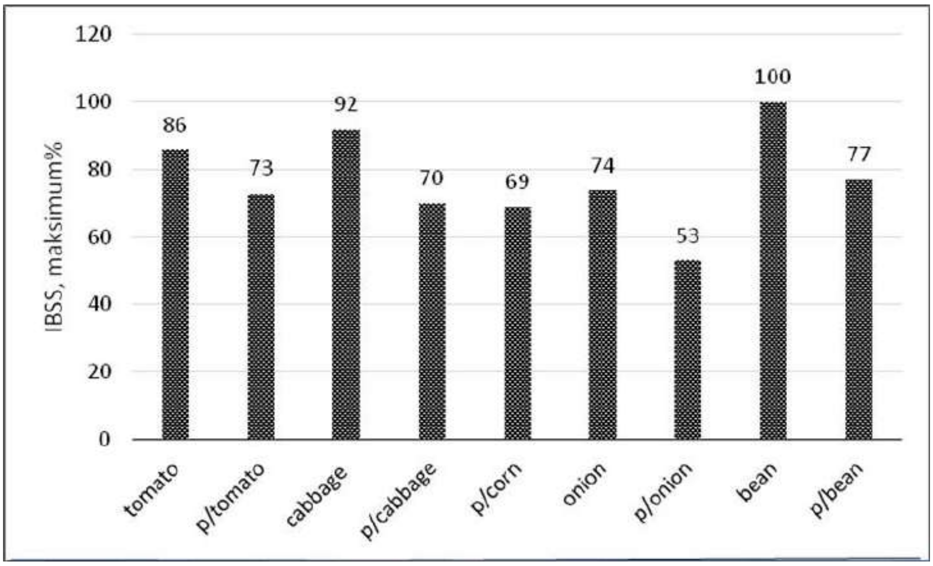

Figure. The IBSS values for the irrigated yellow-gley soils

Integral index of the bioecological soil status (IBSS). The IBSS values for the irrigated yellow-gley soils, it is 100% in the virgin soils, 92% upon the crop rotations, and 70% upon the permanent crop growing.

A five-grade scale has been suggested for the biological assessment of soils by Kazeev with coauthors [9]. In our case, the IBSS values in the virgin soils and in the soils used in the crop rotation systems was 74-100%; these soils may be qualified as soils with very high biological activity. Under permanent crops, the IBSS values vary within 53–77%, which corresponds to high and moderate biological activity. The results of this analysis show that the biological soil parameters may be regulated via using appropriate crop rotation systems. The biological assessment of soils shows that the soil fertility in the subtropical zone may be preserved and even increased upon irrigation and rational soil management.

CONCLUSION

The soils used in the rotation and virgin soils are assigned to the group of soils with very high biological activity. The soils under permanent crops are characterized by their high and moderate biological activity.

In the moderately humid subtropical regions, the biological activity of the soils is preserved upon their cultivation with irrigation

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CHARACTERIZATION AND NUTRIENT DYNAMICS OF CHESTNUT SOILS: A COMPREHENSIVE REVIEW

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Chestnut soils are a type of soil that is commonly found in Azerbaijan. These soils are characterized by their high levels of organic matter, which makes them ideal for growing crops. Nutrient dynamics in chestnut soils are also important to consider, as they can affect the growth and health of plants. Chestnut soils are a type of soil found in Azerbaijan that are characterized by their high levels of organic matter and nutrient content. These soils are important for agriculture and forestry, as they provide a fertile environment for plant growth.I n terms of nutrient dynamics, chestnut soils are known for their ability to retain nutrients, particularly nitrogen, and phosphorus. This is due to the high levels of organic matter in the soil, which acts as a sponge to absorb and hold onto nutrients. Additionally, chestnut soils have a high cation exchange capacity, which means that they can exchange positively charged ions (such as calcium, magnesium, and potassium) with the surrounding environment. When it comes to characterization, chestnut soils are typically classified as Alfisols or Inceptisols. Alfisols are characterized by their high levels of clay and organic matter, while Inceptisols are characterized by their relatively young age and lack of distinct soil horizons. Overall, the characterization and nutrient dynamics of chestnut soils in Azerbaijan are important topics for research and understanding. By studying these soils, we can better understand how to manage and utilize them for sustainable agriculture and forestry practices

INTRODUCTION

Chestnut trees are an important part of Azerbaijan's ecosystem, and their soils play a crucial role in maintaining the health of these trees. The review on the characterization and nutrient dynamics of chestnut soils aims to provide a comprehensive understanding of the factors that influence the growth and development of chestnut trees in Azerbaijan. Specifically, the review will focus on the physical, chemical, and biological properties of chestnut soils, as well as the nutrient cycling processes that occur within these soils. By examining these factors in detail, the review will help to identify strategies for improving the health and productivity of chestnut trees in Azerbaijan. Chestnut soils are a type of soil that is common in Azerbaijan. They are characterized by their high clay content, which makes them very fertile and ideal for agriculture. Nutrient dynamics in chestnut soils are important to understand because they can affect the growth and health of crops. In terms of physical properties, chestnut soils are typically dark in color and have a crumbly texture. They are also well-drained, which is important for preventing waterlogging and promoting healthy root growth. As for your speech, you may want to focus on the specific ways in which nutrient dynamics and physical properties of chestnut soils impact agriculture in Azerbaijan. For example, you could discuss how farmers in the region have adapted their farming practices to account for the unique characteristics of chestnut soils. Water-holding capacity and drainage

Chestnut soils in Azerbaijan have a unique set of physical properties that affect their water-holding capacity and drainage. These soils are typically high in clay content, which can lead to poor drainage if not managed properly. However, they also have a high water-holding capacity, which can be beneficial for crop growth. Nutrient dynamics in chestnut soils can also be affected by their physical properties, as well as by factors such as climate and management practices.

MATERIAL AND METODS

Chestnut soils, also known as brown forest soils, are a type of soil found in various regions around the world, including Azerbaijan. These soils are characterized by their moderate fertility and relatively high organic matter content. Chestnut soils are found in different parts of Azerbaijan, primarily in the lowland areas of the country. They occur in regions such as the Apsheron Peninsula, Ganja-Gazakh, Guba-Khachmaz, and Shirvan. Chestnut soils have distinct soil profiles consisting of different layers or horizons. The topsoil layer, known as the A horizon, is typically rich in organic matter and darker in color. It provides good nutrient content for plants. Below the A horizon, there is a transition zone called the B horizon, where organic matter gradually decreases, and mineral content increases. The lowermost layer, called the C horizon, consists of weathered parent material. The profile was shown below.

Figure 1 Chestnut soil profiles in different places

Chestnut soils generally have a loamy texture, which means they have a balanced mixture of sand, silt, and clay particles. This texture allows for good water retention while still providing adequate drainage. The soils also contain a reasonable amount of nutrients, making them suitable for agriculture. Chestnut soils are agriculturally significant in Azerbaijan. They are suitable for a wide range of crops, including cereals (wheat, barley), legumes (beans, lentils), vegetables, and fruits. These soils provide favorable conditions for plant growth, allowing farmers to cultivate various crops in the region. To optimize agricultural productivity on chestnut soils, proper soil management practices are essential. This includes adopting measures such as crop rotation, organic matter incorporation, and nutrient management. However, there are challenges associated with chestnut soils, such as erosion due to their moderate texture. Soil erosion control measures, such as contour plowing and terracing, may be necessary to mitigate this issue. It's important to note that specific characteristics of chestnut soils may vary depending on the local climate, parent material, and other factors. Therefore, local variations within Azerbaijan may exist. Soil type of Azerbaijan was given in the next figure.

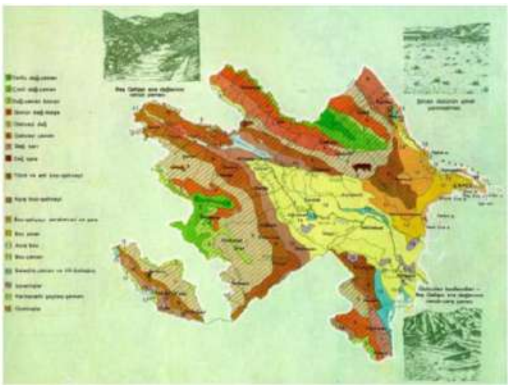

Figure 2. Soil Types of Azerbaijan Republic

Consulting local agricultural or environmental authorities can provide more specific and up-to-date information about chestnut soils in a particular region of Azerbaijan.

Climate condition of the soil

Chestnut soils typically develop under specific climatic conditions. Here are the general climate conditions that favor the formation and development of chestnut soils: Temperate Climate: Chestnut soils are commonly associated with temperate climates. These climates generally have moderate temperatures with distinct seasonal variations. The presence of four distinct seasons (spring, summer, autumn, and winter) contributes to the gradual accumulation and decomposition of organic matter, which is important for the formation of chestnut soils. Sufficient Precipitation: Chestnut soils tend to develop in regions with sufficient rainfall throughout the year. Adequate precipitation ensures a continuous supply of water for plant growth and the leaching of minerals through the soil profile. Typically, annual precipitation ranges between 600 to 1200 millimeters (24 to 47 inches). Well-Defined Wet and Dry Seasons: In areas where chestnut soils are found, a well-defined wet and dry season pattern is often observed. This seasonal variation in precipitation influences the soil's water content and nutrient dynamics. The wet season allows for the leaching of excess salts, while the dry season promotes the decomposition of organic matter and the development of a distinct soil profile. Moderate Temperature Range: Chestnut soils develop in areas with moderate temperature ranges. This means that extreme temperatures, such as intense heat or prolonged freezing, are not common. The moderate temperature range allows for the gradual decomposition of organic matter and the accumulation of humus. Sufficient Growing Degree Days: Growing degree days (GDD) is a measure of the accumulated heat available for plant growth. Chestnut soils are often associated with regions where the sum of GDD is sufficient to support the growth and development of vegetation. The availability of a suitable growing period is important for the accumulation of organic matter and the overall soil fertility. It's important to note that these are general climate conditions, and the specific characteristics of chestnut soils can vary depending on local variations in climate, topography, and other factors. Local variations may lead to differences in soil properties even within regions where chestnut soils are found. Therefore, it's always advisable to consult local soil and climate data for a specific area to get a more accurate understanding of the climate conditions influencing chestnut soil formation.

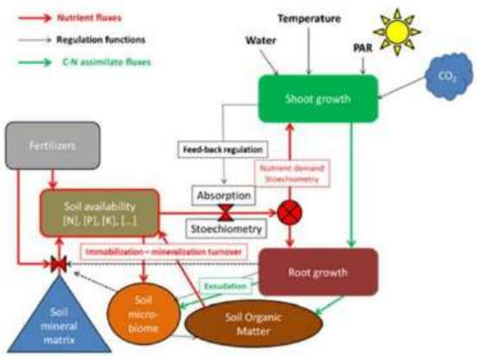

Figure 3. Correlation between Climate-Soil and Nutrients

The correlation between climate, soil, and nutrients in Azerbaijan is an important factor in understanding the dynamics of chestnut soils. The climate in Azerbaijan is characterized by hot summers and cold winters, with precipitation varying across the country. These climatic conditions have a significant impact on the physical and chemical properties of chestnut soils. For example, the water-holding capacity and drainage of chestnut soils are influenced by the amount and timing of precipitation. In addition, the chemical properties of chestnut soils, such as pH and nutrient availability, are affected by the climate.

The soil type in Azerbaijan is also an important factor in the nutrient dynamics of chestnut soils. Chestnut soils are characterized by a high content of clay and organic matter, which can affect the availability of nutrients to plants. The soil microbial communities in chestnut soils play a crucial role in nutrient cycling and availability. These communities are influenced by a variety of factors, including climate, soil type, and land use practices.

Overall, understanding the correlation between climate, soil, and nutrients in Azerbaijan is essential for managing chestnut soils and ensuring sustainable agriculture. By studying the physical, chemical, and biological properties of chestnut soils, we can develop strategies to improve soil health and nutrient availability, while also mitigating the impacts of climate change.

CONCLUSION

The conclusion summarizes the key findings presented in the paper and emphasizes the importance of adopting sustainable soil management practices for chestnut soils in Azerbaijan. The need for further research and monitoring of these soils is also highlighted. By providing a comprehensive understanding of chestnut soils in Azerbaijan, this paper aims to contribute to the scientific knowledge base and support informed decision-making for sustainable land use and agriculture in the region.

RESULTS AND DISCUSSIONS

The chestnut soils have been widely studied in Azerbaijan by Academician Hasan Aliyev, academician Garib Mammadov, academician Mammademin Salayev and so on. At present the most effective soils type in agrarian sector is the chestnut soil on the middle and low mountainous belts of the country.

Under chestnut soils, also known as grey brown soils, a variety of crops can be cultivated. Grey brown soils are fertile and well-drained, making them suitable for various agricultural purposes. Here are some common crops that are often cultivated in areas with grey brown soils: Cereal Crops: Grey brown soils are well-suited for growing cereal crops such as wheat, barley, oats, and rye. These grains are staple crops and can be used for human consumption, livestock feed, or processed into various food products. Legumes: Leguminous crops like beans, peas, lentils, and chickpeas thrive in grey brown soils. Legumes have the ability to fix atmospheric nitrogen through their symbiotic relationship with nitrogen-fixing bacteria, which enhances soil fertility. Oilseeds: Oilseed crops such as sunflowers, canola, and flax can be successfully grown in grey brown soils. These crops are valuable for their oil content and have various industrial and culinary uses. Vegetables: Grey brown soils are suitable for a wide range of vegetable crops, including tomatoes, cucumbers, peppers, eggplants, potatoes, carrots, onions, garlic, leafy greens, and others. These crops are important for local consumption and can be commercially cultivated. Fruits and Berries: Various fruit trees and berry plants can be cultivated in grey brown soils. This includes apple trees, pear trees, cherry trees, plum trees, raspberry bushes, blackberry bushes, and other fruit-bearing plants. These crops are popular for both local consumption and commercial purposes. Forage Crops: Grey brown soils can support the growth of forage crops such as alfalfa, clover, and various grasses. These crops are cultivated to provide feed for livestock and are important for the livestock industry. Medicinal and Aromatic Herbs: Grey brown soils can be used to cultivate various medicinal and aromatic plants. Herbs like mint, chamomile, thyme, rosemary, oregano, sage, and lavender are commonly grown for their medicinal or culinary uses. Field Crops: Other field crops that can be cultivated in grey brown soils include sugar beets, corn, soybeans, and other crops suitable for the local climate and market demand. The specific crops cultivated under grey brown soils may vary depending on local climate, market demand, and agricultural practices. Farmers and agriculturalists adapt their crop choices based on the suitability of grey brown soils and economic opportunities in their respective regions. Climate condition for the soil formation has great importance.

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FACTORS INFLUENCING THE PROCESSES OF MOVEMENT OF EASILY SOLUBLE SALTS ON SALINE SOILS OF THE FOOTHILL PART OF ILE ALATAU

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The article presents changes in the content of water-soluble salts in comparison with autumn, spring and summer periods for 2 years. The quantitative content of easily soluble salts is given for the layers of the upper part of the soil. The authors show color changes on the soil surface from the presence of easily soluble salts. The authors give links between significant color changes and the amount of precipitation. The color changes that have occurred are compared with Google maps, where color differences are clearly visible. The role of air temperature is also taken into account. The authors of the article bring the concept of drought to data related to the effusion regime and the accumulation of salts on the soil surface.

Keywords: *Cations and anions, Weather differences, Morphological changes, Comparison*

INTRODUCTION

At the present stage, management in the field of land resources protection is closely related to the resistance of soils to climate change. In this direction, the most important scientific problem of our time is the development of saline soils. To evaluate this, remote analysis methods are used. About a quarter of fertile lands are lost as a result of secondary salinization (Safina G.R., Fedorova V.A.). In the work of Safin G.R., Fedorov V.A. It is given that the largest areas of saline soils in Russia are occupied in Kalmykia (78%), Astrakhan (56.7%) and Volgograd (45%) regions (Safina G.R., Fedorova V.A.).

The authors Kotenko M.E. confirm that the nature and degree of soil salinity changes in time and space. Kotenko M.E., et al. write about the role of wind in the accumulation of salts in the upper soil layer. The change in soil salinity in seasonal dynamics is associated with humidity, temperature, and the degree of dilution of solutions (Kotenko M.E., et al.). Kotenko M.E., et al. write in the article (p. 47): “This means that at a depth of 40-50 cm of meadow solonchak soil, salts are pumped “up and down” over the year on a larger scale than their minimum content on the horizon.".

In work, ed. Vargas R., monitoring of soil salinity using remote sensing is given. To organize remote monitoring of soil salinity, it is proposed to study the seasonal and long-term dynamics of soil salinity and the rate of salinization-desalinization processes.

Jamantikov H., write that the presence of a large amount of sodium sulfates and sodium chlorides in the soil solution enhances the decomposition of dolomite flour to calcium and magnesium bicarbonate. The activity of the latter leads to intensive incorporation of calcium and magnesium cations into colloids with displacement of sodium cations from colloids.

Pilipenko V.N., give that the highest salt content is in the 0-25 cm layer. Pilipenko V.N., write about an increase in the chloride ion from 4.6-6.9 in 1991 to 10.2*15.4 meq/100 g of soil in 2001.

Zalibekov ZG, consider the issues of cyclic accumulation, migration of easily soluble salts in seasonal, annual and long-term cycles.

Turdaliev Zh.M., write that the level of groundwater has risen to a critical one from 0.5 to 2 m from the surface, in the places of formation of meadow, meadow alluvial and meadow saz soils. Saline soils of medium, strong and very strong degrees of salinity and solonchaks have developed here.

In the book [Sokolov, I. Assing, Kurmangaliev] for the Almaty region are given: meadow solonchaks; salt marshes; solonchak solonetzes. The authors [Sokolov, I. Assing] cite the following complexes and combinations of soils: meadow-brown desert-steppe solonchak-alkaline soils with solonetzes and solonchaks; meadow-serozem solonchak-alkaline soils with solonetzes and solonchaks; meadow saline soils with solonetzes and meadow solonchaks.

MATERIAL AND METHODS

The objects of study are meadow solonchaks; meadow-serozem highly saline with solonchak soils in the Enbekshikazakh district of the Almaty region. On these soils, the presence of salts in the upper part of the soil was studied. Expeditionary, visual and chemical methods of soil research were used. Soil samples were taken in layers: crust, 0-5, 5-10, 10-20, 20-30 cm. Easily soluble salts were analyzed by the water extract method. To establish the patterns of movement of salts (cations and anions), weather data from the Shelek meteorological station were used.

From these positions, there is a close connection between the migration of easily soluble salts and drought phenomena. Since the drought is characterized by a long absence of precipitation (or a significant reduction in comparison with the average long-term norms). This leads to a sharp decrease in air humidity, evaporation of soil moisture.

Under our research conditions, drought is a phenomenon that causes the rise of aqueous solutions through soil capillaries. Atmospheric drought, causing the evaporation of water from the soil surface, contributes to the constant influx of new moisture to the upper layers of the soil. With such a current, a new portion of easily soluble salts is added to the soil surface. In this case, atmospheric drought leads to soil salinization, which also leads to a deterioration in vegetation development.

RESULTS AND DISCUSSION

In the foothills of the Almaty region, the growing season of 2020 was characterized as dry. It was long-term, many months of anomalously dry weather, when 11.7 mm of precipitation fell in May, and 2.3 mm in June. At the same time, the air temperature in May rose to a maximum of 35.9º C, the average value was 21.0º C, and the air temperature in June was 35.9º C and 23.2º C, respectively. That is, the most important months for plant growth turned out to be extremely dry. The next 3 months also did not differ in rainfall: July - 10.3, August - 9.4 and September - 5.8 mm. During these months, the air temperature was high: in July 37.9º C maximum, the average 25.1º C, then 36.5º C and 24.9º C, then 32.9º C and 19.5º C, respectively. Such conditions led to the drying up of the soil, lowering the level of groundwater.

Conditions in 2021 were somewhat different, but also turned out to be dry. So the month of May was more rainy and 26.5 mm of precipitation fell. In June, only 7.6 mm fell, even less in other months - 2.7, 1.3, 0.6 mm. At the same time, the air temperature in May rose to a maximum of 34.9º C, the average value was 21.1º C, and the air temperature in June was 35.7º C and 23.9º C, respectively. During these months, the air temperature was high: in July 40.3º C maximum, the average 27.8º C, then in August 36.6º C and 24.8º C, then 36º C and 21.4º C, respectively.

It should be considered that the prolonged many months of anomalously dry weather in 2020 also affected the soil processes in 2021. In the aggregate of two dry years, the soil drought was more severe. Atmospheric-soil drought led to the rise of salts in the upper layers of the soil in 2021. There were salts on the surface of the fields.

Figure 1 (photo) shows the accumulation of salts on the soil surface of the Lavar solonchak on November 24, 2021.

Figure 1 – Visible accumulations of salts on the soil on November 24, 2021. The surface of the Lavar solonchak

Figure 2 – The surface of the Lavar solonchak in the photo October 10, 2022.

Atmospheric precipitation in 2022 was completely different. Firstly, in March, precipitation was 2-3 more than in the previous 2 years. Also, the precipitation for May and June was much higher, which led to large movements of rapidly soluble salts in the soil. Despite the fact that the air temperature in May rose to a maximum of 33.5º C, the average value was 20.4º C, which was lower than the average for 2020 and 2021. by 0.6 and 0.7º C. The air temperature in June was 38.3º C and 25.2º C, which exceeded previous years by 2.4 and 2.7º C, respectively. During these months, the air temperature was high: in July 40.2º C maximum, the average 27º C, then in August 35.1º C and 23.4º C, respectively.

Usually, evaporation increases with an increase in air temperature, but precipitation in 2022 led to changes in salts in areas where they were observed from the soil surface. Precipitation on May 21, 22 was significant. They moistened the soil to a depth of 15-25 cm and deeper.

On the Lavar salt marsh on November 24, 2021 (Figure 1), salts protruded on the surface, forming a crusty-puffy solonchak. A few months later, in this area, the salts were not a continuous cover as in the photo, but small spots.

In our field expeditions, we found that in 2022 the salt cover changed on the meadow-serozem solonchaks. Winds play an important role in the movement of salts in solonchaks. So according to (National Action Plan, p. 7) they give: "The Chilik mountain-valley wind is formed from the movement of cold air from the glacier area at the head of the Chilik River to the Ili valley. The wind blows along the river during the day from the northwest to the southeast, and at night in the opposite direction. The wind speed during the year is 8-10 m/s". We constantly felt the direction of the east wind in the westerly direction. When we were present at the objects under study, in different seasons, the wind speeds were both very weak and very strong.

The role of elevated air and soil temperatures and their connection with easterly winds. We observe that in the Lavar area the eastern part of the uneven areas is dried up by the winds, that is, we are convinced here that the wind, drying up the surface of the uneven part of the soil, causes the salts to rise more towards the eastern part of the micro-sections. The identification of salts, which is clearly visible from the eastern part on the irregularities, intensifies after light precipitation. During May 22-23, 11.9 mm of precipitation fell. Salts begin to appear there, which gradually increase. Within 7-8 days, the area was almost completely covered with salt. These states of salts on the soil surface turned out to be intermediate, since in June the salts again decreased. During this period of time, the composition of the vegetation has changed. Vegetation at the Lavar site at the time of October 10, 2022 became more diverse and larger than it was in autumn 2021, as shown in Figure 2.

CONCLUSION

Conducted expeditionary studies in the foothills of the Ile Alatau showed that dry years lead to the rise of salts on the soil surface. Here an important role is played by such factors as the absence or small amount of precipitation, and the drying effect of winds. At the same time, the rise of salts occurs intensively already in May. The rapid rise of salts is associated with the presence of a large amount of easily soluble salts at depths from 0 to 30 cm.

Weather conditions that affect the processes of movement of easily soluble salts to depths from 0 to 30 cm are precipitation that can dissolve them. Local winds also play a role in the transfer of easily soluble salts outside the solonchaks.

The surface of the Lavar salt marsh in spring 05/05/2021 (Figure 3) and in autumn 12/14/21 was the same color of salts on Google maps. On Google maps, the surface of the Lavar solonchak in the photo from 06.2022 is different (Figure 4). The difference is that the solid white area has been transformed into an area with no salt on the surface. Single salt spots are visible on the site. By this time, it turned out that under the conditions of the summer-autumn period, there was almost no white salt on the soil surface (Figure 4). At the same time, the territories in neighboring areas differ in color on Google maps that were in 2021 from the images of 2022. We mean that this is a difference, which consists in the presence of white salt areas around the Lavar salt marsh. That is, on Google maps in 2021, areas with white salt areas became almost invisible on Google maps in the fall of 2022.

Figure 3 - The surface of the Lavar solonchak 05.2021

Figure 4 - The surface of the Lavar solonchak 06.2022

As we can see, the factors influencing the processes of movement of easily soluble salts on the soil surface of the foothill part of the Ile Alatau are also reflected in Google maps obtained in 2021 and 2022. Judging by the Google map (photo 06.2022), salts again decreased in June.

This allows a preliminary determination of the most effective assessment of soil salinity and their areas. Comparison of map data with maps of 2017, 2018 and 2019 showed that in these years, in summer and autumn, there was even less salt on the soil surface than in June 2022. However, a large amount of salt is always contained in the upper layers of the soil

Thus, a combination of expeditionary, remote, and chemical research methods characterize the processes occurring on saline soils. In the study areas, there is a significant variability in the reflectivity of some solonchaks and their transition to the category of highly saline soils. In the presence of a large amount of data from remote and ground measurements, it is possible to establish relationships with weather conditions and the reflectivity of solonchak salts.

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STUDY OF MUTATION VARIABILITY DUE TO THE EFFECT OF GAMMA RAYS ON COTTON SEEDS

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Research work is being conducted to obtain donors genotype of which is completely differ from the initial form by the effect of physical mutagens, i.e. gamma rays, on the seeds of the cotton plant. Thus, the effect of gamma rays accelerates metabolism, especially physiological and biochemical processes in the seed-cell, changes occur in the structure of chromosomes and new mutant forms are obtained that are not characteristic of the initial form. Chromosomal variation in the M1 generation leads to branching of the bush, large and numerous balls, thick and large leaves and the emergence of sterile and semi-sterile form of the bush. Amazing twists and horns have formed on the stem. Fasciated sympodial branches, hereditary and mutational variability spectra were observed.

Key words: *physical mutagen, cotton, variety, mutation variability, initial material.*

INTRODUCTION

All over the world, extensive research is being conducted to obtain new intensive type varieties and donors by the method of mutagenesis. In research, including experimental mutagenesis, genes are the material basis for transferring hereditary traits and properties from parent forms to new generations. Genes are located in the nucleus of the cell in a certain number of bodies called chromosomes of different shapes and sizes. Normally, on the eve of division, each chromosome produces a second chromosome that is exactly like itself, each cell having the same number of chromosomes. However, chromosomal aberrations occur due to the breaking of olfactory fibers in chromosomes under the influence of gamma rays. That is, the chromosomes are not assembled to an equal number of poles, but to one pole. This leads to the emergence of mutations and donors with a new chromosome arrangement that is not similar to the parents genotype.

The main goal of the experimental mutagenesis, , the conducted research, is the acquisition of mutation variability, mutants, initial donor forms for selection, by the effect of gamma rays on the seeds of cotton varieties at different doses.

MATERIAL AND METHODOLOGY OF RESEARCH

The seeds of three cotton varieties - Ganja-183, China-37, Amphidiploid form as research material were irradiated with Co60 x-rays in doses of 150,300,450 g for two years at the Institute of Radiation Problems of the Azerbaijan National Academy of Sciences. Then, the seeds of cotton varieties were sown in the experiment base Research İnstitute of Plant Protection and İndustrial Crops in open field conditions in the second ten days of April in the experiment area according to the 90 x 20 scheme. Each variety was sprayed in two spots at each dose as a control.

In the M1 generation, phenological observations were made during the vegetation period. In the field observations, the ability of seeds to germinate in the field, the vitality of plants, the period between phases, the number of sympodial and monopodial branches in the bush, the height of the stem, the location of the first bar branch, the number of cones in the bush, the type of branching, hairiness of the stem and leaves, color, resistance of plants to diseases and pests, also, as a result of laboratory analysis, the mass of raw cotton obtained from one cocoon, fiber yield, length of the fiber in flight, etc. has been studied. At the end of vegetation in M1, phenotypic characteristics of 150-200 plants were drawn. From individual samples collected in M1, family seeding will be done in M2.

Part of research

Gamma radiation has caused failure of one cotyledon leaf in some plants. Germination viability of seeds, plant height, number of cones and sympodial branches, degree of variation, spectrum and genetic efficiency are studied under the influence of radiation.

In contrast to the control during the vegetation period, the variants have a poor yield in shoots. In the seeds treated with 300 and 450 gray doses, the energy decreased, in the damaged seedlings, the cotyledon leaves were deformed, the formation of true leaves was delayed, and the weak plants gradually disappeared.

In the M1 generation, due to the influence of the gamma ray, strange twists, horns, an increase in the number of sympodial branches along with the height of the main stem, early maturity, productivity, fiber output, etc., appeared in the stem. signs are studied.

Among the plants in M1, early maturing, double cones, 8 cones, oblong and oval-shaped, multi-slice cone cross-shaped stem, very tall and stunted stems, thick and deep slices with large flower bases, large and small cones, scattered bushes were obtained.

In our 2022 study, all phenological observations and variability were recorded in the M1 generation. The seeds planted in doses of 150 and 300 gray for each variety were sparse and poorly developed. In the 450 gray dose, although there was a 50% yield in the number of plants, more crossing occurred, and even a decrease in the number of plants occurred in the following days.

Plant density and normal development of Ganja-183 variety Ganja-183 at 300 gray dose, 8 cones, thick leaves and large-multi-sliced cones were observed.

In the plants sown on China-37 variety at 150 and 300 gray doses, the plants were very sparse and poorly developed. Multi-variety, multi-cone, early maturing, scattered, fertile, deaf and sterile forms were observed in all the plants planted in 450 gray doses.

In the rows sown according to the variety of amphidiploid origin, the plants are denser and better developed. However, at the 450 gray dose, the emergence of plants was slightly delayed.

In order to collect samples of raw cotton in generation M1, raw cotton of 20 cones was collected from the first and second places of II-V bar branches of all plants for each replication.Thus, in the M1 generation, 12 variants sown in each dose with three cotton varieties were sown in the experimental field in 2023.

The seeds of the three cultivars were sown in 12 rows for comparison with irradiation at the same doses.

In the conducted experiment, raw cotton of 141 plants was collected as an individual sample. Bio-morphological indicators of plants - vegetation period, plant height, the number of cones and sympodial branches on the bush are determined, economic indicators - fiber yield, fiber length, mass of raw cotton in one cone and other analyzes and calculations are carried out in laboratory conditions.

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THE ROLE OF PHOSPHORUS IN SOIL FERTILITY

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In nature, the parent rock of most soils is made up of apatite minerals, which are derivatives of orthophosphoric acid. The forms of phosphorus compounds in the soil and their absorption by plants are one of the main issues of agrochemical research. In the study, the effect of organic fertilizers with different contents on phosphorus transformations in the soil in different growth phases of the sugar beet plant under the conditions of gray-meadow soils was studied. For this purpose, a field experiment with sugar beet plant was established in the Dayag station of the Institute of Soil Science and Agrochemistry in the village of Garabork, Ujar region. In the experiment, ammonium salt, simple superphosphate, potassium sulfate, semi-rotted manure, biohumus and "Shirvan" compost were used as organic fertilizers. When comparing options with organic fertilizers, the highest amount of phosphorus forms was obtained in the option with 7 tons of biohumus per hectare. From the results obtained from the field experiment, it was determined that as a result of the effect of the given fertilizers, an increase in the amount of phosphorus forms was observed in all variants compared to the control variant. When comparing options with organic fertilizers, the highest amount of phosphorus forms was obtained in the option with 7 tons of biohumus per hectare. In this version, phosphorus-13.9, which is soluble in water in the phase of formation of 3-4 leaves under the sugar beet plant; activated phosphorus-34.2; Soluble in 0.5n CH_3COOH-248.4; 478.2 mg/kg soluble in 0.5n HCl; according to the phase of mass maturation - 9.8; 26.7; 252.3; 486.8; at the end of vegetation - 6.3; 21.2; 260.5; 489.0 mg/kg was observed. Looking at the obtained results, we see that the amount of soluble and mobile phosphorus in water decreases towards the end of vegetation, 0.5n CH_3COON; The amount of phosphorus dissolved in 0.5n HCl increases towards the end of vegetation. This is explained by the fact that a certain part of phosphorus is absorbed by plants, and a certain part goes into a form that is difficult to dissolve.

***Keywords**: biohumus, fertilizer, organic, phosphorus, soil*

INTRODUCTION

In nature, the parent rock of most soils is made up of apatite minerals, which contain derivatives of orthophosphoric acid. In the process of soil formation, phosphorus contained in the parent rock is involved in the biological cycle as a result of wind erosion, the effect of animals and microorganisms. There are quite a variety of organic and inorganic compounds of phosphorus. This chemical element enters the soil mainly through plant and animal remains, fertilizers, soil-forming rocks [1].

The physiological role of phosphorus in plant nutrition is very large. Phosphorus participates in the synthesis of proteins, energy exchange, and the study of hereditary characteristics. The main part of phosphorus that can be assimilated by plants is contained in organic matter. When there is a lack of phosphorus, the growth of the stem of the plant stops, the crop spoils before ripening, the lower leaves turn blue-green and then turn brown [4].

MATERIAL AND METHODS

The scheme of the experiment is as follows:

1. Control (no fertilizer)
2. $N_{100}P_{50}K_{120}$ (equivalent to 20 t of manure)
3. "Shirvan" compost 20 t/ha
4. Manure 20 t/ha
5. Biohumus 7 t/ha

Field research works were carried out at the Dayag station of the Institute of Soil Science and Agrochemistry in the village of Garabork, Ujar region. Soil and organic fertilizer analyzes were conducted in the Institute's soil-agrochemical research and mass analysis laboratory (Palintest-7500) according to the methodology established in agrochemical research. The obtained results are presented in the tables.

RESULTS AND DİSCUSSİON

The roots of plants receive phosphorus in the soil in two forms, so if the pH of the soil solution is less than 7, monophosphate ion (PO4); If the pH is greater than 7, the predominant form is the diphosphate ion (P2O7). These ions form compounds of Ca in alkaline soils, iron and aluminum compounds in acidic soils. The availability of phosphorus in the soil greatly affects the demand of plants for this element. The forms of phosphorus in the soil are reflected in the following figure.

Total phosphorus consists of the sum of organic and mineral compounds. It includes organic phosphorus, mineral compounds of phosphorus, potentially assimilable phosphorus, assimilable phosphorus.

The amount of total phosphorus mainly depends on the granulometric composition of the soil, the characteristics of the parent rocks, and the amount of phosphorus in the planting layer depends on the activities of people, biological factors, as well as the accumulation of the main mass of roots in the zone with residues.

Organic phosphorus is mainly contained in humus. A certain amount of organic phosphorus is contained in phytin, phosphatite, nucleic acid, and other organic compounds of peat.

Mineral phosphorus is found in the soil in the form of calcium aluminum and iron salts. Thus, calcium salts are easily absorbed by plants due to their easy solubility. Iron and aluminum salts are more difficult to be assimilated by plants due to their relatively difficult solubility. As a result of applying fertilizers for a long time, organic and mineral phosphorus compounds are in a state of mutual transformation.

1. Phosphates in the soil solution are completely absorbed by the plant. Thus, this fraction of phosphorus is intensively used by plants starting from the first period of plant growth and development. This fraction of phosphorus of the soil is a very important indicator, it expresses the dynamic reserve of phosphorus in it.

2. Phosphates adsorbed by its solid phase in the top layer of the soil, which can pass into the soil solution mainly when the balance of phosphorus is disturbed under certain conditions. This fraction of phosphorus represents the amount of total available phosphorus in the soil.

3. Hardly soluble phosphates accumulate in primary and secondary minerals in the mineral network of the soil. This part of soil phosphorus does not participate in kinetic changes between the solid and solution phases of the soil.

In the last hundred years, the rapid growth of the population of the republic, the excessive expansion of settlements, the intensive development of mining, energy, transport and other industries have led to a multiple increase of anthropogenic effects on the environment, natural ecosystems, as well as its individual components, including land cover. As a result, the area of arable and other lands (forest fund, summer and winter pastures) decreased, their fertility indicators deteriorated, and their biopotential decreased. For this reason, the lack of phosphorus formed in the soil as a result of soil erosion and intensive use has become an urgent issue [3].The forms of phosphorus compounds in the soil and their absorption by plants are one of the main issues of agrochemical research. The parent rock of most soils is made up of apatite minerals containing phosphorus compounds. In the process of soil formation, phosphorus in the parent rock is involved in the biological cycle as a result of wind erosion, the effect of animals and microorganisms. The ratio between organic and mineral compounds of phosphorus varies depending on the soil's genetic characteristics, physico-chemical properties, and the degree of cultivation. The main part of phosphorus that can be assimilated by plants is contained in organic matter. As a result of applying fertilizers for a long time, organic and mineral phosphorus compounds are in a state of mutual transformation. Also of greatest importance in agrochemical research are the soluble compounds of phosphorus that can be assimilated by plants in the soil. [2].

In order to study the effect of organic and mineral fertilizers on the amount of forms of phosphorus in the conditions of gray-meadow soils of Ujar, a field experiment was conducted with sugar beet plant. The experimental work consisted of 5 options, 3 repetitions, the area of each section is 50 m^2.

In the experiment, ammonium salt, simple superphosphate, potassium sulfate, semi-rotted manure, biohumus and "Shirvan" compost were used as organic fertilizers. The composition of "Shirvan" compost is as follows: manure - 30%, bird droppings - 10%, waste from industrial processing of agricultural products - 10%, plant residues - 30%, household waste - 10%, slaked lime + ash + simple superphosphate - 10% %. The biohumus presented by the company "Absheron Bio-Technology" used during the experiment contains organic matter-30%, humus-9.0 at a moisture content of 55%; total nitrogen-3.2; phosphorus-2,6; potassium is 2.0%.

In order to study the dynamics of the amount of forms of phosphorus under the sugar beet plant, according to the phases of the plant's development (phase of 3-4 leaf formation, mass ripening phase, end of vegetation) 0-20; The amount of phosphorus soluble in water, soluble in 0.5n CH_3COOH and 0.5n HCL was determined in soil samples taken from a depth of 20-40 cm. The obtained results are given in the table.

Table.

Organic applied in conditions of gray-meadow soils of Ujar the effect of fertilizers on the amount of forms of phosphorus in the soil (in mg/kg)

№	Scheme of the experiment	Depthcm	3-4 leaf formation phase				Mass ripening phase				End of vegetation			
			Soluble in water	Mütəhərrik	Soluble in 0,5n CH3COOH	Soluble in 0,5n HCl	Soluble in water	Mütəhərrik	0,5n CH_3COOH-	0,5n HCl-	Soluble in water	Mütəhərrik	Soluble in 0,5n CH_3COOH	Soluble in 0,5n HCl
1	Control (nofertilizer)	0-20	7,6	24,4	230,6	465,7	7,6	19,4	238,4	466,4	3,8	15,6	245,4	470,6
		20-40	5,4	16,4	209,6	428,4	4,8	9,6	211,8	430,2	2,0	7,5	217,2	438,5
2	$N_{100}P_{50}K_{120}$ (Equivalent to 20 t of manure)	0-20	10,3	26,7	240,3	470,5	8,1	20,4	246,8	475,2	4,8	17,4	250,6	478,2
		20-40	7,6	14,3	222,6	430,5	5,8	10,8	220,8	438,4	2,3	8,5	222,3	440,1
3	"Shirvan" compost 20 t/hectar	0-20	13,2	32,4	245,6	478,4	9,4	28,6	246,7	484,2	5,8	23,8	250,1	478,6
		20-40	8,4	14,7	220,6	434,2	7,2	13,8	223,7	440,5	2,5	10,2	226,7	443,5
4	Manure 20 t/hectar	0-20	15,6	38,2	250,8	480,8	10,2	29,8	258,5	488,4	6,0	24,6	265,6	492,8
		20-40	8,9	19,8	221,8	435,4	6,2	14,6	225,5	440,2	2,7	11.2	228,6	448,9
5	Biohumus 7 t/hectar	0-20	13,9	34,2	248,4	478,2	9,8	26,7	252,3	486,8	6,3	21,2	260,5	489,0
		20-40	8,5	13,3	224,6	432,5	5,7	14.6	224,8	440,4	2,9	9.5	228,1	440,8

In order to study the dynamics of the amount of forms of phosphorus under the sugar beet plant in the conditions of the gray meadow soils of Ujar, on the development phases of the plant 0-20; Soil samples were taken from a depth of 20-40 cm. dynamic; The amount of phosphorus dissolved in 0.5 n CH_3COOH and 0.5 n HCL was determined. Looking at the obtained results, we see that as a result of the effect of given fertilizers, an increase in the amount of phosphorus forms was observed in all variants compared to the control variant. So, in the 0-20 cm layer of the soil, in the control option without fertilizer, in the phase of 3-4 leaf formation, water-soluble phosphorus is -7.6; activated phosphorus -24.4; Soluble in 0.5n CH_3COOH- 230.6; Phosphorus dissolved in 0.5n HCL-465.7, correspondingly in the mass ripening phase-7.6; 19.4; 238.4; 466.4; and at the end of vegetation -3.8; 15.6; 245.4; While it is 470.6 mg/kg, in the version given "Shirvan" compost, the forms of phosphorus are -13.2 in the phase of 3-4 leaf formation, respectively; 32.4; 245.6; 478.4; -9.4 in mass ripening phase; 28.6; 246.7; 484.2; at the end of vegetation - 5.8; 23.8; 250, 1; It was equal to 478.6 mg/kg.

CONCLUSİON

When comparing options with organic fertilizers, the highest amount of phosphorus forms was obtained in the option with 7 tons of biohumus per hectare. In this version, phosphorus-13.9, which is soluble in water in the phase of formation of 3-4 leaves under the sugar beet plant; activated phosphorus-34.2; Soluble in 0.5n CH_3COOH-248.4; 478.2 mg/kg soluble in 0.5n HCL; according to the phase of mass maturation - 9.8; 26.7; 252.3; 486.8; at the end of vegetation - 6.3; 21.2; 260.5; 489.0 mg/kg was observed. Looking at the obtained results, we see that the amount of soluble and mobile phosphorus in water decreases towards the end of vegetation, 0.5n CH_3COON; The amount of phosphorus dissolved in 0.5n HCl increases towards the end of vegetation. This is explained by the fact that a certain part of phosphorus is absorbed by plants, and a certain part goes into a form that is difficult to dissolve.

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THE INFLUENCE OF CROP ROTATION AND SEEDING ON THE QUANTITATIVE INDICATORS OF PLANTS AND THE NUMBER OF WEEDS

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In the work of increasing the productivity of agricultural plants and raising the culture of agriculture, weeding of the cultivated fields is of great importance.Weeds create unfavorable conditions for the development of plants and rapidly absorb nutrients and moisture in the soil, causing a decrease in the yield and its quality. Therefore, the role of crop rotations in the fight against the main weeds of grain is great.

The effect of planting schemes on the structural indicators of plants was also different. Thus, the obtained product depends on the quantitative indicators of the plants located in a single area.

Key words: *plant diversification, crop rotation, continuous cropping, winter wheat, fodder pea, barley, productivity*

INTRODUCTION

The application of advanced cultivation technologies developed on scientific basis for the development of agriculture in the republic is the actual problem of the day to achieve the preservation of the structure and fertility of the soil, as well as to achieve an increase in productivity through the effective use of technological processes.

One of the most important measures to increase the productivity of plants placed in the crop rotation is the application of the correct cultivation system. Timely and quality soil cultivation creates conditions for the accumulation of nutrients in the soil, the timely decay of roots, plant residues and siderate left in the soil after harvesting, the efficient use of mineral fertilizers, and the improvement of the activity of beneficial microorganisms, which are the main factors that increase productivity. [1]

It can be considered very useful for them to correctly assess the degree of availability of cultivated plants in the crop rotation and the effect on soil fertility by selecting short rotation cropping schemes for planting and cultivating similar cereal crops on a small plot of land in peasant farms.

Plant rotation in a scientifically based manner ensures increasing the amount of nutrients in the soil and their efficient use, protecting the soil from erosion by creating favorable water-physical properties, and ensuring proper control of weeds, diseases and pests.

Recently, ecological, soil-protecting, resource-saving, including biological diversity problems have been identified as important priorities in the republic, and serious efforts are being made in the development of this field.

Alternating agricultural plants according to their biological characteristics and soil fertility is to cultivate the soil in accordance with the agro-ecosystem. When alternating plants with different root structures, the structural indicators of the plants and the corresponding productivity also increase [7, 8]. In crop rotation, which is one of the most important areas of the agricultural system, along with grain crops, inter-row cultivation, nitrogen-rich legumes and fodder crops are important [9].

MATERIAL AND METHODS

Taking these into account, in 2022, in the Absheron Auxiliary Experimental Farm area, the quantitative indicators of plants and the amount of weeds, which have a great impact on productivity reduction, were comparatively studied in the research conducted with the autumn forage pea-autumn wheat-barley type short rotation crop rotation and continuous crops. "Azerbaijan-1508" of fodder pea, "Gobustan" of winter wheat and "Jalilabad-19" of barley were used in the study.

The results of our research show the effect of planting schemes on the weeding rate and quantitative indicators of the experiment.

Since the research work was carried out under irrigation conditions, favorable conditions for the development of weeds were created. As we know, weeds create unfavorable conditions for the development of plants and rapidly absorb nutrients and moisture from the soil, causing a decrease in the yield and its quality.

RESULTS AND THEIR DISCUSSION.

The calculations and observations showed that, despite the same cultivation in both crops, the amount of weeds in a single field prevailed in continuous cultivation (table 1).

Table 1

The number of weeds in the fields depending on the planting schemes, number/m2 (second year of the study)

Plants	Developmental phases	Crop rotation	Continuous cropping
Fodder pea "Azerbaijan 1508"	Branching	9.7	14.7
	Flowering	7.7	12.6
	Bean formation	6.0	6.4
Winter wheat "Gobustan"	Tubing phase	10.2	15.4
	Filling of grain	7.1	14.4
	Maturation	4.2	6.0
Barley "Jalilabad-19"	Tubing phase	11.8	16.9
	Filling of grain	8.9	13.7
	Maturation	5.5	7.4

As can be seen from the table, the amount of weeds per unit area for fodder peas in the crop rotation option is 9.7 in the branching phase, 7.7 in the flowering phase, and 6.0 in the bean formation phase, while in the continuous planting option, 14.7; 12.6; 6.4 units arranged. In the winter wheat crop rotation option, the number of weeds in the tubing phase is 5.2 units compared to continuous sowing, and a decrease of 5.1 units was observed in barley.

Table 2

Effect of crop rotation and continuous crops on winter wheat and barley yield quantitative indicators

Indicators	Crop rotation		Continuous cropping	
	Winter wheat "Gobustan"	Barley "Jalilabad-19"	Winter wheat "Gobustan"	Barley "Jalilabad-19"
Total biomass per unit area, g	1633.0	1256.3	1607.1	1179.0
Plant height, cm	104.4	77.0	95.4	70.4
Number of fertile stems per 1 m2, (in numbers)	336.1	293.8	328.3	281.8
The length of the spike, cm	9.1	10.2	8.4	9.7
The number of grains in 1 spike, quantity	50	26	46	24
The mass of grain in 1 spike, g	1.47	1.46	1.45	1.44
The mass of grain from the unit area, g	496.1	427.3	475.0	404.0

As can be seen from the table, quantitative indicators for both plants were high in the crop rotation option. In the mentioned variant, the total biomass of spring wheat grain taken from one area is 1633.0 g, plant height is 104.4 cm, the number of fertile stems in one area is 336.1, the length of the spike is 9.1 cm, the number of grains in one spike is 50, the mass of grain in one spike is 1.47 g., the mass of the grain from the unit area was 496.1 g.

For a barley plant, the total biomass from a joint taken from a unit area is 1256.3 g, the height of a plant is 77.0 cm, the number of fertile stems per unit area is 293.8, the number of grains in one spike is 26, the mass of a grain in one spike is 1.46 g, the mass of a grain from a joint taken from a unit area is 427.3 g is assigned.

In the continuous cropping option, the total biomass of winter wheat taken from one area is 1607.1g, the height of the plant is 95.4cm, the number of fertile stems in one area is 328.3, the length of the spike is 8.4cm, the number of grains in one spike is 46, the mass of the grain in one spike is 1.45g, from one area the mass of the grain coming out of the seam was 475.0 g.

The development of fodder pea has been varied in the variant of crop rotation that ensures biological diversity, as well as in continuous cultivation. Phenological observations were made regularly during the developmental phases to monitor how each plant was developing. Green mass of plants in 1m2 area, plant height before harvest, number of branches and number of beans per plant were determined in the phase of fodder pea pod formation. All the indicators we mentioned prevailed in the first option.

CONCLUSION

The results obtained from the research and the analyzes show that the effect of planting schemes on the quantitative indicators of plants is different. Thus, the obtained product depended on the structural indicators of plants located in a single area. Also, the low amount of weeds in the crop rotation option was of particular importance in this study.

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INFLUENCE OF POULTRY MANURE ON FERTILITY OF SODDY-PODZOLIC SOIL

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The poultry industry is one of the most important components of the agro-industrial complex of the Republic of Belarus. With an increase in the production of the main products, at the same time, the flow of waste from poultry farms proportionally increases, the most voluminous of which is poultry manure. In terms of nutrient content, it surpasses any organic fertilizer, and in terms of availability it is not inferior to mineral fertilizers. The organic matter of the manure (the main part of the dry matter of this fertilizer) improves the structure of the soil, its water and air regime, physicochemical and agrochemical properties. But poultry manure can adversely affect the environment: through the migration of substances along the soil profile to groundwater; through the imbalance of soil nutrients, due to the long-term use of high doses in permanent areas; accumulation in plant products of nitrates and other elements that adversely affect human or animal health.

Research on the study of changes in the properties of soddy-podzolic soils when using poultry manure was carried out in the production conditions of OJSC "Vitebsk Broiler Poultry Farm", at the Department of Soil Science and the Chemical and Ecological Laboratory of the Belarusian State Agricultural Academy. Content of nutrients in poultry manure, agrochemical parameters of soil were determined according to generally accepted methods. Agrochemical parameters largely determine state of soil cultivation. As indicators of soil cultivation, value of acidity (pH), content of mobile forms of phosphorus and potassium, humus and microelements are used.

With the systematic introduction of high doses of chicken manure, there is an increase in soil fertility and at the same time, there is a real threat of contamination of agrobiogeocenosis with nutrients. When assessing the impact of industrial poultry enterprises on the environment, it is necessary to strictly control the chemical composition, the doses of manure and the granulometric composition of the soil.

Keywords: *Poultry manure, Soddy-podzolic soil, Fertility, Granulometric composition, Agrochemical parameters, Agrophysical properties.*

INTRODUCTION

The poultry industry is one of the most important components of the agro-industrial complex of the Republic of Belarus. With an increase in the production of the main products, at the same time, the flow of waste from poultry farms proportionally increases, the most voluminous of which is poultry manure. In terms of nutrient content, it surpasses any organic fertilizer, and in terms of availability it is not inferior to mineral fertilizers. The organic matter of the manure (the main part of the dry matter of this fertilizer) improves the structure of the soil, its water and air regime, physicochemical and agrochemical properties. But poultry manure can adversely affect the environment: through the migration of substances along the soil profile to groundwater; through the imbalance of soil nutrients, due to the long-term use of high doses in permanent areas; accumulation in plant products of nitrates and other elements that adversely affect human or animal health [1, 2].

The change in the properties and level of soil fertility under the influence of anthropogenic impacts in different natural zones and regions has very different rates and directions, which depend on the general soil and ecological conditions of the territory. Under such conditions, there is an urgent need to estimate changes in the agrophysical properties and agrochemical parameters of soils, taking into account the specific features of the impacts on the soil cover [3, 4]. The degree of influence of manure fertilizers on soil fertility depends on the dose of application, the crop under which they are applied, the duration of application, and the granulometric composition of the soil [5, 6]. Under such conditions, there is an urgent need to assess changes in the agrophysical and agrochemical properties of soils, taking into account the specific features of targeted and non-targeted impacts on the soil cover.

MATERIALS AND METHODS

Research on the study of changes in the properties of soddy-podzolic soils when using poultry manure was carried out in the production conditions of OJSC "Vitebsk Broiler Poultry Farm", at the Department of Soil Science and the Chemical and Ecological Laboratory of the Belarusian State Agricultural Academy.

OJSC "Vitebsk Broiler Poultry Farm" – one of the largest in the Republic of Belarus. The poultry farm is located in the north-eastern part of the Republic of Belarus. This region is characterized by a temperate continental climate. The average annual air temperature in this region is +5.3°C. The average annual humidity is 78%. The experiments were carried out on soddy-podzolic, cultivated, medium loamy soil, underlain from a depth of 130 cm by moraine loam and soddy-podzolic, cultivated, cohesive sandy loamy soil, developing on water-glacial sandy loam, replaced by sand from a depth of 130 cm. Poultry manure on the farm is used for fodder crops at a dose of 80 t/ha and grain crops – 40 t/ha.

Content of nutrients in poultry manure, agrochemical parameters of soil were determined according to generally accepted methods in the Chemical and Ecological Laboratory of the Belarusian State Agricultural Academy.

RESULTS AND DISCUSSION

The analysis showed that the content of nutrients in poultry manure at natural humidity is: total nitrogen 1.40%; phosphorus 1.51%, potassium 1.37 calcium 0.83%, magnesium 0.62%, content of Zn 76.3 mg/kg, Mn 53.8 mg/kg, copper 14.3 mg/kg of dry matter, that is a highly concentrated organic fertilizer.

Agrochemical parameters largely determine state of soil cultivation. As indicators of soil cultivation, value of acidity (pH), content of mobile forms of phosphorus and potassium, humus and microelements are used [7].

Among the most important properties of the soil is the reaction of the environment. The general direction of the soil-forming process, the chemical and mineralogical composition, the content and composition of organic matter, the composition of exchangeable cations, the presence or absence of salts, the vital activity of living organisms, the composition of soil air and soil moisture play a role in giving the soil a particular reaction of the environment. In turn, the reaction of the soil environment has a great influence on the properties of the soil and the nature of the processes occurring in it. The reaction of the environment is associated with the solubility of many compounds and the availability of nutrients to plants, the vital activity of organisms and the formation of humic acids, the decay and synthesis of minerals [8].

In order to determine the effect of poultry manure on soddy-podzolic soil fertility of different granulometric composition, the results of the XIII round of agrochemical survey of these areas were taken as the initial content of nutrients. The results of the determination of acidity showed that, in compare with the XIII round of the survey, the acidity of the cohesive sandy loam soil changed from 5.88 to 7.2, and the acidity of medium loam from 5.96 to 6.52. According to the degree of acidity, the soil is neutral and is favorable for the cultivation of crops demanding the reaction of the soil solution.

The weighted average content of mobile phosphorous over the past 4 years has increased in cohesive sandy loamy soil by 62 mg/kg (from 208 to 270 mg/kg of soil), which is higher than the optimal values (200-250 mg/kg), in medium loamy soil by 114 mg/kg (from 184 to 298 mg/kg) and corresponds to the optimal value (250-300 mg/kg). Thus, the soil of the farm is characterized by an increased content of mobile phosphorous, which can subsequently lead to soil phosphatization and decrease in the efficiency of phosphorous fertilizers. In this case, an excess of phosphorous in the soil can disrupt the ratio between nutrients and sometimes reduce the availability of zinc and iron to plants [9]. The high and very high content of mobile phosphorous in the arable horizon of the medium loamy and cohesive sandy loamy soil is apparently associated with the introduction of high doses of poultry manure.

The content of mobile potassium increased by 74 mg/kg on sandy loamy soil (from 158 to 232 mg/kg of soil), on medium loamy soil by 12 mg/kg (from 172 to 184 mg/kg of soil), which is below the optimal value for medium loamy soils (220-250 mg/kg). The content of mobile potassium is 232 mg/kg in cohesive sandy loamy soil, at the level of the optimal value (200-240 mg/kg). It should be taken into account that an excess of potassium in soils leads to burns along the edges of the leaves, the leaves become light green, the plant withers and droops (due to a violation of water supply), signs of a lack of magnesium, often manganese, zinc and iron appear [1]. As a result of the research, it was found that, in general, with a favorable nutritional regime for these elements, there was some imbalance in their content in the soil. For virgin soddy-podzolic sandy loamy soil, the ratio of P_2O_5 to K_2O, on average, is 1.0:2.4; for highly cultivated – 1.0:1.6 [8]. Thus, as a result of the impact on the soil, specific nutritional properties arose in relation to the elements under consideration, which manifested themselves in a significant increase in the content of phosphorus and potassium in the soil and a traceable imbalance between P_2O_5 and K_2O = 1.0:1.3 and 1.0:0.9.

When characterizing soil fertility, special attention should be paid to the humus content, since this is one of the most important indicators of soil fertility. Humus is a reserve source of all nutrients, regulates the most important physicochemical and biological properties of soils, and preserves its energy potential [1]. The weighted average content of humus, over the past 4 years after the agrochemical survey, decreased on cohesive sandy loamy soil by 0.14% (from 2.54 to 2.40%), on medium loamy soil increased by 0.17% (from 2.45 up to 2.62%), but the content is at the level of the optimal value (2.5-3.0%). Such a content of organic matter in combination with a light granulometric composition can provide a high sorption capacity of soils, which must be taken into account when disposing of waste from the poultry industry.

Taking into account agrochemical indicators, the degree of cultivation of soddy-podzolic soil was calculated [7]. Calculations show that the soddy-podzolic cohesive sandy loam soil (Index of cultivation = 1.16) and medium loamy (Index of cultivation = 1.14) in the farm are highly cultivated.

The soil, as a physical body, has various properties, which are largely determined by the composition, ratio, interaction and dynamics of the solid phase of the soil (mineral and organic substances), liquid (soil solution) and gaseous (soil air). A special role is played by the physical properties of the soil, such as the density of the soil structure, the density of the solid phase and porosity. According to the density of the upper horizons, the degree of cultivation of the soil is estimated [8]. Taking into account the density of the arable horizon, the analyzed cohesive sandy loamy (dv = 0.96) and medium loamy (dv = 1.0) soil is cultivated and is suitable for the cultivation of grain and tilled crops, since for grain and tilled crops the optimal density of addition is 1.0-1.2 g/cm3 [10]. The density of the solid phase of the soil (d) depends on the nature of the minerals that make up the soil, the amount of organic matter. The more heavy minerals in the soil, the higher the density of its solid phase. The optimal density of soddy-podzolic soils is 2.65 g/cm3 [10]. The density of the solid phase of the cohesive sandy loam soil increased with a depth of 2.08 in A arable horizon up to 2.42 g/cm3 in horizon C; medium loamy with 2.16 A arable horizon up to 2.80 g/cm3 in horizon C, respectively.

Soil air (gas medium) – the most important, most dynamic component of the soil, is in close interaction with the solid, liquid and living phases of the soil. Soil air is a source of oxygen for the respiration of plant roots, aerobic microorganisms and soil fauna. Soil air – a source of carbon dioxide for plants used in photosynthesis. Of the total amount of CO_2 used to create a crop, from 38 to 72% comes to the plant from the soil. The oxygen demand of plant roots is satisfied mainly by free soil air, which is constantly involved in gas exchange between the soil and the atmosphere. The total porosity is usually 55-70% in the upper soil horizons and 35-50% in the lower ones [8]. The cohesive sandy loamy soil of the experimental plot had porosity of A arable horizon 56%, medium loamy – 54%, which characterizes it as excellent.

For a more complete characterization of the agrophysical properties and behavior of the agrochemical parameters of the soil, their distribution along the soil profile was considered. For this purpose, on soils of different granulometric composition, after harvesting grain, soil sections were laid. The migration of nutrients along the profile of the studied soils showed that on the cohesive sandy loam soil, the humus content decreases with depth from 2.40 to 1.53%, the amount of mobile phosphorous increases from 365 in A arable horizon to 404.5 mg/kg in horizon C, potassium – from

128 to 198 mg/kg, mobile manganese – from 68.2 to 82.3 mg/kg of soil, which may be due to the weak holding capacity of these soils and the removal of excess of these elements into the lower horizons. The accumulation of nutrients in the parent rock (horizon C) is undesirable for groundwater.

На среднесуглинистой почве с глубиной наблюдается снижение подвижного фосфора с 241,8 в Ап до 56,3 мг/кг в горизонте С, калия с 104 в Ап до 60 мг/кг, но увеличение содержания микроэлементов меди, цинка и марганца.

On medium loamy soil, with depth, there is a decrease in mobile phosphorous from 241.8 in A arable horizon to 56.3 mg/kg in horizon C, potassium from 104 in A arable horizon to 60 mg/kg in horizon C, but there is an increase in the content of microelements (copper, zinc and manganese).

CONCLUSION

With the systematic introduction of high doses of poultry manure, an increase in soil fertility occurs and at the same time, there is a real threat of contamination of agrobiogeocoenosis with nutrients. When assessing the impact of industrial poultry enterprises on the environment, it is necessary to strictly control the chemical composition, the doses of manure and the granulometric composition of the soil.

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THE INFLUENCE OF SOIL POLLUTION WITH VARIOUS CLASSES OF PESTICIDES ON REPRESENTATIVES OF THE MESOFAUNA OF LIGHT CHESTNUT SOILS IN THE SOUTH-EAST OF KAZAKHSTAN

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The article shows the effect of pesticides on soil invertebrates, which can serve as important indicators of soil pollution and the state of its fertility. The role of some species of soil invertebrates as indicators of soil pollution with pesticides and the possibility of using them in monitoring and assessing the ecological state of soils are considered. The physical and chemical properties of light chestnut soil in the South-East of the republic of Kazakhstan were studied. A study was made of the degree of change in the mesofauna of soils in order to determine their relative resistance to pollution by pesticides. Species of soil invertebrates have been identified that should be used as indicators for monitoring soil pollution with pesticides. The results obtained will expand knowledge about the change in the mesofauna of light chestnut soils under the influence of pesticide pollution in agrocenoses of the South-East of Kazakhstan.

Key words: *Pollution, Indicators, Soil mesofauna, Monitoring, Pesticides, Ecology*

INTRODUCTION

The use of living organisms as biological indicators of environmental change necessitates the development of a number of criteria on the basis of which indicator species can be selected [1]. These include the biological activity of soils (mesofauna, enzymes). The impact of pesticides, as well as the environmental assessment of the state of soils in the south-east of Kazakhstan, is carried out by establishing a number of diagnostic indicators that reduce biological activity.

The purpose of the study was to reveal the effect of soil pollution with various classes of pesticides on representatives of the mesofauna of light chestnut soils.

The objectives of the research included:

- To identify species of soil invertebrates that are indicators of pollution of light chestnut soils with pesticides.
- To study the effect of pesticides on the mesofauna and the humus state of soils.

The novelty of our research, in contrast to the existing works in the scientific literature, is based on the study of the influence of anthropogenic impacts on the mesofauna of soils in comparison with its main indicators, which will allow us to establish a correlative relationship between the soil fauna and the main traditional indicators of soil fertility.

As shown by recent studies, pesticides, various methods of tillage and plant protection products have a negative impact on soil biota. The use of pesticides can lead to a restructuring of the ecological situation in the soil, changing its biocenosis - inhibiting some groups of some groups of soil organisms and stimulating the reproduction of others, whose representatives are able to produce phytotoxic substances and thereby exacerbate the negative impact of the drugs used [2].

The impact of pesticides, as well as the environmental assessment of the state of soils in the South-East of Kazakhstan, is carried out by establishing a number of diagnostic indicators that reduce biological activity. Fragmentary information about the mesofauna of light chestnut soils, underestimation of their role and importance in the formation and reproduction of soil fertility, the lack of methods for biodiagnostics and soil indication determined the relevance and need for systematic research in this direction.

Similar and related alternative studies are not conducted in Kazakhstan.

Research data on the development of physicochemical and biological parameters for monitoring anthropogenic impacts can serve as a basis for such purposes:

– determining the composition of chemical pollutants in the soil, including pesticides, heavy metals, polychlorinated biphenyls and other organic compounds.

– indication and biodiagnostics of soils.

As a result of the investigations carried out, an assessment was made of the degree of sensitivity to various pesticides on the mesofauna of soils.

MATERIAL AND METHODS

Laboratory studies of selected soil samples for the content of pesticides were carried out by gas chromatography (GC) with mass spectrometric detector (MSD) in Biosphere ecology laboratory of the Center for Physical and Chemical Research Methods and Analysis of Al-Farabi Kazakh National University [3]. Collection of mesofauna, accounting of abundance - the method of manual disassembly according to Gilyarov.

RESULTS AND DISCUSSION

Field experiments were laid on light chestnut soils of the Almaty region. According to the granulometric composition, the described soil belongs to light loamy soils. The data on the chemical composition of the morphological section show that the light chestnut soil is characterized by a moderate content of humus (Table 2).

Table 2

Main agrochemical indicators of light chestnut soil

Depth, cm	Humus,%	Total nitrogen, %	C:N	Gross potassium, %	Common phosphorus, %	CO_2 , %
0–24	1.78	0.120	11.8	2.6	0.19	5.80
24–32	1.69	0.119	11.9	2.1	0.16	5.84
32–59	1.00	0.060	9.6	1.09	0.17	5.88
59–103	0.46	0.039	6.8	1.1	0.14	7.30

In the distribution of humus along the profile, the following regularity should be noted: its relatively high content in the upper horizon drops sharply, more than two times, when moving to the next subsurface horizon. A further decrease in the humus content occurs gradually, stretching to a considerable depth.

The content of gross nitrogen in the soil is low and amounts to 0.12%, due to which the ratio of humus carbon to total nitrogen is wide. In this case, it varies within 10–12, i.e., a wider (compared with zonal soils) ratio of humus carbon to total nitrogen in comparison with zonal analogs.

The gross content of phosphoric acid in the humus horizon does not go beyond 0.14–0.19%, which characterizes a low level of supply.

The amount of CO_2 varies from 5.80 to 7.30%, with a minimum in the upper horizon and a maximum in the lower one. The increase in the percentage of CO_2 with increasing depth occurs gradually, which is apparently associated with hydrogenic accumulation.

The results of the analysis of the water extract (Table 3) show that the plow and subplow horizons of the described soil are not saline, but at the same time, a small but toxic amount of normal carbonates is present in the lower horizons, which leads to a weak alkalinity and an average degree of alkalinity of the soil solution.

Table 3

Data of the water extract of the soil section of the light chestnut soil

Depth, cm	Dry residue, %	mg–eq %				pH
		CO_3^{2-}	HCO_3^-	Cl^-	SO_4^{2-}	
0–24	0.164	//	0.9785 / 0.0597	0.0789 / 0.0023	0.4200 / 0.0202	7.8
24–32	0.170	//	0.0510 / 0.8360	0.0674 / 0.0019	0.487 / 0.0234	7.9
32–59	0.182	0.0037 / 0.123	1.772 / 0.1081	0.1171 / 0.0033	0.291 / 0.0140	8.1
59–103	0.268	0.0139 / 0.463	2.032 / 0.1240	0.1491 / 0.0042	0.291 / 0.0140	8.3
Note: in the numerator, mg–eq. in the denominator - %						

The dry residue in the upper horizons does not exceed 0.164%. The salt maximum is located in the middle part of the profile.

This distribution indicates the uptake of water-soluble salts from deep horizons. Of the anions, the HCO_3^- ion predominates with a low content of sulfate and chlorine ions. It should be noted that normal carbonates are found in the profile. Its quantity along the profile is unevenly distributed. They are absent in the humus horizon (0–32 cm), their content is not high in the parent rock, and in the middle part of the profile it is within the limits of toxicity for plants (>0.001%).

Quantitative indicators of the most important physical and water-physical properties of light chestnut soils are shown in Table 4. The specific gravity ranges from 2.61–2.70 g/cm^3, gradually increasing with depth.

Table 4

Physical and water-physical properties of light chestnut soil

Depth, cm	Volumetric weight, g/cm ^{3}	Specific weight, g/cm ^{3}	Total porosity,%	Maximum field moisture capacity, %	Maximum hygroscopic moisture, %
0–24	1.20	2.61	51	27.1	5.02
24–32	1.24	2.61	50	26.3	4.28
32–59	1.30	2.68	49	26.2	4.43
59–103	1.33	2.70	47	22.0	4.41

The volumetric mass of the upper horizons is relatively small, 1.20–1.24 g/cm^3, and its sharp increase is observed only from a meter depth. In this regard, the total porosity of the upper horizons is relatively high, 47–51%. Consolidation begins with a layer lying deeper 80 cm.

The agrochemical characteristics of the soils of the experimental plot, on which field experiments were laid, are presented in Table 5.

Table 5

Agrochemical properties of irrigated light chestnut soils of the experimental plot

Depth, cm	Content of humus, %	CO_2, %	Gross forms, %		Moving forms in soil, mg/kg			
			N	R	$N_{l.g.}$	$N–NO_3$	R_2O_5	K_2O
0–24	1.78	5.9	0.221	0.190	87	25	26	435.1
24–32	1.69	5.8	0.172	0.180	69	36	13	417.2

The humus content in the plow horizon is 1.78%, which gradually decreases with depth. The content of gross nitrogen is 0.221%; average phosphorus is 0.190%. According to the availability of available nutrients, the soils of the experimental plot are characterized as moderately provided with easily hydrolysable nitrogen - 87 mg/kg and high potassium - 435.1 mg/kg. According to the content of mobile phosphorus, it belongs to the group of poorly supplied soils - 22–25 mg/kg of soil.

Thus, the light-chestnut soil, in terms of water-physical properties and the level of potential fertility, is quite favorable for the cultivation of all types of crops.

We noted that there is a clearly pronounced correlation between the content of humus in the soil and the abundance of the complex of soil invertebrates (Table 6), which makes it possible to use data on the general composition of the mesofauna to characterize this indicator as well**.**

Table 6

Humus content and abundance of mesofauna in light chestnut soils

The soil	Humus, %	Number of invertebrates	
		Total species	Number per $1m^2$
Light chestnut	1.78-1.0	4	16

The data in Table 6 show how the content of humus affects the abundance of soil mesofauna, with the content of humus in the upper arable layers being 1.78%, the abundance of soil mesofauna was 16 specimens/m ^{2} .

Thus, we have established the dependence of indicators of biological activity (mesofauna) on the content of organic compounds in the soil**.**

We have carried out research on the identification of soil invertebrates, which are indicators of contamination of light chestnut soils under the *influence of pesticides.*

The activity of soil mesofauna is certainly affected by the degree of soil contamination with pesticides. For soils in which the content of pesticides exceeds 2 times more, pronounced changes are observed. The number of species of soil invertebrates from the family (Carabida) is decreasing, the most resistant species (Curculionidae, Scarabaidae) are beginning to predominate.

The study of the effect of pesticides on soil-dwelling invertebrates is especially important because soil animals, soil, crops, are in close interaction. The use of pesticides causes a decrease in the number of beneficial soil invertebrates.

The effect of pesticides on soil fauna depends on many factors: not only on the chemical properties, forms of application and concentration of the preparation, but also on the properties of the soil, primarily on the content of humus in it, humidity, mechanical composition, pH, etc. We found that pesticides are low toxic for Lumbricidae and highly toxic even in small amounts for members of the Carabida family.

Our results indicate that soil contamination with small doses of pesticides leads to a change in the species composition of soil invertebrates. The data obtained by us confirm that there is a significant decrease in the species diversity (by 20%) of the complex of soil invertebrate families of lamellar (Scarabaidae) and an increase in the absolute dominance of such species as: earthworms (Lumbricidae), ants (Formicidae).

Analysis of data on the mesofauna of light chestnut soils showed that the dominant species are insect larvae - Lumbricidae, Formicidae, Scarabaeida.

Pesticides inhibit the activity of soil invertebrates. Pollution of light chestnut soils with pesticides even affected such a stable indicator as the content of humus in the soil . The decrease in humus content depends, in our opinion, on the action of oppressed representatives of soil invertebrates of the saprotrophic level - Lumbricidae.

We have conducted research on the effect of pesticides on the humus content in light chestnut soil (Table 7).

Table 7

Influence of pesticides on the content of humus in light chestnut soil

Pesticide	Term, days	Pesticide content in soil				
		Control	1 MPC	10 MPC	100 MPC	*HCP* $_{05}$
Atrazine	7	2.85	3.01	3.23	3.19	0.27
	thirty	2.84	2.85	2.91	3.00	0.32
	180	3.20	3.05	3.10		0.34
	HCP $_{05}$	0.27	0.26	0.24	0.28	
Oxyfluorfen	7	2.88	3.02	3.10	3.06	0.34
	thirty	2.84	3.14	3.42	3.15	0.32
	180	3.19	3.26	3.23	0.29	0.35
	HCP $_{05}$	0.26	0.29	0.40		

Pollution of light chestnut soil with pesticides had an impact even on such a stable indicator as the content of humus in the soil. Moreover, the values of the content of soil humus in some decreased from 4% to 2.7%. This decrease in humus content depends not only on the activity of soil invertebrates, but also on the action of oppressed representatives of soil invertebrate animals of the saprotrophic level, which prepare organic residues in the soil, for the activity of destructors. Our studies have shown that the anthropogenic factor (pesticides, heavy metals, etc.) have a significant impact on the mesofauna of soils and Curculionidae, Scarabaeidae are mainly found in soil.

a b

Figure 3 - Larva from the family Scarabaeidae (a); Curculionidae (b) - indicator species for light chestnut soils

Thus, the mesofauna, along with other soil characteristics, may well be used as a bioindicator. Biodiagnostics of the studied soils was carried out by us according to the classification based on the habitat of soil invertebrates (Table 8).

Table 8

Bioindicators of the studied soils

Soil type, subtype	Type	Class	Detachment	Family
Light chestnut soils	Arthropoda	Insecta	Coleoptera	Curculionidae Scarabaeidae

Thus, these bioindicator species of the studied soils are present regardless of the level of pesticide content. For light chestnut soils, typical representatives are the larvae of the mesofauna of soils from the family - Curculionidae , Scarabaeidae. Representatives of these families can be used as indicators when conducting research on the studied soil [4-7].

CONCLUSION

The effect of pesticides on soil mesofauna is an important research topic in the field of ecology and soil science. Pesticides inhibit the activity of soil invertebrates. Pollution of light chestnut soils with pesticides even affected such a stable indicator as the content of humus in the soil. The decrease in humus content depends, in our opinion, on the action of oppressed representatives of soil invertebrates of the saprotrophic level – Lumbricidae.

The obtained results give grounds to conclude that, in contrast to the abundance indicators, the species composition of soil invertebrates can be used as an indicator of soil contamination with pesticides and the state of the ecosystem as a whole.

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DENSITY OF SOD-PODZOLIC RECLAIMED SOILS UNDER CONDITIONS OF BIOSTIMULANTS APPLICATION

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The article presents data on quantitative changes in indicators characterizing the agronomic properties of sod-podzolic light loamy soil occurring during the cultivation of crops using a biostimulator. It was found that when applying the biological product EridGrow in natural conditions and at an optimal humidity level, the density of the addition of sod-podzolic light loamy soil during the harvesting of the pea-oat mixture of crops decreases from 1.34 to 1.31 g / cm3, and the total porosity of the soil increases from 42.76 to 49.05%.

Keywords: *Biostimulator, Sod-podzolic soil, Density, Porosity.*

INTRODUCTION

The total area of reclaimed land in the Republic of Belarus is 3.4 million hectares, of which 2.9 million hectares are occupied by agricultural land, including arable – 1.4 million hectares and meadow – 1.5 million hectares.

To ensure compliance with the design norms of land drainage, a complex complex of hydraulic engineering and other structures is used (158.1 thousand kilometers of canals and water intakes, 977.5 thousand kilometers of closed drainage network, 3.2 thousand bridges, 2.2 thousand regulatory locks, 24.2 thousand regulatory pipes, 54.6 thousand crossing pipes, 499 pumping stations, 4.8 thousand kilometers of protective and enclosing dams, 17.7 thousand kilometers of operational roads, 1074 ponds and reservoirs). Despite significant capital investments, the efficiency of the reclaimed hectare is not always noticeable (Levshunov I., et al., 2021; Rokochinskiy A., et al., 2021).

In the North-eastern regions, and in particular in the Vitebsk and Mogilev regions, reclaimed agricultural land is characterized by high plowing, a significant lack of highly productive meadow lands.

At the same time, fallow lands have been formed on drainage systems over the past decades, and a significant part of the plowed lands is subject to erosion, man-made pollution.

Soils are heterogeneous in granulometric composition. Among them, in the Mogilev region, sandy loam and sandy account for more than half of arable land – 53.98%, clay and loamy – 37.30%, peat – 0.004%. Therefore, it is noticeable that soils that are not very fertile require increased attention when they are introduced into agricultural circulation. Degraded agricultural lands during reclamation use leads to deterioration of the soil condition, its functions, changes in physical and chemical properties, gradual decrease and loss of fertility (Katterer T. et al., 2006). As a result, agricultural lands become unsuitable for growing crops and grazing animals, there is no effective return from the reclamation measures carried out (Zanten B. et al., 2014).

When solving issues related to the preservation of soil fertility and environmental protection, it is of great importance to create and maintain their optimal agrophysical condition using agrochemical methods of soil reclamation on drained lands. The main agrochemical indicators are the acidity of the soil, the content of humus, mobile forms of phosphorus and potassium, magnesium and calcium, as well as trace elements of boron, copper, zinc. Attention should be paid to improving the water-physical properties of soils, its structural and aggregate composition. This is possible when developing technological proposals for the reclamation of degraded soils using in combination with water and agrochemical reclamation. The latter, currently, taking into account the presence of new compositions of mineral organic fertilizers and biological products on the market, require a new approach. For the operational involvement of such lands in agricultural turnover, it is necessary to improve the integrated regime of land reclamation and in connection with the use of modern agricultural machinery and equipment. Thus, the modes of complex reclamation of degraded drained soils proposed for a number of years will allow regulating the water-air and food regime of soils in a complex, which will lead to the preservation and increase of the fertility of sod-podzolic soils. And the fallow lands present on drainage systems with the use of biological products should be returned to full crop rotation within the regulatory time frame. This will allow you to receive project crop yield increases, and the products will meet environmental and regulatory requirements.

The purpose of this work was to study the density of sod-podzolic reclaimed soils under the conditions of the use of biostimulators.

MATERIAL AND METHODS

The pilot site is located in the North-Eastern part of the Goretsky district of the Mogilev region on the Voskhod reclamation system, 27 km from the district center of Gorki and 86 km from the regional center of Mogilev with a hilly-westerly relief. The plot belongs to the Lenino Stud Farm.

The reclamation system is located in the village of Khodorovka, the area of which is 2555 hectares, of which the drainage area is 2000 hectares, the irrigation area is 305 hectares. 388 hectares are occupied under roads, canals and ponds. The length of reclamation channels is 80 km. The transport connection between the district center is carried out thanks to the dirt road Gorki – Lenino – Staroselye –Khodorovka. The beginning of the construction of the reclamation system – 1989 Land drainage is provided by closed pottery drainage (systematic and selective). Irrigation – sprinkling with mechanical water outlet.

Having studied the design data on the Voskhod reclamation system, it can be concluded that the predominant soils throughout the territory are sod-podzolic light loamy loess. The level of groundwater occurrence varies throughout the object from 1.0 m to 9 m.

After a thorough examination of the reclamation drainage system, a 0.7 ha site was selected for research, which had not been used for a long time, to restore it in the crop rotation system.

After prolonged non-use of the soil and agrochemical analysis, a pea-oat mixture was sown on the site, which was grown for animal feed. To activate soil activity and rapid growth of agricultural crops, tests were carried out using the biological product EridGrow (EG) at different doses of application in natural conditions and at an optimal humidity level (1l/ha, 2l/ha, 3l/ha) (Table 1).

After harvesting, oilseed radish was sown by the state, which was used as a green fertilizer (siderate) in late autumn.

Table 1

– Scheme of experience

№	Experience options	Name of the option
1	Control version (without the use of a biological product)	C
2	Optimal hydration	OU
3	Biopreparation of EridGrow at a concentration of 1 l/ha	EG1
4	Biopreparation of EridGrow at a concentration of 2 l/ha	EG2
5	EridGrow biopreparation at a concentration of 3 l/ha	EG3

Agrochemical indicators of the soil at the beginning of the experiment are presented in Table 2.

Table 2

Chemical parameters of the soil at the beginning of the experiment

N, %	P_2O_5, mg/kg	K_2O, mg/kg	Nitrates, mg/kg	pH	Humus, %
0,18	162,9	142,3	30,8	5,79	3,24

RESULTS AND DISCUSSION

When solving issues related to the preservation of soil fertility and environmental protection, it is of great importance to create and maintain their optimal agrophysical condition using agrochemical methods of soil reclamation on drained lands.

Attention should be paid to improving the water-physical properties of soils, its structural and aggregate composition. This is possible when developing technological proposals for the reclamation of degraded soils using in combination with water and agrochemical reclamation.

The density of the soil at the experimental site was determined by the method of the cutting ring. Analyzing the data obtained, we conclude that the density of the topsoil is over–compacted (1-10cm) is 1.34 g / cm^3 (Fig.1). Observations were made of changes in soil density during the sowing and harvesting of the pea-oat mixture, the plowing of the siderate. Figure 1 shows a graph of changes in the average density of the soil by layers.

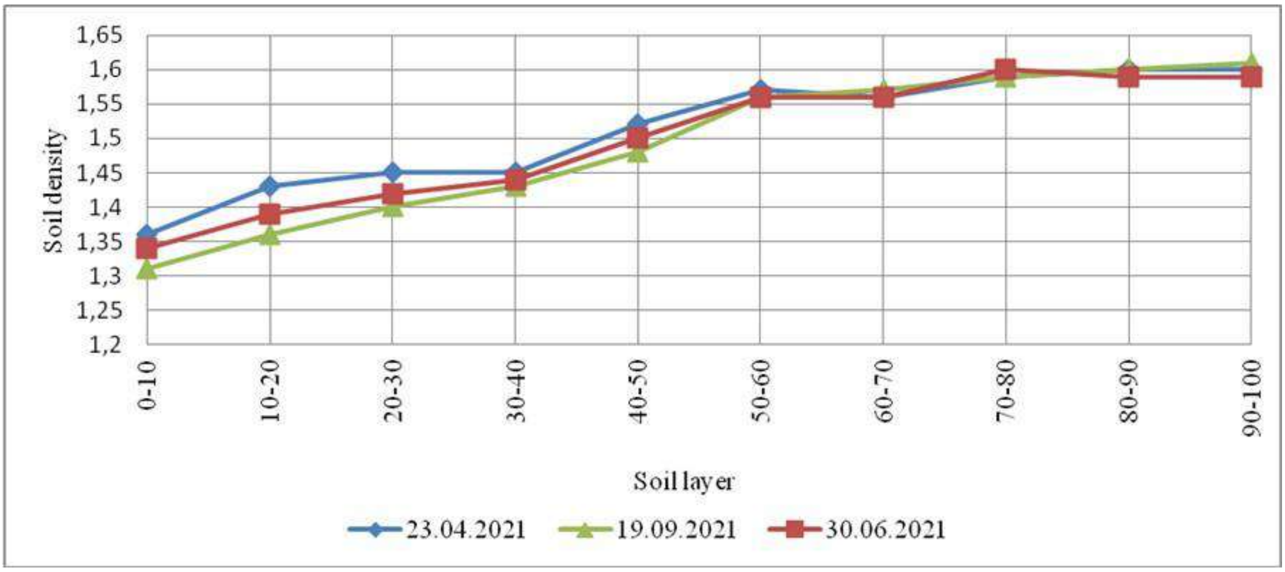

Fig. 1 – Change in soil density for the first year of observations

The graph shows that during the growing season, the density of the arable soil layer decreases from 1.34 to 1.29 g/cm^3.

When growing fruit crops, the need of plants for soil air should not be neglected. It follows from this that it is necessary to create an optimal water-air regime (Dubenok N. N. et al., 2020). The greatest changes in the total porosity were noted in the arable layer. At the beginning of the growing season after plowing, according to the classification of N. A. Kachinsky, it corresponded to the category satisfactory (Table 3).

Table 3

Total porosity of the soil according to the variants of the experiment, %

Option	The beginning of the growing season	The end of the growing season	Average
C	43,05	42,47	42,76
OU	44,04	43,60	43,82
EG1	45,27	44,87	45,07
EG2	49,58	48,52	49,05
EG3	49,38	48,46	48,92

By the end of the growing season, there was a slight over-compaction of the soil.

CONCLUSION

When grown on reclaimed sod-podzolic soils, pea-oat mixture with the use of the biological preparation EridGrow, its addition density during the harvest period decreases from 1.34 to 1.29 g / cm^3, and the total porosity of the soil increases from 42.76 to 49.05%, which indicates a positive effect of these measures on the physical properties of the soil.

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COMPARATIVE ASSESSMENT OF SUDANESE GRASS AND PEARL MILLET GENOTYPES IN THE ARID CONDITIONS OF SOUTH-EAST KAZAKHSTAN

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Agriculture continues to be one of the sectors most affected by extreme weather events. In 2021, abnormally high temperatures caused a drought in the southern regions of Kazakhstan that resulted in crop losses. Early introduction of particularly drought-resistant, high-yielding crops capable of growing throughout the country is the most effective solution to the problem. Sudanese grass and African millet are among the most promising drought-prone crops in the region. In the conditions of the south-east of Kazakhstan drought-resistant crops (Sudanese grass and African millet) are highly productive, valuable by quality fodder crops, providing high yields of biomass and grain. If the cultivation technology is observed, the yield of green mass of Sudanese grass and African millet up to 40 t/ha, of grain up to 1.7 t/ha and 2.2 t/ha accordingly are formed. For cultivation in the republic it is necessary to expand the sowing of Sudanese grass and African millet, as the most adapted to the extreme agro-ecological conditions of annual crops.

Keywords: *Sudanese grass, Pearl millet, Yield, Biomass, Plant height*

INTRODUCTION

Climate change, degradation of soil and natural resources, desertification, water scarcity and frequent droughts, inevitable reduction of natural reserves of energy raw materials threaten food security both globally and nationally. Kazakhstan's climate has warmed significantly. Comparison of the average long-term air temperature for two consecutive periods, 1961-1990 and 1991-2020, shows that the average annual temperature in the country increased by 0.9 C^{o}. February and March were significantly warmer, by 2.0 and 1.7 C^{o}, respectively. The temperature in July and December did not change much. The average annual amount of precipitation over the territory remained practically unchanged, but in some months it increased - the maximum in February (by 15,6%), while in September and October it decreased by 10,8% and 14,8%, respectively (1). According to the UNDP climate change projections for Kazakhstan, between 2020 and 2039, under two different scenarios the temperature will rise by 1.7 to 1.9 degrees Celsius annually, and between 2040 and 2059 by 2.4 to 3.1 degrees Celsius annually. At the same time, the country can expect an overall increase in annual precipitation, but with one significant caveat - in the summer period from the middle of this century in Kazakhstan may decrease the amount of precipitation (italics).

Agriculture continues to be one of the sectors most affected by extreme weather events (2). In 2021, record high temperatures in Central Asia damaged the agricultural sector, with Kazakhstan experiencing an unprecedented temperature increase of up to 46.5°C. Abnormally high temperatures and their impact on river and reservoir runoff led to severe livestock losses: it is estimated that more than 2,000 animals fell (3), and in Uzbekistan a drought started, which led to crop losses and limited supplies of seasonal vegetables (4), highlighting the importance of ensuring the resilience of the agricultural sector to external shocks. Various mechanisms can be used for this, such as integrated soil fertility and watershed management to reduce soil erosion and runoff, vegetation management and sustainable forestry Increasing agricultural productivity in drylands will contribute to the following objectives: climate change control and conservation of terrestrial ecosystems (5). In this regard, the current situation of global climate change dictates the need to find and introduce new drought-resistant crops [6], such as Sudanese grass (Sorghum x drummondii, seeds Poaceae) is one of the traditional annual crops that meet all the requirements of a highly productive crop: good herbage production (up to 2 cuttings per year), high nutritional value, drought tolerance and high green matter yield [7] and African millet (Pearlmillet) are widely spread throughout the world and are considered very important in the development strategy of arid pasture forage and livestock production [8, 9]. The use of seeds of intensive varieties and hybrids adapted to local cultivation is important for obtaining high yields of good quality, especially under conditions of arid and changing climate. The timing of plant maturity, phenological phases, and resistance to adverse weather conditions, diseases and pests depend on the choice of varieties and hybrids. All of these factors combine to produce a high yield of good quality at a lower cost [10].

Thus, early introduction of particularly drought-tolerant, high-yielding crops capable of growing throughout the country is the most effective solution to the problem.

MATERIALS AND METHODS

Plant material

For our country, the introduction of new varieties of annual grasses is primarily important in order to produce fodder for livestock farming. Therefore, seed multiplication of drought-tolerant, high-yielding varieties is of great importance. Evaluation of source material in terms of ability to withstand environmental stressors is the main condition for the selection of new varieties characterized by lower cost per unit yield [11], and introduction of drought-resistant high-yielding crops that can grow throughout the country, and their introduction is the most effective solution to climate change and reduced precipitation [12].

Field experiments on the study of Sudanese grass and pearl millet genotypes were conducted in rainfed conditions of south-east Kazakhstan. The role of these crops increases in years with extremely adverse weather conditions [13]. As a rule, acute dry years undermine the economy of farms for a number of years, so there is no stability in farming. This has necessitated the study and widespread adoption of a drought-tolerant crop. Domestic and foreign sorghum crop genotypes were tested in the conditions of southern and south-eastern Kazakhstan and promising lines for creating varieties were highlighted [14, 15, 16], and the effect of mineral fertilizers on sugar content and crop productivity was studied [17, 18].

In this regard, one of the solutions is to evaluate high-yield varieties of Sudanese grass and African millet with high green matter yields, unlimited multipurpose potential and adapted to unfavourable environmental factors.

Varieties and numbers of Sudanese grass- Kazakhskaya 3, Ailana 2017, Chimbay Jubilee, SREM and SugarGrase; pearl millet - Hashaki 1, IP 6104, GB 8735, ICMV 221, Raj 171, Sudan POP III, BairBajsa, ICTP 8203, MC94 C2, HHYB Tall, J-6, JBV 2, Guerinian 4/2 and IP 19586 were tested under semi rainfed conditions in south-east Kazakhstan. Field trials were set up in triplicate, and the placement of the plots was randomized. Seeding was done manually in the third decade of April with a simultaneous application of 100 kg of ammophos, the area of the plot was 14 m2 (width 2.8 m, length 5 m).

Thus, the introduction of high-yielding drought-tolerant crops such as Sudanese grass and African millet in Central Asia will enable adaptation and mitigation of global climate change.

Description of study area

The territory of Kazakhstan is characterised by a great diversity of natural and climatic conditions, and 80% of the cultivated land is located in areas with insufficient moisture, including the rainfed lands in the south-east of Kazakhstan, which are characterised by increased aridity. Of the total area of rainfed land in the region, 1.4 million hectares are rainfed. Solution of set tasks was carried out by establishing and conducting of field experiments in conditions of semi-arid (from 280 to 400 mm) rainfed soils of the south-east of Kazakhstan on stationary laboratory of agriculture LLP

“Kazakh Research Institute of Agriculture and Plant growing”. The field experiments, observations and records were made according to the method of B.A. Dospekhov.

The soil cover of the experimental plot is light chestnut piedmont soil formed on loess-like loam has a clearly expressed fertile profile. Characteristic feature of light chestnut soils is their high carbonation, their boiling is noted from HCl from surface. On mechanical composition of soils belongs to coarse dusty loams, the contents of physical clay 39-42%, coarse dust 45-51%, silt 12-17%. Provision of easily hydrolysable nitrogen is medium, mobile phosphorus is low, exchangeable potassium is medium. The upper horizon contains humus up to 2.02%, 0.12-0.14% of gross nitrogen.

The area where the experimental field is located is part of the light-chestnut subzone of soils. Light-chestnut carbonate soils are located on the hilly eroded plains of the foothills, occupying the absolute elevations of 700-900 m above sea level. Ground waters are more than 10 m deep and have no impact on the soil formation process.

The meteorological conditions of 2021 differed significantly from the mean annual values and were characterized by a great variety (Table 1). According to meteorological data, spring 2021 was wetter (88.9 mm) and warmer than the long-term average, especially in March, which exceeded the long-term average by 3.4 degrees. Precipitation in the first ten-day period of April contributed to sufficient accumulation of moisture in the soil to produce good sprouts. Summer temperatures, except for August, were 1.9-2.7 degrees warmer than the long-term average and precipitation was below the 30.8 mm long-term average. In terms of agrometeorological conditions, the summer was characterised as sharply dry and hot.

Table 1

Meteorological conditions for the growing season 2021, Almalybak weather station, LLP “Kazakh Research Institute of Agriculture and Plant growing”

Month	Decade	Atmospheric precipitation, mm		Air temperature, t°C		Relative humidity, % 2021 y
		2021 y	average annual	2021 y	average annual	
April	I	32,1	16,4	8,3	7,9	66
	II	4,0	21,6	15,7	10,9	
	III	20,2	18,4	13,3	12,2	
	For the month	56,3	56,5	12,4	10,4	
May	I	64,9	18,7	18,8	15,8	63
	II	15,8	22,7	16,6	16,0	
	III	0,9	20,2	22,7	17,4	
	For the month	81,6	61,6	19,4	16,4	
June	I	7,1	24,4	25,7	20,3	50
	II	2,6	16,1	21,3	21,2	
	III	11,2	13,4	22,3	22,1	
	For the month	20,9	53,9	23,1	21,2	
July	I	1,4	10,8	29,7	23,5	41
	II	21,4	8,8	23,3	23,7	
	III	-	7,0	27,6	25,0	
	For the month	22,8	26,6	26,9	24,1	
August	I	1,4	9,4	27,4	23,3	50
	II	25,8	6,4	19,5	22,2	
	III	-	5,4	25,1	20,7	
	For the month	27,2	21,2	24,0	22,1	
September	I	0.8	4.4	23,8	18.8	50
	II	0.8	6.1	21,0	16.5	
	III	-	5.4	16,8	12.8	
	For the month	1.6	15.9	20,5	16.0	

In general, according to the characteristics of weather conditions in 2021, the growth and development of plants of Sudanese grass and African millet was unfavorable due to a lack of moisture and hot weather in summer.

RESULTS

Sudanese grass and African millet is a drought-resistant, high-yielding crop with a good quality of green mass and one of the most valuable annual fodder grasses, contributes to the rapid introduction of these crops into production.

Within the framework of a number of international projects, high-yielding, salt-resistant plants were tested in collection nurseries: sorghum, African millet and other crops, the work was aimed at developing agrotechnical methods of cultivating new valuable crops for the economic and sustainable development of arid feed production and animal husbandry [19]. Sorghum crops are well adapted to semi-arid and arid regions due to its resistance to abiotic stresses such as drought and salinization [20]. In addition, one of the unconventional crops may be African millet, which can serve as an economically profitable alternative, and often a repeat grain crop for the development of marginal saline lands in the Central Asian region. Therefore, it is very important for agricultural production to know which crops and even varieties should be sown on degraded and arid lands. In this regard, through the study and introduction of various genotypes in the arid lands of the south-east of Kazakhstan, it will contribute to increasing agricultural productivity, which will significantly improve the income of farmers. Moreover, the study and adaptation of non-traditional genotypes, such as African millet in the face of climate change, contributes to the development of entire branches of agriculture, such as animal husbandry (biomass) and poultry (grain).

To date, Sudane grass and African millet have not been widely used in this region. In this regard, one of the ways to solve it is the screening of highly productive varieties of Sudanese grass and African millet, which have a high yield of green mass, unlimited multi-purpose capabilities and adapted to adverse environmental factors.

The year 2021 was unfavourable for high yields; according to the results of the study, sorghum and pearl millet produced average green matter yields during the flowering phase. The green matter yields in our trials varied depending on the biological traits of the samples studied. The highest green matter, dry weight and grain yields were formed by those samples that had the highest plant height (Table 2). In terms of biomass and grain yield, the varieties Kazakhstan 3, Aylana 2017 and Chimbay Jubilee stood out and were between 15.52-46.3 t/ha and 1.51-1.7 t/ha respectively. Plant height of African millet ranged from 170-240 cm depending on the genotypes studied (Table 3). HHYBtall, BairBajsa, IP 6104 formed high green matter and grain yield and were between 33.19-39.94 t/ha and 1.62-2.19 t/ha respectively. In terms of grain yield, HHVBCtall stood out with 2.19 t/ha.

Table 2

Plant height, biomass and biological yield of Sudanese grassgrain

Name of genotypes	Plant height, cm	Green biomass, t/ha	Dry biomass, t/ha	Biological grain yield, t/ha
Kazakhstan 3	356	46,30	27,17	1,71
Aylana 2017	296	34,02	16,01	1,62
Chimbay Jubilee	286	32,09	15,52	1,51
SREM	234	22,09	5,52	1,01
Sugar Grase	230	21,05	5,26	1,02

Table 3

Plant height, biomass and biological grain yield of African millet

Name of genotypes	Plant height, cm	Green biomass, t/ha	Dry biomass, t/ha	Biological grain yield, t/ha
Hashaki 1	210	35,98	9,0	1,24
IP 6104	215	33,19	8,30	1,90
GB 8735	215	19,82	4,96	0,9
ICMV 221	185	33,45	8,36	1,35
Raj 171	210	22,09	5,52	0,73
Sudan POP 111	170	12,68	3,17	0,51
Bair Bajsa	220	39,94	9,99	1,62
ICTP 8203	240	31,95	7,99	0,81
MC94 C2	220	34,87	8,72	1,41
HHVBCtall	210	39,44	17,36	2,19
J-6	200	39,07	9,77	1,58
JBV-2	200	22,55	5,64	0,91
Guierinian 412	180	16,02	4,01	0,65
IP 19586	240	29,57	7,39	0,59

CONCLUSION

In the conditions of the south-east of Kazakhstan drought-resistant crops (Sudanese grass and African millet) are highly productive, valuable forage crops, providing high yields of biomass and grain. If the cultivation technology is followed, the yield of Sudanese grass green mass will reach 450 hundredweight per hectare and African millet 400 hundredweight per hectare; grain yield will reach 17 hundredweight per hectare and 22 hundred weight per hectare, correspondingly. For cultivation in the country it is necessary to expand the sowing of Sudanese grass and African millet, as the most adapted to the extreme agro-ecological conditions of annual crops.

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SECTION 2.

SOIL RESOURCES MANAGEMENT, SOIL FERTILITY, ENVIRONMENT AND AGROECOLOGICAL ASSESSMENT

ASSESSMENT OF THE IMPACT OF CLIMATE CHANGE ON SOIL FERTILITY IN AZERBAIJAN

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The article is devoted to the assessment of the impact of climate changes on soil fertility in Azerbaijan. The research process was carried out using the modern operative-interactive CWBM and IESA methods. The assessment with the new method is carried out by accepting the soil-air-water environment as a single mechanism and taking into account the influence of complex factors. In the research process, most of the climate factors affecting the soil heat-moisture balance were used. Changes in climate factors during the years 2000-2022 played a positive role in the process of soil degradation in most cases. As a result, during this period, the actual soil moisture decreased by 15.8%, and the area of fertile soils decreased by 18.5%. Studies show that as a result of increasing the temperature in the range of about 0.19-0.22°C; with a decrease in precipitation by 16-18 mm, moisture coefficient of 0.20-0.23, actual soil moisture of 4.3-4.5 mm, the area of fertile soil cover decreases by about 5.8-6.2%. Especially the intervals of temperature 14.3-14.6°C, precipitation 300-450 mm, moisture coefficient 0.35-0.38, maximum soil retention 1000-1100 mm are more critical levels and are accompanied by sharper increases in soil degradation. Compared to 2000, in 2022, the area of highly degraded bare soil has grown by 17.3% (1234.2 km^2). In 2050, this increase is predicted to be 27.4% (2692.8 km^2) more than in 2022.

Keywords*: climate changes, CWBM method, Hydrological soil groups, IESA method, maximum soil retention, soil fertility*

INTRODUCTİON

As a result of the reforms carried out in the Republic of Azerbaijan, a powerful socio-economic potential has been created in the country. However, against the background of global climate change, the depletion of natural resources creates additional problems in implementing reforms. The gradual decrease in water, land and biological resources creates a serious imbalance with the development of the economy, especially agriculture, and population growth. Constant and continuous study of vital water, land and biological resources and their adequacy to climate change is necessary for the continuous and sustainable implementation of socio-economic reforms. Therefore, research work to solve existing problems is also of great importance. It is clear that under the influence of climate and other factors, the available natural resources will continue to decline. For this reason, scientific directions and methods should be determined so that research does not lag behind the general pace of reform development. At present, modern conditions require the assessment of natural resources with more modern, sensitive and operational methods that can respond to any changes. Taking into account the current trends in world science and their need for Azerbaijan, we have developed the CWBM (Complex water balance method) and IESA (Interactive electronic soil assessment) methods, which are operational-interactive methods (Mammadov 2018, pp. 46-70); Teymurov, 2019, pp. 78-92).

It is known that changes occurring in natural complexes, especially in the soil and vegetation cover, are primarily associated with changes in the water and heat balance of the area. The most obvious manifestation of climate change is rising temperatures and decreasing rainfall, resulting in lower levels of moisture in most regions, which in turn leads to land cover degradation.

CWBM was developed on the basis of the leading water balance methods currently available in the world, by synthesizing them and taking into account the specific features of the nature of Azerbaijan. With the CWBM and IESA methods, research is evaluated in a completely new context. Currently, in hydrometeorological and soil assessments, preference is given to hybrid and synthesis methods. New synthesis and hybrid methods offer additional benefits by combining important features of several methods at the same time. These aspects were taken into account when conducting a comprehensive assessment of climate and soil elements. Most of the results obtained by the main methods to which they relate are of high accuracy, since they are obtained as a result of long-term observations and experimental researchs. With the help of CWBM and IESA, containing the best features of the basic methods, it is possible to estimate the moisture regime, heat and water balance of the area with high accuracy. The study takes into account most of the components that make up the natural and anthropogenic landscapes. In this case, the relationship between all the components included in the complex can be evaluated individually or in a complex way. In this case, it is possible to calculate the causes of changes in land resources (climatic, landscape, anthropogenic, etc.) and the impact of each of them on the change.

MATERIALS AND RESEARCH METHODOLOGIES

As an example in the research area, the geospace covered by fragment 188-032 of the Landsat satellite image was taken. This geospace with an area of 37.4 thousand km^2 is located in an area covering most of the physical and geographical features of the nature of Azerbaijan. Space images of different years, a digital elevation model (DEM), and hydrometeorological observation data were used as the initial inputs for the study. To determine the types of landscape, land cover, and moisture levels, multispectral space images of the terrain from different periods were processed using normalized difference indices (NDI-Normalized Difference Indices). Considering the content of the research work, difference indices of vegetation (NDVI, SAVI), bare soil and bedlands (BSI), erosion (NDBal), soil salinization (NDSI), residential and build-up (NDBI), urban (UI) , water (NDWI), drought (NDDI) and moisture (NDMI) were preferred in the study. The elevation, slope and aspect values of the study area were determined using DEM, and the morphometric indicators of the rivers using the Hydrology, Surface and Density software of the ArcGIS program. To select similar data and get more reliable correlations between components, multiple linear regression equations (Multiple Linear Regression) were needed. The main source of climate data is the measurement-observation data of the Ministry of Natural Resources and Ecology of the Republic of Azerbaijan.

THE DISCUSSION OF THE RESULTS

Natural complexes are formed from the close unity of numerous components, and a change in one component necessarily affects others. The essence of the new method lies in the study of intercomponent relationships, taking into account the participation of as many components as possible and achieving this relationship in a specific quantitative expression. Studies show that it is possible to obtain relationships between any components that make up natural complexes in various forms (multiple linear regression, correlation, mathematical, trend forms, etc.). Modern scientific and technical innovations (space information, GIS and other multifunctional technologies) have created conditions for a deeper study of intercomponent relationships. The new method is called the Complex Water Balance Method (CWBM), as the new method comprehensively studies the participation of most of the factors that make up the natural complex, and their relationship. Natural and anthropogenic complexes existing in a certain territory are mainly associated with 3 groups of factors:

1) Components that make up the surface cover of the area. These include LULC (Land use and Land cover), vegetation density, soil cover, granulometric composition of soils and HSG (Hydrological soil groups).

2) Morphometric values. It includes average elevation, slope, aspect of slopes, basin area, rivers length, horizontal and vertical surface fragmentation, and river network density.

3) Climate and moisture factors. These include air temperature, precipitation, actual and potential evaporation, humidity coefficient, maximum soil water retention, actual soil moisture, hydrological losses, initial abstraction, etc.

The current presentation is dedicated to changes in soil cover as a result of climatic changes. However, since any area is treated as a single complex, in the study, the impact of other components along with climatic factors on soil cover was considered. On Figure 1 presents maps of several main components that play an important role in the formation of the soil cover, obtained from satellite images in 2022, climate data, and using GIS technologies:

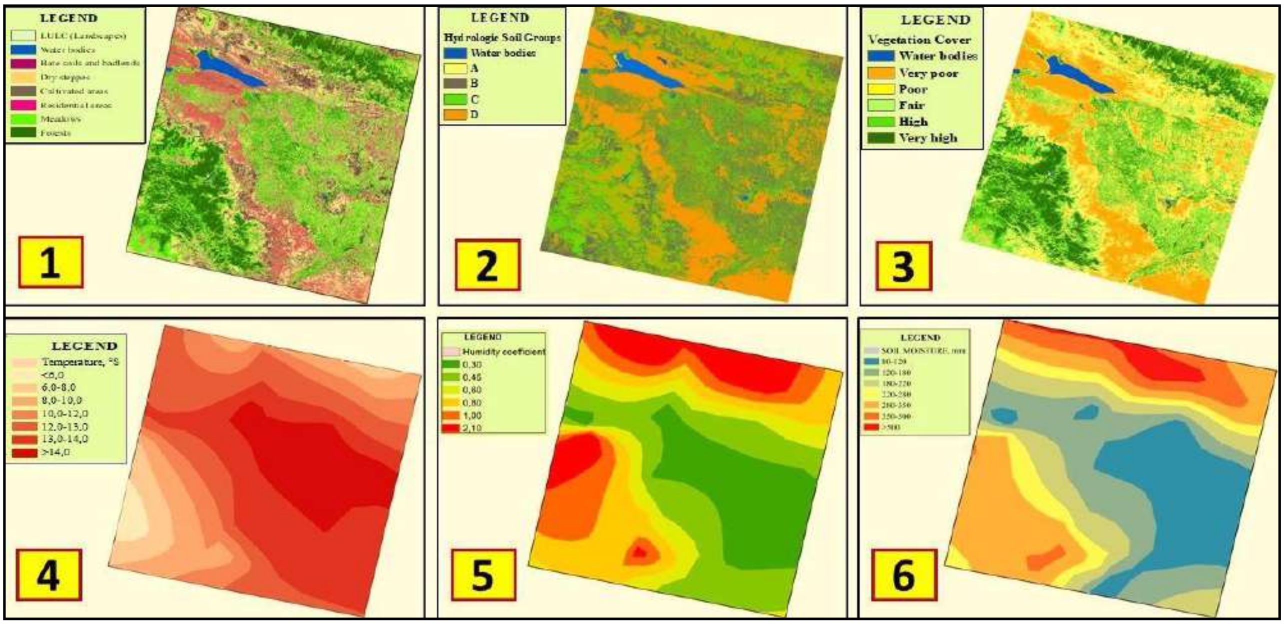

Figure 1. Some important components involved in soil formation: 1-Landscapes; 2-Hydrological soil groups; 3-Vegetation cover; 4-Air temperature; 5-Humidity coefficient; 6-Soil moisture

Using the CWBM and IESA methods, the process of studying the soil-water-air environment is considered as a single mechanism, and the process of assessing soil-climatic factors is analyzed and studied in a completely different context (Teymurov, 2023, pp. 28-32). In traditional scientific approaches, climate factors were estimated based on precipitation and temperature. In modern methods, the concept of "humidity level of the territory" is mainly used. Studies show that assesing humidity rate of areas only from precipitation and temperature does not give satisfactory results. For example, in areas with a sufficiently high level of precipitation, soil and water can be expressed in small quantities. Or vice versa, in regions with high temperatures, they can be very high. Climate and moisture indicators act as indicators in terms of change and the presence of other components (water, soil, vegetation, etc.). Therefore, the humidity level of territories was estimated using predictors characterizing both air moisture and soil moisture. When assessing humidity level of territory among air factors precipitation, temperature, potential evapotranspiration, humidity coefficient; and among soils indicators maximum soil retention, actual soil moisture, HSGs etc. are accepted as the main indicators. Potential evapotranspiration (M) is the amount of maximum mass of water that can be evaporated into the atmosphere; and maximum water retention (S) - is the highest amount of water can be stored by the soils under specific natural conditions. (Michal Spitalniak, 2021, pp. 51-68). Actual soil moisture (F) is the factual amount of water stored in the soil under existing conditions. The humidity coefficient (R) is expressed as the ratio of precipitation to potential evaporation and is considered the most important parameter in terms of determining the degree of air moisture. The Hydrologic soil group (HSG) is the main indicator in the content of the surface runoff formation and the soil infiltration. In the NRCS classification, 12 soil codes and 4 HSGs (A, B, C, D) are distinguished according to the permeability rate depending on the soils granulomertic fraction and porosity. From group A to group D, there is a tendency to weaken infiltration and increase surface runoff.

The collection and processing of the necessary materials in the research work was carried out in the following order:

1) Satellite images of the areas were collected for different periods and their NDI processing was carried out.

2) Maps of soil degradation, vegetation density and climatic factors have been compiled.

3) Climatic and soil-vegetation maps were joined and reclassified, natural conformities were established based on their quantitative changes in different periods.

Table 1 shows the change in soil-vegetation indicators and the most important climatic factors affecting the study area for 2000-2022.

Table 1.

Changes in soil cover and climatic factors for 2000-2022

Research object	2000	2022	Difference, %
Air temperature, °C	11.5	12.7	+9.45
Precipitation, mm	580.2	521.1	–10.2
Humidity coefficient	0.66	0.55	–16.7
Potential evaporation, mm	873.6	955.8	+8.60
Hydrological soil group (weak infiltration-group D), km^2	12415	14062	+11.7
Maximum soil water retention, mm	1012.1	1121.0	+9.71
Actual soil moisture, mm	236.5	200.6	–15.8
Horizontal surface fragmentation, km/km^2	1.96	2.19	+10.5
Area of dense vegetation cover, km^2	5834.4	4782.2	–17.9
Area of fertile soils, km^2	7843.3	6395.4	–18.5

Studies have shown the existence of a very close relationship between the influence of climatic variables and soil cover changes, and these relationships have been reflected in concrete values. Climate changes, especially the decrease in air and soil moisture, intensifies the process of soil degradation. It is possible to trace the negative manifestations of the soil cover as a result of climate change, both against the background of an increase in their area and quantitative indicators. As can be seen from table 1, the change in climatic indicators that determine the humidity level of the area in 2000-2022 was unfavorable for soil fertility. During this period, there is a negative trend of 8-12% in the change in factors affecting both air moisture and soil moisture. Against the background of a simultaneous decrease in the level of air and soil moisture, the area of dense vegetation decreased by 17.9%, and the area of fertile soil under their combined influence decreased by 18.5%. For 2000-2022 the area of only high-fertility soils decreased by 1447.9 km2, which is 3.87% of the total research area.

Our studies showed that with an increase in temperature by about 0.19-0.22°C; and a decrease in precipitation by 16-18 mm, a moisture coefficient of 0.20-0.23 and soil moisture of 4.3-4.5 mm, the area of fertile soil cover simultaneously decreased by about 5.8-6.2%. Especially in the temperature range of 14.3-14.6°C, precipitation of 300-450 mm, humidity coefficient of 0.35-0.38, soil moisture of 80-120 mm, soil fertility is accompanied by a higher decrease. Before these intervals, the relationship between climatic and soil indicators is mainly in the form of a linear regression dependence, and after the indicated critical limits, it manifests itself in the form of mathematical dependences, accompanied by a logarithmic or other sharp increase. When classifying the most important climatic factors affecting soil cover, low-medium-high intervals were determined: for air temperature <8°, 8°-12°, >12°C; precipitation <450, 450-850, >850 mm; humidity coefficient <0.6, 0.6-1.0 >1.0; actual soil moisture <120, 120-400, >400 mm; maximum soil retention <800, 800-1100, >1100; potential evaporation <500, 500-1000, >1000 mm. As a result of a decrease in the humidity level, the area of high-quality soils in all cases decreased and the area of low-quality soils increased (table 2).

Table 2.

Changes in the humidity level and the area of soil-vegetation cover in 2000-2022 (%)

Research object	2000			2022		
	low	average	high	low	average	high
	Air moisture indicators					
Atmospheric precipitation, mm	43.7	35.9	20.4	50.3	35.2	14.5
Air temperature, °C	7.8	27.3	64.9	5.9	23.8	70.3
Potential evaporation, mm	19.4	40.7	39.9	17.5	37.8	44.7
Humidity coefficient	45.0	35.3	19.7	52.8	30.0	17.2
	Soil moisture indicators					
Maximum soil water retention, mm	31.6	34.0	34.4	18.0	39.2	42.8
Actual soil moisture, mm	38.0	41.5	20.5	45.5	40.9	13.6
Infiltration capacity (HSG)	21.8	55.1	23.1	24.7	55.7	19.6
	Change of soil-vegetation cover					
Soil cover fertility	35.7	43.3	21.0	42.1	41.8	16.1
Vegetation density	50.6	33.8	15.6	62.1	27.1	10.8

In figure 2 shows the changes in maximum soil retention, precipitation and soil fertility, which are the main indicators of humidity level of areas, for the period 2000-2022.

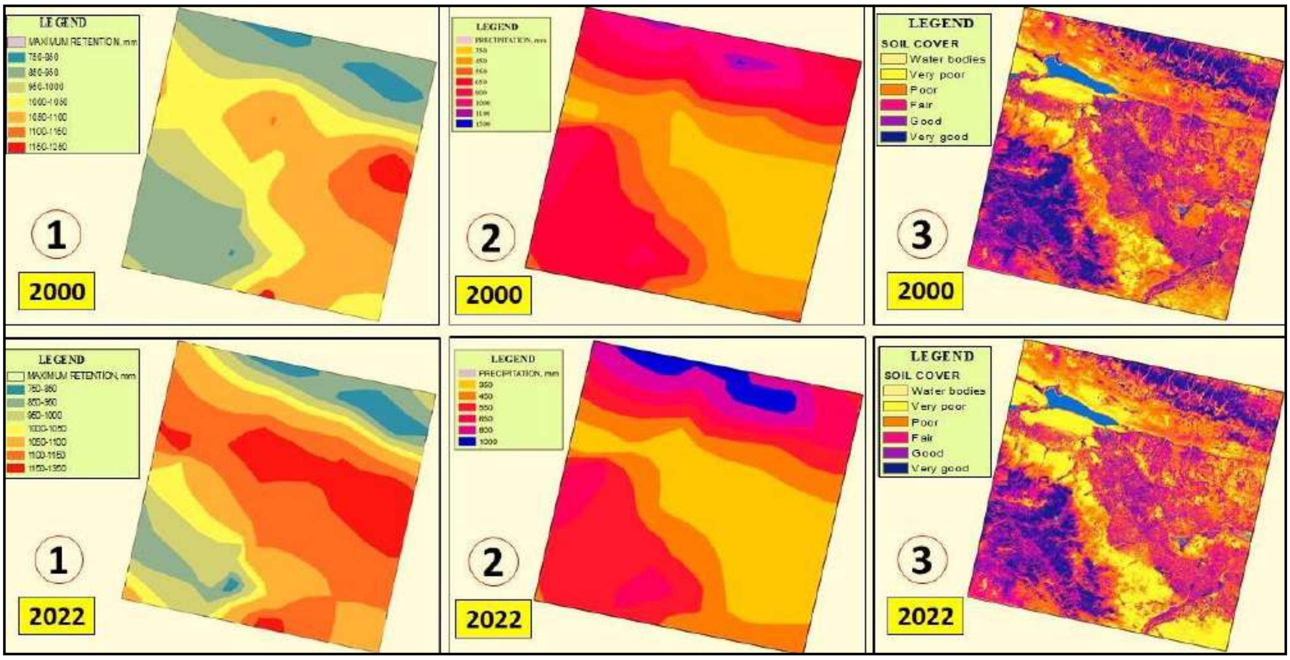

Figure 2. Changes for 2000-2022: 1- Maximum soil retention; 2–Precipitation; 3–Soil cover

In 2000-2022, there were significant changes in the hydrological soil groups (HSGs). An increase by 11.7% of the area of group "D", characterized by poor water permability, led to a decrease in the infiltration capacity of the territory. This process played an active role in the degradation processsignificantly reducing soil moisture.

During this period, a serious increase in soil erosion was observed in the area, and horizontal fragmentation of the surface over the entire area increased from 1.96 km/km^2 to 2.19 km/km^2 (10.5%). The erosion process was most active in cultivated areas, and most weakly in areas with dense forest cover.

Determining the role of anthropogenic and climatic factors in soil degradation is one of the most difficult scientific problems to solve. In addition, the advantages of the combined use of

Analogue terrains, Counter-approach and NDI methods allow you to track the results of natural and anthropogenic impact on changes separately. By combining change maps of various components and reclassifying, it is possible to track the extent of these effects using various software in ArcGIS. Since there are very few natural landscapes left on the plains and foothills, this process is more accurately observed in mid-mountain and high-mountain regions. The analysis of anthropogenic impacts was determined by the way processing and decipher of vegetation (NDVI), moisture (NDMI), erosion (NBaI), salinity (NDSI), drought (NDDI), urbanization (UI) indices. (Can Trong Nguyen, 2021, pp. 114-125; Miguel Angel Rivera, 2023, pp. 88-97; Ahmet Karaburun, 2010, pp. 77-85). During the study years of the, the effects of climate change manifested themselves faster than the effects of anthropogenic changes. The boundary between climatic and anthropogenic impacts was discovered by comparing land plots with similar physical-geographical conditions, but different land use. The impact of human activities is mainly tested by the change in the area of rural and urbanized settlements, cultivated areas, badlands located in the plains and foothills. The rate of soil degradation is different in areas subject to anthropogenic impact. As can be seen from Figure 1, although negative climatic impacts increased to a greater extent on agricultural lands (yards, crops, pastures) in the study period, the expansion of the area of infertile soils was relatively slow. Various therapeutic measures carried out in these areas could at least partially slow down the growth rate of the degradation process.

The CWBM assessment is based on 3 stages of the study: Previous, Current and Forthcoming. Study of the physical-geographical conditions of the area from the past period, being carried out in parallel with the modern evaluation, allows to follow the quantitative and qualitative changes that occurred in the past period. At the same time, the reasons for these changes, the assessment of the role of various factors, and the analysis of the mistakes made are the basis. These, in turn, provide additional advantages in terms of predicting and modeling possible changes. The forthcoming studies of the territory are carried out on the basis of a possible change in the direction of landscape, climatic and anthropogenic impacts in a long-term period; changes in the settlement and employment of the population; the content of the upcoming socio-economic and agrarian reforms, etc. At present, in contrast to the traditional three-way forecasts, preference is given to the modern multi-way forecasting model. Modern scientific technologies make it possible to predict millions of options taking into account the influence of complex factors and interactively manage them according to the content of natural and anthropogenic changes and transformations. Table 3 and Figure 3 show the areas of degraded soils based on Previous (2000), Current modern (2022) and Forthcoming (2050) studies of the area. The forecast for 2050 is given with only one of the climate models (CCCM), based on possible landscape changes, the rate of population settlement and the content of expected reforms (Mammadov, 2002, pp. 104-115; Makhmudov, pp. 48-54).

Table 3.

Changes in soil fertility in the study area in different periods

Soil cover condition	2000		2017		2050	
	km^2	%	km^2	%	km^2	%
Water bodies	673.2	1.80	602.1	1.61	456.3	1.22
Very poor (bare soils)	5909.2	15.8	7142.4	19.1	9834.2	26.3
Poor	7180.8	19.2	9124.6	24.4	10767.2	28.8
Fair	8265.4	22.1	7592.2	20.3	6244.3	16.7
Good	7517.4	20.1	6917.3	18.5	5647.4	15.1
Very good	7854.0	21.0	6021.4	16.1	4450.6	11.9

Compared to 2000, in 2022 the area of highly degraded unsuitable lands increased by 17.3% (1234.2 km^2). It is predicted that in 2050 this increase will be 27.4% more (2692.8 km^2) than in 2022.

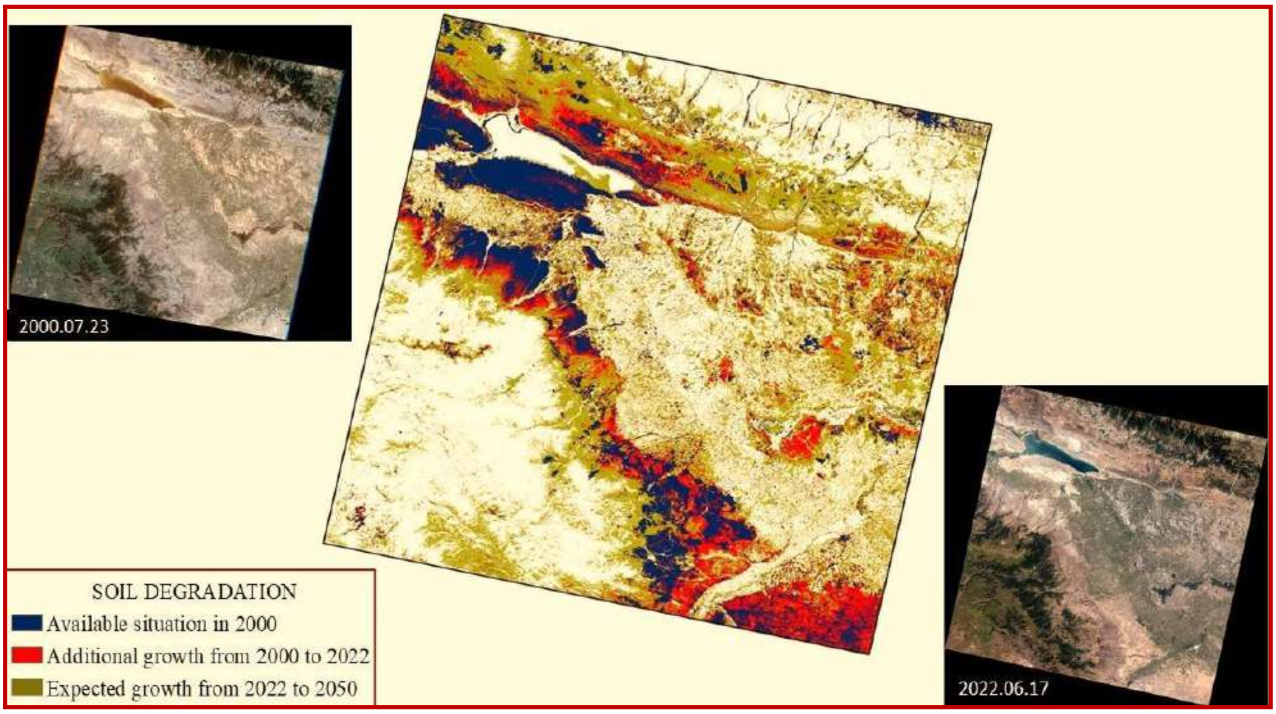

Figure 3. Areas of degraded soils in the study area in 2000, 2022 and 2050

CONCLUSİON

The new method (CWBM) is very important from the point of view of solving many problems, such as the heat-moisture balance of the area, the assessment and forecast of natural resources, the protection of the existing ecosystem, territorial planning, and more efficient management of the use of water, soil and other natural resources. In the CWBM, the entire research process is carried out without spatial and temporal restrictions on the basis of satellite images of the area and GIS technologies. CWBM is an innovative and operational-interactive method. The results obtained with its help are distinguished by their sensitivity and adequacy to any changes, high accuracy. The advantages of the new method make it relevant to popularize and expand the use of the possibilities of its application.

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AGROECOLOGICAL ASPECT OF LAND RESURSE USE IN FOOD SAFETY AND NUTRIENT ELEMENTS BALANCE IN THE SOIL

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INTRODUCTION

Ensuring food security is one of the main goals of the agricultural and economic policy of every country. In general, this policy forms the vector of movement of the ideal situation in any national food security system. From this point of view, striving for food security is a continuous process. It is clear that the components of food security do not depend only on economic indicators. It also depends on a number of other factors, including natural resources and their condition. Among the natural resources, one of the factors that determine food security belongs to the land. Initial soil fertility, soil characteristics, the limitation of its use in agriculture and degree of anthropogenic degradation of soil significantly determine all components of food security. Protecting and increasing soil fertility, as well as increasing the productivity of agricultural plants, in other words, obtaining high and quality crops from a single area, is one of the most important factors in ensuring food security. Although the provision of mineral fertilizers to agricultural plants has increased year by year, it is known that these indicators are not enough to increase the level of soil diversity. From this point of view, it is important to return nutrients taken with the crop to the soil. The lack of organic fertilizers makes the need for widespread application of mineral fertilizers more evident [5,6,8,9].

RESEARCH METHODOLOGY

The conducted studies were conducted in accordance with the generally accepted methodology in soil science and agrochemistry. The research object covered the arable land used in Azerbaijan's agriculture [1,11].

The research covered the land areas cultivated with cereals, cotton, tobacco, potatoes, vegetables, melons and fruit-berry crops.

The distribution of mineral fertilizers on separate fields and the productivity of agricultural plants was determined using the statistical collection "Azerbaijan's Agriculture", and the balance indicators were determined by calculation [1,7].

During the research, the book 1975, “Агрохимиче методы исследования почв” edited by O.A. Sokolov, was also used [10, 13].

RESULTS OF THE RESEARCH AND ITS ANALYSIS

As a result of the conducted research, the cultivated areas under different agricultural crops in the Agricultural system of Azerbaijan and the total cultivated area of our republic for different years were determined. Also, in different years, giving mineral fertilizers to agricultural crops is defined as 100% nutrient (pure) substance. The amount of nutrient elements (NPK) taken from the field and agricultural plants cultivated by calculation using the tables prepared for the above-mentioned indicators the balance of nutrients in the soil was calculated [2,3,4,7,12].

Table 1 shows the amount of arable land in different years in our republic and the amount of arable land for different plant groups. In 2003, the total cultivated area was 1219.5 thousand ha, including 776.3 thousand ha of cereals and legumes, of which 592.2 thousand ha were planted with wheat. The cultivated area of technical crops was 88.9 thousand ha, potatoes, melons and vegetable crops were 164.3 thousand ha, and fodder crops were 190.0 thousand ha. In 2018, the amount of cultivated land increased by 518.5 thousand ha compared to 2013 and reached 1738.0 thousand hectares. Compared to 2003, the amount of grain and leguminous crops has increased by 306.8 thousand hectares and has reached the highest level (1083.1 thousand ha) so far.

Table 1.

Sown area of agricultural plants (thsd.ha).

Indicators	Years					
	2003	**2017**	**2018**	**2019**	**2020**	**2021**
Total sown (cultivated) areas	1219,5	1665,7	1738,0	1717,1	1630,9	1644,5
Total cereal and leguminous	776,3	977,2	1083,1	1072,3	989,1	998,7
wheat	592,2	596,1	679,1	670,0	588,4	572,3
leguminous	8,4	17,1	26,0	17,2	42,7	10,4
Industrial crops (total)	88,9	180,9	159,0	130,2	122,0	122,0
Potatoes, melons and vegetables (total)	164,3	151,5	149,7	147,7	143,6	144,6
Forage crops (total)	190,0	356,1	346,2	366,9	376,2	379,2

In 2021, the amount of cultivated areas, decreased by approximately 93,000 hectares, including the area of wheat crops by 106,800 hectares compared to 2018. When analyzing the indicators of 2021, a decrease in the cultivated areas of other plants was observed in the cropping structure, except for fodder crops.

Application of mineral fertilizers has a great role in increasing the productivity of agricultural plants. The amount of mineral fertilizers given to the agricultural fields of our republic in different years is given in table 2. As can be seen from the table, given to cultivated areas mineral fertilizers on the basis of 100% nutrient (pure) substances were observed to increase in 2013 by 82.0 and 81.0 kg/ha respectively, and in 2021 a significant decrease was determined by 47.0 kg/ha. Giving mineral fertilizers to the agricultural fields of our republic a sharp decrease was due to a sharp decrease in the import of mineral fertilizers to the country due to the pandemic. So, if the total import of mineral fertilizers amounted to 350.5 thousand tons in 2020, this indicator decreased by 229.6 thousand tons in 2021, in other words, by 34.5%.

Table 2.

Application of mineral fertilizers in agriculture on the basis of 100% active substance

Indicators and names of plants	Years					
	2013	**2017**	**2018**	**2019**	**2020**	**2021**
A total of a thousand tons (total, thsd. tons)	29,3	118,7	141,3	159,3	151,6	88,0
per hectare of cultivated, kg	16	63	72	82	81	47
of which: Grain (corn free)	20	62	86	89	88	66
to Cotton	30	144	84	127	131	70
to tobacco	66	114	141	131	137	67
to Potatoes	28	41	81	81	87	49
to vegetables and melon plants	24	62	91	96	98	27
to fodder plants	4	18	35	26	29	9
Fruit trees	12	52	63	64	73	40
To the vineyards	7	60	40	51	54	18
Share of fertilized area, %	68	72	84	80	79	66

Table 3.

Yield of agricultural products (100 kg/ha) and removal of nutrients from the soil by crop.

The row	By plant groups	Yield, by years (100 kg/.ha)						10 centners of nutrients with the main product taken from the soil in kg			It was carried out from 1.0 ha land area, kg/ha											
		2003	2017	2018	2019	2020	2021	N	P_2O_5	K_2O	2013			2018			2020			2021		
											N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
1.	Cereals crops	26,6	29,8	30,0	32,1	31,8	32,8	30	12	25	79,8	31,9	66,5	90,0	36,0	75	95,4	38,2	79,5	98,4	39,4	82
2.	Cotton	15,0	15,3	17,6	29,5	33,6	28,5	45	15	50	67,5	22,5	75	79,2	26,4	88,0	151,2	50,4	168	128,2	42,7	142,5
3.	Tobacco	22,4	16,6	19,0	19,3	22,1	21,3	60	15	40	134,4	33,6	89,6	114,0	28,5	76,0	132,6	33,2	88,4	127,8	32,0	85,2
4.	Potatoes	124	150	149	169	174	184	6,2	2,2	9,5	7,7	2,7	11,8	9,2	3,3	14,2	10,8	3,8	16,5	11,4	4,1	17,5
5.	Vegetables	140	155	162	176	188	190	2,5	1,0	4,0	3,5	1,4	5,6	4,0	1,6	6,5	4,7	2,8	7,6	4,8	1,9	7,6
6.	Watermelons and melons	112	187	192	209	224	228	3	1	3	3,4	1,1	3,4	5,8	1,9	5,8	6,7	2,2	6,7	6,8	2,3	6,8
7.	Fruit and berry plants	70,0	68,4	68,0	71,0	70,3	71,5	5	3	6	35	21,0	42,0	34	20,4	40,8	35,1	21,1	42,2	35,8	21,5	43,0
8.	Grapes	50,9	84,1	92,8	104,8	99,4	98,2	2,0	1,5	5,0	10,2	7,6	25,5	18,5	14,0	46,4	19,8	15,0	49,7	19,6	14,8	49,1

According to the indicators of 2020, it was observed that mineral fertilizers were given at a high rate of 137 kg/ha to tobacco plants, and at a low rate (29 kg/ha) to fodder plants on the basis of 100% nutrient substance.

During the conducted research, the productivity of agricultural plants and the removal of nutrients from the soil were also studied. In Table 3, the yield indicators and the amount of nitrogen, phosphorus and potassium removed from the soil are determined for plants and plant groups in different years.

During the observations conducted between 2013 and 2021, the productivity of cereal crops was 26.6-32.8 s/ha; productivity of cotton plant 15.0-33.6 s/ha, productivity of tobacco - 16.6-21.3 s/ha; potato yield 124.0 - 184 s/ha; of vegetable plants productivity 140.0-190.0 s/ha; the productivity of melon plants was 112.0 - 228 s/he, the production of fruit and berry plants was 70.0-71.5 s/ha, and the productivity of grape plants fluctuated between 50.9 - 104.8 s/ha. The productivity of agricultural crops was determined to be higher in 2020 and 2021.

Taking into account the productivity indicators of agricultural plants, the amount of nutrients (NPK) taken from the soil with each 10 centners of the main product was determined.

During the conducted research, it was determined that the highest indicators of nitrogen removal with 10 centners of the main product are 60 kg in tobacco plants, 45 kg in cotton plants, and lower indicators are 2 kg in grape plants, and 2-3 kg in melon plants.

It was determined that phosphorus from the soil is higher (15 kg), 1-2.2 kg by tobacco and cotton plants, and less by melons, vegetables, grapes and potatoes.

Cotton and tobacco plants took 50 kg/ha and 40 kg/ha of potassium from the soil, respectively.

It was determined that the removal of potassium from the soil by melons, vegetables and grapes was 3.4 and 5 kg, respectively.

Taking into account the productivity of agricultural plants and the main nutrient elements (NPK) carried by the crop, the amount of nitrogen, phosphorus and potassium taken from 1 ha of land in different years were also determined.

Table 3 also shows the amount of nutrients taken from 1.0 hectares of cultivated land in different years.

The amount of nitrogen, phosphorus and potassium taken from each hectare of the soil in the cultivated areas of cereal crops varied over the years. Nitrogen transport by crop 2013-2021 - c79.8 - 98.4 kg/ha, phosphorus 31.9 - 39.4 kg/ha, and potassium 66.5 - 82.0 kg/ha, which compared to 2013 - 2021 - 18.6 kg/ha per nitrogen element per year from 1.0 hectares of land; Phosphorus application 7.5 kg/ha; and potassium was 25.5 kg/ha. It was determined that the amount of nutrients taken from the soil with technical plant products is higher among agricultural plants. The amount of nutrients carried out by the tobacco plant is 127.8 - 34.4 kg/ha for nitrogen; 28.5 - 33.6 kg/ha for phosphorus; 76.0 - 89.6 kg/ha was determined for potassium. The amount of nitrogen, phosphorus and potassium nutrients carried out by the cotton crop was also determined and varied from 67.5 to 151.2 kg/ha, phosphorus from 22.5 to 50.4 kg/ha, and potassium from 75.0 to 150 kg/ha. 168.0 kg/ha was found to be high compared to other agricultural crops.

Thus, during the conducted research, it was determined that the quantity of basic nutrients (NPK) taken from each hectare of land in agricultural crops is higher for technical crops (tobacco, cotton), and lower for vegetable and melon crops.

During the conducted research, the balance of nutrients (NPK) under agricultural plants was also determined. Researchers have always been interested in plant nutrition and the balance of nutrients in agriculture. Back in 1825, professor of Moscow University M. G. Pavlov touched on these issues in his scientific work in agricultural chemistry. "Complete return" of Y. Libikh's nutrients to the soil M.Pavlov mentioned the idea and showed the importance of returning nutrients to the soil. But later studies on the balance of nutrients in agrochemistry to develop with Y. Libih's "Chemistry in addition to agriculture and physiology" and the teaching of the complete return of mineral substances taken from the so il by plant products to the soil started.

Table 4.

The balance of nutrients (N, P, K) in the soils where agricultural plants are cultivated (kg/ha)

The row	Plants and plant groups 100% nutritional (pure) matter by account (in kg)	Mineral fertilizers were applied to 1.0 ha of land (N, P_2O_5, K_2O total in kg)				It was carried out from 1.0 ha land area (N, P_2O_5, K_2O total, in kg)				Main nutrients (NPK balance, kg/ha)			
		2003	**2018**	**2020**	**2021**	**2013**	**2018**	**2020**	**2021**	**2013**	**2018**	**2020**	**2021**
1	Cereals crops	20	86	88	66	178,2	201,0	213,1	219,8	-158,2	-115	-125,1	-153,8
2	Cotton	30	84	131	70	165,0	193,6	369,6	313,4	-135	-109,6	-238,6	-243,4
3	Tobacco	66	141	137	67	257,6	218,5	254,2	245,0	-191,6	-77,5	-117,2	-178
4	Potatoes	28	81	87	49	22,2	26,7	31,1	33,0	+5,8	+54,3	+55,9	+16,0
5	Vegetables	24	91	98	27	10,5	12,1	14,1	14,3	+3,5	+78,9	+83,9	+12,7
6	Watermelons and melons	24	91	98	27	7,9	13,5	15,6	15,9	+16,1	+77,5	+82,4	+11,1
7	Fruit and berry plants	12	63	73	40	98,0	95,2	98,4	100,3	-86	-32,2	-25,4	-60,3
8	Grapes	7	40	54	18	43,3	78,9	84,5	83,5	-363	-38,9	-30,5	-65,5
9	kg per hectare of cultivated land	16	72	81	47	97,8	105,0	138,5	128,2	-81,8	-33	-57,5	-81,2

The extension of soil fertility restoration is the continuous provision of plant productivity in the original conditions. In addition, increasing productivity creates favorable conditions for improving the environment. It was determined that this is possible with the active balance of nutrients in agriculture [Mineev V.Q.-190]. Nutrient balance – input (with fertilizers, natural sources, etc.) and used (carried away by crops, natural losses – leaching, gaseous volatilization, etc.) is a quantitative expression of the amount in a specified time frame. Determining the balance of nutrients is very important in assessing the level of fertilization in agriculture. In agriculture, the indicator of the balance indicator of nutrient elements "0" (zero) or indicators around this number indicate the favorable level of fertilization, and sharp departures from the zero number, on the contrary, as a measure of the ineffectiveness of fertilization, in other words, indicators significantly above zero indicate excess fertilization, and indicators significantly below zero, i.e., a negative balance of nutrients is evaluated as an indicator of the lack of substances. During the conducted research, the balance of nutrients in the soil under different agricultural plants was calculated using literature data and taking into account productivity indicators.

The balance of main nutrients (NPK) under agricultural crops is given in table 4. As can be seen from the table, "negative" results were obtained in the balance of the main nutrients in the soil in most of the agricultural plants. It was determined that the balance of the main nutrients in the soil was "positive" only for three plants and plant groups (under melon, vegetable and potato plants). In 2013-2021, the balance indicators of nutrient elements for the sum of nitrogen, phosphorus and potassium under melon plants (+16, 1 kg/ha) – (+82.4 kg/ha); under vegetable crops (+13.5 kg/ha) – (+83.9 kg/ha); under potato plants (+5.8 kg/ha) ha) fluctuated between (55.9 kg/ha). In the cultivation of agricultural crops, higher "negative" balance indicators of nutrients in the soil were observed in the areas where tobacco, cereals and cotton crops were cultivated. Thus, the balance of the main nutrients in tobacco crops (-77.5 - 19.6 kg/ha); in cereal crops (-115.0 - 158.2 kg/ha); and in cotton crops it was determined as (109.6 kg/ha) - (-243.4 kg/ha).

During the research, a "negative" balance of the main nutrients in the soil was also observed under fruit and berry and grape plants. In general, it was observed that the balance of the main nutrients in the soil for the relevant years (2013-2021) for the planting of agricultural plants fluctuated between 33-81.8 kg/ha, with a "negative" balance. In the agricultural crops of Azerbaijan, the shortage of acute nutrients was determined in the lands where cereal grains, tobacco and cotton crops are cultivated, vegetables, melons and in the lands where potato plants are cultivated, it was found that there are certain shortcomings in the application of fertilizers, taking into account the current productivity.

THE RESULT

1. The cultivated areas of agricultural plants of Azerbaijan were investigated and it was determined that the total cultivated areas for the years 2003-2021 were 1738000 hectares higher in 2018, and in 2021 these indicators decreased by 15749 hectares and became 1.644500 hectares. Compared to the corresponding year, a decrease was observed in the cultivated areas of all other agricultural crops, except for the cultivated areas of fodder crops.
2. In 2013-2021, the provision of mineral fertilizers to agricultural crops (on the basis of 100% nutrient (pure) substance) was determined, and in 2018 and 2019, the maximum limit of the use of mineral fertilizers was determined and fertilized in those years the specific weight of the fields in the total planting was determined as 84 and 80%, respectively.
3. The productivity of cultivated agricultural plants in our republic (s/ha) and the amount of nutrients taken from the soil with the crop have been determined. The amount of nutrients taken from the soil with technical plants (tobacco, cotton) is higher, and the amount of nitrogen, phosphorus and potassium taken with tobacco is 127.0 in 2021, respectively; 32.0 and 85.2 kg/ha; and 128.2 respectively in the areas planted with cotton plants; 42.7; and 142.5 kg/ha of nutrients are determined. It was determined that the carrying of nutrients is relatively lower than the areas where vegetables and melons are cultivated. It was determined to be 2.3 and 6.8 kg/ha.

4. The balance of nutrients (N, P, K) was determined in the lands where agricultural crops were grown, and it was determined that the balance of nutrients under other agricultural crops, except for melons, was "negative" during 2013-2021. In 2021, the highest "negative" balance is in cotton (-243.4 kg/ha) and tobacco (-178.0 kg/ha); and it was found to be (-153.8 kg/ha) in cereal crops.

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IMPACT OF EROSION PROCESS ON ECOLOGICAL PARAMETERS OF THE SOILS IN ALPINE AND SUBALPINE MEADOWS IN SHAHDAG NATIONAL PARK

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Recently, both in our republic and globally, large-scale human interference in natural ecosystems, disregarding land and ecological laws, has led to degradation of the vegetation cover. The uncontrolled grazing of cattle in high-altitude and mid-altitude areas, at the boundary of summer pastures and forests, has resulted in the lowering of these forests' upper limit, intensification of erosion processes, and other exogenous processes. Natural landscapes have often been replaced by secondary landscapes or entirely transformed by humans into agro-landscapes. On the whole, unchecked human interference in nature has caused the soil cover, considered a critical component of the biosphere and a fundamental element in agriculture, to be subjected to varying degrees of erosion. This process, primarily noticed alongside a decrease in humus, a primary and vital soil indicator, continues to this day. It's worth noting that currently, an area of 3743.5 thousand hectares, constituting 43.3% of the entire territory of the republic, is experiencing some degree of erosion.

In the Shahdag National Park, these lands are mainly used as summer pastures and meadows, with a portion (particularly the mountain-meadow-steppe areas) allocated for growing grains and root crops. Research has determined that favorable hydro-physical and physicio-chemical properties, coupled with dense grass coverage, slow down the formation of water runoff and the development of erosion processes on these lands. However, in some areas, these lands are subject to various degrees of erosion due to inconsistencies in the livestock grazing rotation system and the impact of overgrazing. To protect these soils from erosion, enhance their fertility, and boost the productivity of grassy plants, it's necessary to regulate the number of large cattle per hectare of pasture (the recommended grazing standard is 4-8 heads), increase the extent of artificial grass plantations, and conduct landscaping works in certain areas. Meanwhile, on some plots, especially in mountain-meadow-steppe lands where cultivation takes place, it's vital to adhere to erosion control measures and limit their cultivation.

Keywords*: Erosion process, Grazing rate, Meadows, Mountain-grass steppes, Shahdag National Park, Summer pastures.*

INTRODUCTION

First of all, it should be noted that summer pastures are a forage base for the development of animal husbandry in our republic, they are of great importance for regulating the water regime and protecting soils. However, the withdrawal of livestock to summer pastures ahead of schedule and in the same way, excessive grazing during the pasture period above the norm and unsystematicly leads to the violation of the grass layer on the slopes, the development of the erosion process, the formation of floods. Recently, as a result of unsystematic grazing in a number of areas of the mountain-meadow zone, summer pastures have been completely washed out, unable to provide livestock areas with the necessary fodder, completely become unusable and turn into rocky areas. In such places, during heavy rains, strong water flows occur, which wash away and destroy the soil. In the mountain-meadow zone, washed soils differ sharply from unwashed ones. So, on washed soils, there is no sod layer rich in humus, the structure is not clearly expressed or it becomes dusty, and an increase in backfill is clearly noticeable.

MATERIALS AND METHODS

The study of the soil erosion process in Azerbaijan is carried out on the basis of the methods adopted in the former USSR. The amount of soil washed away in nature is calculated by determining the volume of small and large furrows formed after rain. For this, the necessary profiles, plans are drawn up and photographs are used. At present, the geographic distribution of the process of soil erosion and the mapping of eroded soils are carried out through accurate research, the foundations of which were laid by K. A. Alekbarov since 1945.

K. A. Alekbarov for the first time in Azerbaijan conducted extensive research in the field of studying the essence of the process of soil erosion and its geographical distribution. Subsequently, valuable research in this area was carried out by G. A. Aliyev, K. M. Mustafaev, A. A. Ibragimov, B. G. Shakuri, G. Sh. Mamedov and others. As for the research, we have carried out soil-ecological research on the summer pastures of the Shahdag National Park.

RESULTS AND DISCUSSION

As a result of the research, it was found that when cattle graze more than the norm on summer pastures, the grass cover is gradually trampled down and destroyed, the soil surface hardens, and its water-physical properties and structure worsen (table). Thus, the number of water-resistant aggregates larger than 1 mm in pastures located on the territory of the Guba region is 73.8%, the bulk density of the soil is 1.05 g/cm3, the total porosity is 55.4%, the water permeability is 5.2 mm/min. When precipitation falls in such areas, rainwater is gradually absorbed into the soil and no erosion process is observed. In areas with excessive and unsystematic grazing, the number of water-resistant aggregates was 50.3%, bulk density 1.56 g/cm3, total porosity 40.1%, water permeability 0.6 mm/min. Rainfall in such areas is poorly absorbed into the soil, forming a surface runoff of water and causing erosion.

Ravines formation has been observed as a result of overgrazing in pastures. Such lumps can be found in the Khinalyg meadows of Guba, Sudur Gusar, Laze Gabala, Filfili Oguz, etc. Here, with a long withdrawal of livestock for irrigation along the same path along the slope, the grass cover is destroyed and the soil surface is disturbed, as a result of which conditions for the formation of furrows due to the influence of rainwater in these areas. These furrows gradually expand and grow, turning into puddles and dividing pastures into relatively small areas. Cutting down summer pastures with ditches leads to a reduction in pasture areas suitable for cattle breeding and disruption of the water regime of rivers.

As in the mountain-meadow zone cesspools are formed, so in the mountain-forest-meadow zone, which forms the transition zone, such cesspools are often found. Therefore, it is necessary to take measures to cover the mountain slopes with vegetation. Otherwise, the erosion process will develop faster and the areas affected by it will increase, as a result of which the slopes of the mountains will be deprived of soil, and the tillage rocks will be exposed and come to the surface. These rocks break down and break into relatively small pieces, causing very large spills and debris on the lower slopes. All these materials move during heavy rains and form flood flows.

Table

Influence of the erosion process on the granulometric composition and chemical parameters of soils

Soil name	Erosion rate	Depth in cm	Granulometric composition in %		Humus in %	Total nitrogen in %	CaCO3 (relative to CO2) in %	Sum of absorbed bases in mg-eq in 100g of soil
			<0,001 mm	<0,01 mm				
Grassy mountain-meadow	Unwashed	0 – 7	31,36	65,69	12,86	0,42	“none”	57,14
		7 – 15	31,06	73,00	10,24	0,24	“---”	45,51
		15 – 30	38,28	62,60	6,36	0,12	“---”	32,79
		30 – 42	45,22	56,32	4,31	0,08	“---”	29,98
		42 - 59	5,20	64,80	1,08	0,05	“---”	29,00
	Washed out medium	0 – 15	26,00	60,16	4,89	0,18	“none”	32,30
		15 – 36	18,16	45,60	2,74	0,12	“---”	31,68
		36 – 62	–	–	2,27	–	“---”	38,86

Mountain grassy steppe	Unwashed	0 – 12	12,40	54,60	5,40	0,22	“none”	–
		12 – 33	12,80	48,00	4,42	0,17	“---”	–
		33 – 47	11,16	44,60	3,80	0,14	“---”	–
		47 – 77	23,92	42,00	3,00	0,12	“---”	–
		77 - 85	16,21	44,06	2,01	0,05	“---”	–
	Washed out medium	0 – 17	–	–	2,66	0,17	“none”	–
		17 – 40	–	–	1,68	0,10	“---”	–
		40 – 72	–	–	1,84	–	“---”	–
		72 –110	–	–	1,68	–	“---”	–

CONCLUSION

Thus, as a result of excessive and unsystematic grazing on pastures, which is constantly increasing due to the development of animal husbandry in the modern era, as a result of improper and rational use of pasture lands, the development of the erosion process on pastures has accelerated, and their productivity has decreased. It has been established that about 75% of summer pastures in some areas of the Shahdag National Park have been eroded to one degree or another. Therefore, in order to prevent soil erosion on pastures, it is necessary to carry out complex reclamation measures, first of all, to comply with the grazing rate and use a reverse grazing system.

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SELECTING LANDSCAPE AND SOIL INDICATORS FOR ECOLOGICAL MONITORING IN THE GILGILCHAY BASIN CONDITION

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The Gilgilchay basin is one of the areas where landscape complexes and land cover have been anthropogenically affected in our Republic. Landscape complexes and soil cover of the basin have undergone changes under the influence of anthropogenic factors; forests have decreased to the extent that they lost their function of soil and water retention, steppes have been plowed, subalpine meadows and meadow-steppe have reduced their natural possibilities due to excessive grazing. For this reason, the organization of ecological monitoring on soil and landscape complexes in the Gilgilchay basin is of both scientific and theoretical importance, as well as economic importance.

In addition to the development of settlements, which is a form of pressure on the landscape and land cover, the development of infrastructure in the Gilgilchay basin was high during the observation period. Over the course of 33 years, the development dynamics of settlements and infrastructure were monitored, and it was determined that anthropogenic and man-made areas increased by 47-55% within different landscape zones. In addition to the development of settlements, which is a form of pressure on the landscape and land cover, the development of infrastructure in the Gilgilchay basin was high during the observation period.

Due to the development of roads and other infrastructures, land loss of 90 ha occurred in the entire Gilgilchay basin in 2020 compared to 1986-1987.

Keywords*: monitoring, landscape, settlement, polygon, aerial photographs.*

INTRODUCTION

In the XX-XXI centuries, the intensive development of various sectors of the economy, agriculture and infrastructure on a global scale, as well as the trends observed in demographic increase, and as a result of these processes, global climate changes, the decrease of biodiversity, desertification and aridification, and other ecological problems, which are becoming more acute, are the same as in the whole world, it has become a source of great complications in the republic of Azerbaijan. It is possible to better observe these negative trends in individual regions of the republic.

However, environmental protection and optimization of "human-nature" relations in our Republic is one of the priority areas of the state. However, despite taking serious measures in the last ten years, the intensive exploitation of natural resources due to economic necessity, population settlement (excessive expansion of both cities and towns, and rural settlements) and the increase in the density of infrastructures continue to have their effect on the soil and landscape cover. The solution of this problem requires the implementation of specific nature protection measures in the complex organization, legal, economic and also natural complexes, including, in our opinion, more than doubling the area of Specially Protected Areas (increasing it to 15-17% across the Republic). Adoption of National programs in this matter would allow to achieve better results. It is well known that in order to protect natural complexes and at the same time to optimize anthropogenic effects on land resources in agricultural use, it is necessary to have correct information about the tendency of these processes based on long-term observations. Organization of "ecological monitoring" on natural complexes (landscape complexes, ecosystems, etc.) and lands of different categories is one of the main measures in the field of environmental protection.

THE OBJECT AND METHODOLOGY OF THE RESEARCH

The comparative analysis of observational materials shows that compared to the year 2000 and the previous years (1986-1987), there have been significant changes in the natural landscape cover in the Gilgilchay basin due to the expansion of settlements, the increase in economic activity and other reasons.

This has shown itself both in the occurrence of changes in the boundaries of natural landscapes and in the transformation of landscape complexes. This can be seen from the monitoring conducted on the basis of the comparison of aerial photos of historical periods (1986-1987 and 2017-2020).

We have selected polygons (observation grounds) within different landscape zones in the Gilgilchay basin in order to conduct a comparative analysis of aerial photographs taken in different periods. The selection of polygons (observation grounds) within these landscapes is not accidental. Preliminary investigations show that changes are more pronounced in the landscape complexes named below.

ANALYSIS AND DISCUSSION

The settlement of Sadan, located in the Siyazan district, within the broad-leaved forest landscape of the moderately fragmented low mountains, was chosen as the first polygon (observation site). Figure 1 shows a comparison of the photos taken in 2019 and the period up to 1986 of the Sadan settlement.

As can be seen from Figure 2, in 1986, the area of Sadan district was 26 ha, but in 2019, this indicator increased to 58 ha. That is, the total increase of the area of the settlement during 33 years was 32 hectares (55%). This should be considered a fairly high indicator (1 ha on average). As can be seen from the figure, the increase was mainly due to the areas of meadows and bushes (once a forest, and then transformed into steppes and bushes) located around the settlement.

a) ***b)***

Fig 1. Perennial dynamics in the area dimensions of Sedan settlement within the broad-leaved forest landscape of moderately fragmented lowland:
a) 1986: b) 2019

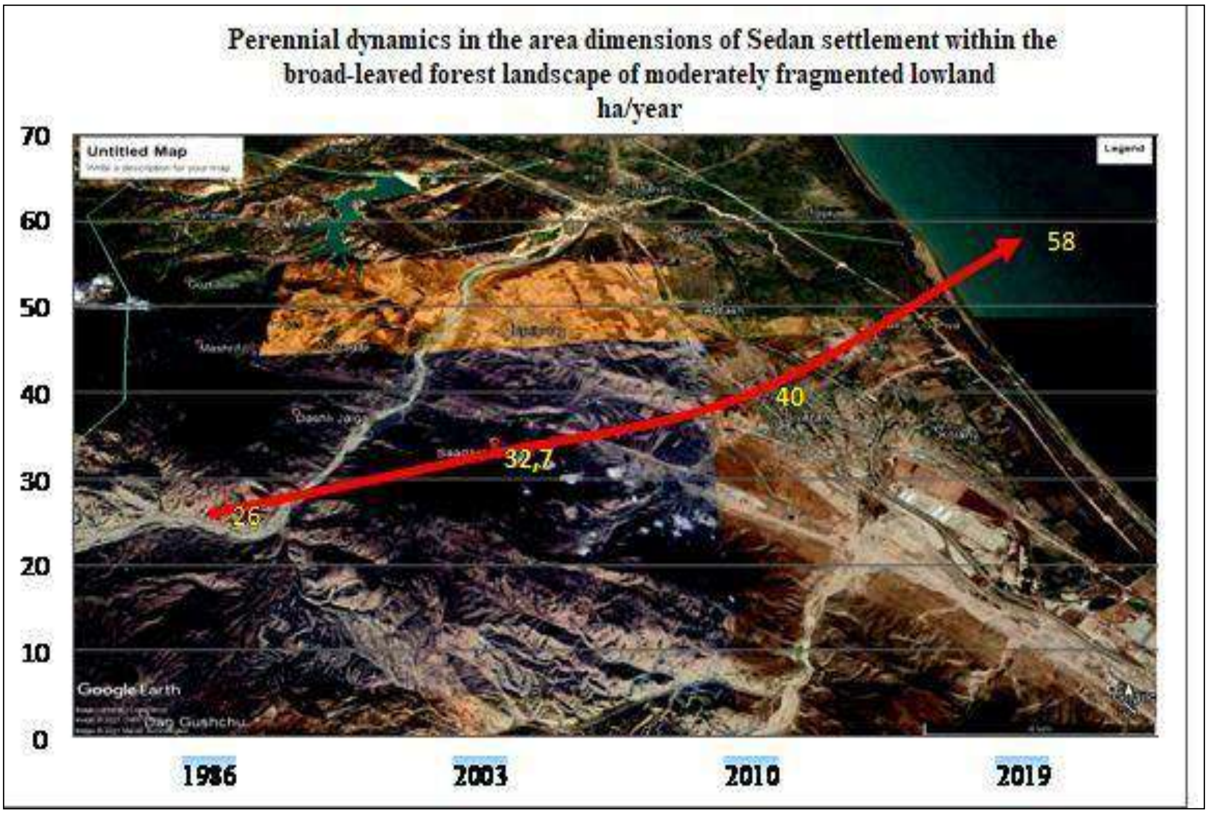

Fig 2.

The second polygon (observation site) - the territory of Aghbash settlement, located within the semi-desert landscape of medium and poorly fragmented dagar plains and lowlands, was taken. The territorial increase of the settlement was greater within this landscape.

As can be seen from the calculations and figures (Figures 3 and 4), the total area of Agbash village was 87 ha in 1987, and the indicator was already 163 ha in 2020. Thus, the increase of the settlement was 76 ha (47%) during the observation period (33 years).

a) ***b)***

Fig 3. Perennial dynamics in the area dimensions of Agbash settlement within the semi-desert landscape of the middle and weakly divided mountain plains:
a) 1987 b) 2020

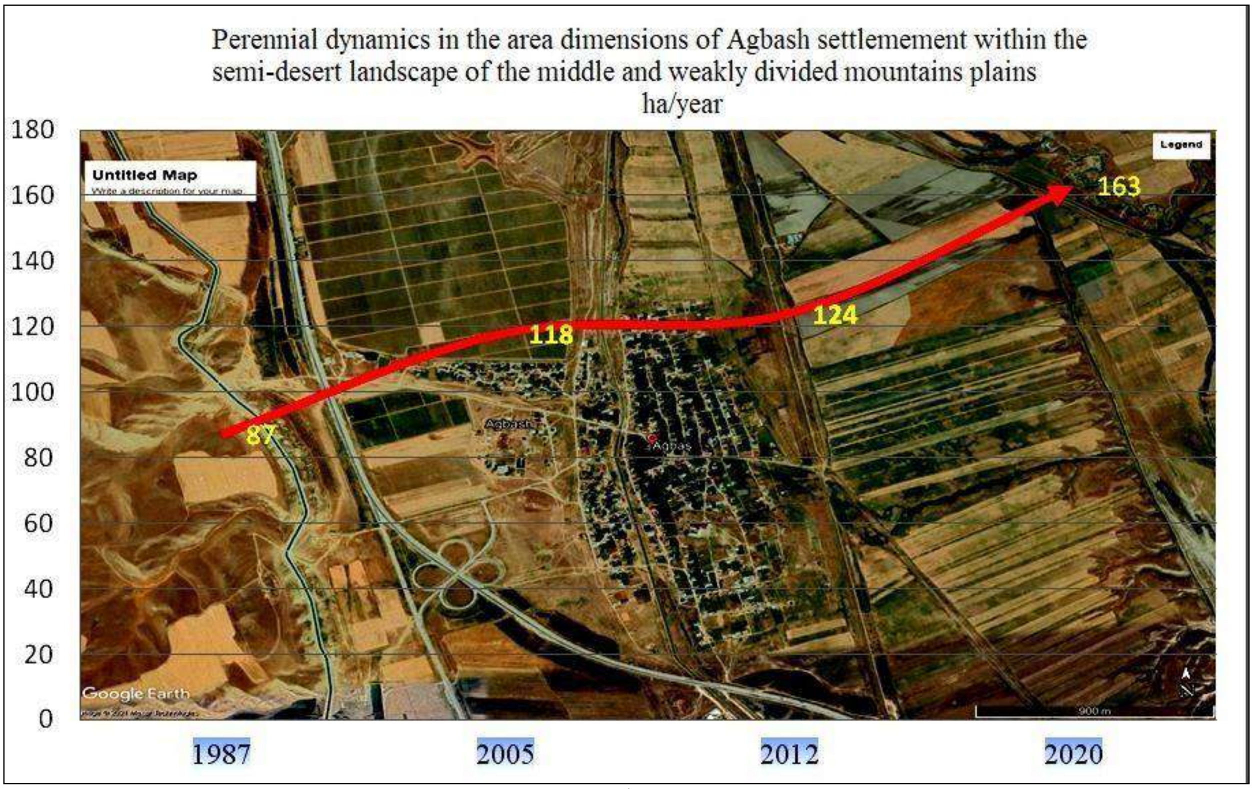

Fig 4.

In addition to the increase of settlements, which is a form of pressure on the landscape and land cover, the increase of infrastructure in the Gilgilchay basin was high during the observation period.

Due to the increase of roads and other infrastructures, land loss of 90 ha occurred in the entire Gilgilchay basin in 2020 compared to 1986-1987.

CONCLUSION

As mentioned above, any human economic activity and settlement takes place within a certain landscape. However, human economic activities (agriculture, forestry, etc.) and settlement (urbanization, construction of communications, etc.) cause changes in the historically formed structure of natural landscapes (for example, the formation of grass cover under trees and the formation of xerophytic forests due to the thinning of mesophilic forests) and sometimes it replaces it with another (for example, the formation of steppes).

Based on the comparative analysis of aerial photographs taken in different periods, monitoring of the incresing dynamics of settlements and infrastructure was carried out in the Gilgilchay basin for 33 years, and it was determined that anthropogenic and man-made areas increased by 47-55% within different landscape zones.

A conceptual model of protection, restoration and management of land cover, farm sites and landscape complexes within the Gilgilchay basin has been put forward. As we mentioned, according to modern concepts, the management of land and landscape resources should be carried out based on the formation of the optimal ratio of "nature-farming" relations. So, just as the use of natural resources, as well as land and landscapes is necessary for the existence of human society, the protection of nature and its biodiversity, landscape and land is also one of the vital issues.

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DYNAMIC EXCEL TABLES FOR SOIL DATA PROCESSING

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There are indicators that are critical to assessing the state of land and the environment. The results of soil studies depend directly on the accuracy or reliability of the soil data. This is through the mathematical and statistical treatment of soil data. Soil appraisal decides the quality of the soil in terms of property scores, which correlate with yield. The purpose of assessing soil fertility is to develop a unified system of quantitative characteristics of soil productivity, to justify the implementation of the principles of land cadaster, soil fertility management and crop planning. Land assessment should necessarily be related to specific areas or cadastral zones. In this regard, soils, as the main object of such valuation, have an important advantage over other elements of the natural landscape.

There are techniques for conducting soil appraisal and mathematical processing of the data. To speed up data processing, to make soil indicators informative, dynamic, updatable, and mobile, and to make spatial analysis of soil data available, we have compiled they in dynamic Microsoft Excel tables for Windows. Typing soil analysis data into Excel tables is the most time-consuming work, then the process goes on automatically. According to soil appraisal method, soil type data transferred to 0-20, 0-50, 0-100 cm depth. The soils evaluated first in a closed and then in an open appraisal scale using a 100-point system. Mathematical and statistical analysis decides the degree of reliability of the data. Excel formulas as well as some built in Excel functions such as "AVERAGE", "COUNT", "DEVSQ", "SQRT", "MIN" and "MAX" were used to calculate translation of soil data values to 0-20, 0-50, 0-100 cm depth, and to calculate mean value (M), mean square (σ), mean error (m), coefficient of variation (C), precision index (P) and reliability (t).

Keywords: *Excel, Soil Assessment, Soils Data, Soil Management, Statistical Data Processing.*

INTRODUCTION

There are indicators that are critical to assessing the state of land and the environment. Soil fertility assessment decides soil quality that correlate with yield. The purpose of assessing soil fertility is to develop a unified system of quantitative characteristics of soil productivity, to justify the implementation of the principles of land cadastre, soil fertility management and crop planning (Mammadov, 2015). Land assessment should necessarily be related to specific areas or cadastral zones. In this regard, soils, as the main object of assessment, have an important advantage over other elements of the natural landscape.

At the present stage of development of soil science, as well as other natural sciences, the connection with mathematics and geoinformatics is increasingly expanding and deepening. The use of mathematical methods makes it possible to process and summarize the accumulated huge factual material. The properties of soils are directly dependent on the conditions in which they formed. These properties reflect all factors of soil formation. Through laboratory analyses, agrochemical and agrophysical properties of soils revealed, which give a correct and objective characterization of soils (Mammadov, 2016). The expression of this characteristic in numbers contributes to the application of mathematical methods in soil science.

In soil assessment studies, that is, in quantifying the level of fertility, the use of mathematical methods is inevitable (Ismayilov, 2015). With the help of mathematical processing, specific values of indicators of soil properties that decide fertility transferred to a relative complex value - an evaluation score.

The results of soil research directly depend on the accuracy or reliability of soil data. For this purpose, mathematical and statistical data processing used.

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MATERIAL AND METHODS

Mathematical and statistical methods of soil research used to express the results of soil analyses in figures, to find agrochemical and agrophysical properties of soils. Mathematical methods used to decide the level of soil fertility. When assessing soil fertility and yield using mathematical calculations, the properties of soil indicators transferred to the estimated scores from 0 to 100 points (Asgarova, 2005, 2019). Mathematical processing of soil data for soil valuation conducted based on the capabilities of Microsoft Excel spreadsheets developed by Microsoft for Windows. Mathematical and statistical analysis performed based on existing mathematical and statistical formulas and built-in functions of Excel (Bolster, 2023).

To do this, first, soil data collected in Excel tables on genetic horizons and the program used to calculate the average numbers for layers 0-20, 0-50 and 0-100. Based on the accepted methods of mathematical calculations for types of soils of the Kura-Araz lowland, decided the mean value (M), standard deviation (σ), mean error (m), coefficient of variation (C), precision index (P) and reliability (t). In mathematical and statistical analysis, the following Excel functions used: "AVERAGE", "COUNT", "DEVSQ", "SQRT", "MIN" and "MAX".

RESULTS AND DISCUSSION

To create an information database on soils of the Kura-Araz Lowland we collected the results of soil analyses in MS Excel tables. The database includes the following parameters: country, region, districts, soil types, soil sub-types, soil section number, geographical coordinates of soil sections, depth of soil sections in centimeter's by genetic horizons and results of soil analyses: granulometric composition, %, including silt, <0,001mm, physical clay, <0,01mm; hygroscopic humidity, %; humus, %; total nitrogen, %; total phosphorus, %; $CaCO_3$ by CO_2, %; pH of water suspension; N/NH_3, mg per 1kg soil; N/NO_3, mg/kg 100g soil; absorbed Na, mg-eq, volumetric whole soil - g/cm^3, specific whole soil - g/cm^3, porosity of soil, %; gross potassium K_2O, %; CO_3, mg-eq. per 100g of soil; CO_3, %, HCO_3, mg-eq. ; HCO_3, %, Cl, mg-eq. per 100 g soil; Cl, %, Na+Ka, mg-eq. per 100 g soil; Na+K, %; solid residue, %; sum of the absorbed bases, mg-eq. Ca+Mg, Ca, Mg; dry residue, %. The information base of soil data used to assess fertility reserves, complex agronomic characteristics of soils, fertility modeling, yield forecasting, evaluation, agroecological assessment, soil fertility management, correct placement of crops "Table 1".

Table 1.

Example of soil analysis data from 3M in EXCEL

E28

	A	B	C	D	E	F	G	H	I	J
1	**a1**	**a2**	**a3**	**a4**	**a5**	**a6b**	**a6**	**a6a**	**a8**	**a7**
2	**Respublika**	**Reqion**	**Rayonlar**	**Torpaq tipleri**	**Torpaq yarim tipleri**	**Kəsim №**	**Coğrafi enliklər**	**Coğrafi uzunluqlar**	**Dərinliklər, sm-lə**	**Alt dərinlikler**
24	Azərbaycan	Kur-Araz	Biləsuvar	Çəmən-boz	Suvarılan çəmən -boz	**3M**	39°32'05.55"N	48°43'27.63"E	0-6	6

continuation of table 1

1	**a8**	**a7**	**a9**	**a10**	**a11**	**a13**	**a14**	**a15**	**a16**	**a17**	**a21**	**a22**
2	**Dərinliklər, sm-lə**	**Alt dərinlikler**	**Qranulometrik tərkib, lil <0,001mm**	**Qranulometrik tərkib, gil <0,01mm**	**Hiqroskopik nəmlik, %**	**Humus, %**	**Ümumi azot, %**	**Ümumi fosfor, %**	**CO2, %**	**CO2-yə görə CaCO3 %**	**ph su suspenzi-yasında**	**N/NH3, mq 1 kq torpaqda**
24	0-6	6	33.50	56.40	5.90	2.29	0.22	0.19	0.15	0.34	7.80	20.67
25	6-29	29	31.35	57.20	4.38	1.88	0.12	0.13	1.86	4.23	7.90	12.21
26	29-67	67	38.40	58.65	6.30	0.62	0.15	0.12	3.34	7.60	8.10	8.40
27	67-100	100	23.45	72.15	6.36	0.36	0.09	0.10	3.91	8.89	8.40	4.63

The application of mathematical methods in soil assessment starts with the recalculation of all physico-chemical data for genetic horizons at given depths of 0-20, 0-50, 0-100, 0-150, 0-200 cm. According to the 3M soil profile, some soil condition indicators are distributed over the genetic horizons as shown in Table 2.

Table 2.

Humus values in the genetic horizons and Calculation of the average humus value per 0-20cm with EXCEL

STDEVA | f_x =(O24*6+O25*14)/20

	F	J	K	O	P	Q	R	S	T	U	V	W
1	a6	a7	a8	a13	a14	a15	a16	a17	a21	a22	a23	a24
2	Kəsim №	Alt dərinlikler	Dərinliklər, sm-lə	Humus, %	Ümumi azot, %	Ümumi fosfor, %	CO2, %	CO2-yə görə CaCO3 %	ph su suspenzi-yasında	N/NH3, mq 1 kq torpaqda	N/NO3, mq/kq 100qr torpaqda	Mütəhərrik fosfor, P2O5, mq/kq
24	3M	6	0-6	2.29	0.22	0.19	0.15	0.34	7.80	20.67	10.70	24.88
25		29	6-29	1.88	0.12	0.13	1.86	4.23	7.90	12.21	11.61	14.28
26		67	29-67	0.62	0.15	0.12	3.34	7.60	8.10	8.40	8.70	3.00
27		100	67-100	0.36	0.09	0.10	3.91	8.89	8.40	4.63	5.61	
28		125	100-125				5.95	13.52	8.50			
29		150	125-150				6.60	15.00				
30			0-20	=(O24*6+O25*14)/20			1.35	3.06	7.87	14.75	11.34	17.46
31			0-50	1.40	0.14	0.13	2.28	5.18	7.97	11.63	10.28	10.81
32			0-100	0.92	0.13	0.12	3.00	6.81	8.14	8.77	8.47	5.92
33			0-150				3.83	8.70	6.28	5.54	5.27	3.94

To calculate the humus content of the 0-20 cm layer, multiply the percentage of humus content by the thickness of the horizon to a depth of 20 cm, then sum up the product obtained and divide the sum by 20cm:

1) 2,29 x 6 = 13,74
2) 1,88 x 14 = 30,08
3) 13,74 + 3,08 = 43,82
4) 43,82: 20 = 2,19

Value of 2.19% is average content of humus in 0-20 cm layer, in this way we calculate content of all investigated nutrition elements in 0-20, 0-50, 0-100, 0-150, 0-200 cm depth. Calculations conducted with data from section #3M showed that in 0-50 cm layer humus content was 1.63% and in 100 cm layer it was 0.92%.

And if you calculate it in EXCEL tables, using EXCEL functions and formulas, it would take more than a year to calculate the data, and even more, if all the information typed into a table, and formulas or functions defined, it would take seconds. In this case, we chose the "STDEVA" function. By calculating the average value only for humus at 0-20, 0-50 and 0-100 cm depth, it is possible to calculate all the other values of "Table 2" with one command.

To allow EXCEL to understand the information, we simply wrote the lower depths separately in column J, in this case, 6, 29, 67, 100. We calculated the average value for 0-20cm depth with the following formula:

=(O24*6+O25*14)/20 = (2.29%*6cm+1.88*14cм)/20cм = 2,00%

To calculate the average value for 0-20cm depth, as seen from column J24 the value of 6cm which corresponds to O24 - 2.29% humus; O25 to calculate the value of the remaining 14cm (20-6=14cm) which corresponds to O25 - 1.88%.

In the same way, the amount of humus and other nutrients can calculate using the following EXCEL formulas in - 0-50, 0-100, 0-150, 0-200cm depths "Table 3-4".

Table 3.

Calculation of the average humus value at 0-50cm using EXCEL

STDEVA =(O24*6+O25*23+O26*21)/50

	F	J	K	O	P	Q	R	S	T	U	V	W	X
1	a6	a7	a8	a13	a14	a15	a16	a17	a21	a22	a23	a24	a25
2	Kəsim №	Alt dərinlikler	Dərinliklər, sm-lə	Humus, %	Ümumi azot, %	Ümumi fosfor, %	CO2, %	CO2-yə görə CaCO3 %	ph su suspenzi-yasında	N/NH3, mq 1 kq torpaqda	N/NO3, mq/kq 100qr torpaqda	Mütəhərrik fosfor, P2O5, mq/kq	Mübadiləli kalium, K
24	3M	6	0-6	2.29	0.22	0.19	0.15	0.34	7.80	20.67	10.70	24.88	280.70
25		29	6-29	1.88	0.12	0.13	1.86	4.23	7.90	12.21	11.61	14.28	233.70
26		67	29-67	0.62	0.15	0.12	3.34	7.60	8.10	8.40	8.70	3.00	134.90
27		100	67-100	0.36	0.09	0.10	3.91	8.89	8.40	4.63	5.61		84.30
28		125	100-125				5.95	13.52	8.50				
29		150	125-150				6.60	15.00					
30			0-20	2.00	0.15	0.15	1.35	3.06	7.87	14.75	11.34	17.46	247.80
31			0-50	=(O24*6+O25*23+O26*21)/50			2.28	5.18	7.97	11.63	10.28	10.81	197.84
32			0-100	0.92	0.13	0.12	3.00	6.81	8.14	8.77	8.47	5.92	149.67
33			0-150				3.83	8.70	6.28	5.54	5.27	3.94	94.16

Calculation of the average humus value for a depth of 0-50 cm:

=(O24*6+O25*23+O26*21)/50 = (2.29%*6cm+1.88*23см+0,62*21см)/50см=1,40%.

Table 4.

Calculation of the average humus value at 0-100cm using EXCEL

STDEVA =(O24*6+O25*23+O26*38+O27*33)/100

	F	J	K	O	P	Q	R	S	T	U	V	W	X
1	a6	a7	a8	a13	a14	a15	a16	a17	a21	a22	a23	a24	a25
2	Kəsim №	Alt dərinlikler	Dərinliklər, sm-lə	Humus, %	Ümumi azot, %	Ümumi fosfor, %	CO2, %	CO2-yə görə CaCO3 %	ph su suspenzi-yasında	N/NH3, mq 1 kq torpaqda	N/NO3, mq/kq 100qr torpaqda	Mütəhərrik fosfor, P2O5, mq/kq	Mübadiləli kalium, K
24	3M	6	0-6	2.29	0.22	0.19	0.15	0.34	7.80	20.67	10.70	24.88	280.70
25		29	6-29	1.88	0.12	0.13	1.86	4.23	7.90	12.21	11.61	14.28	233.70
26		67	29-67	0.62	0.15	0.12	3.34	7.60	8.10	8.40	8.70	3.00	134.90
27		100	67-100	0.36	0.09	0.10	3.91	8.89	8.40	4.63	5.61		84.30
28		125	100-125				5.95	13.52	8.50				
29		150	125-150				6.60	15.00					
30			0-20	2.00	0.15	0.15	1.35	3.06	7.87	14.75	11.34	17.46	247.80
31			0-50	1.40	0.14	0.13	2.28	5.18	7.97	11.63	10.28	10.81	197.84
32			0-100	=(O24*6+O25*23+O26*38+O27*33)/100				6.81	8.14	8.77	8.47	5.92	149.67
33			0-150				3.83	8.70	6.28	5.54	5.27	3.94	94.16

Calculation of the average humus value for a depth of 0-100 cm:

=(O24*6+O25*23+O26*38+O27*33)/100 = (2.29%*6cm+1.88%*23см+0,62%*38см+ +0.36%*33см) /100см= 0.92%.

Now, having marked results of 0-20, 0-50, 0-100cm depths, we pull the plus sign to the end of columns and get results for all indicators. Having received this data, it is necessary to calculate the average indicators for each type of soil of the study area at 0-20, 0-50, 0-100, 0-150, 0-200 depth. Average value of light grey soils of Kura-Araz lowland at depth of 0-20, 0-50, 0-100 cm calculated with use of EXCEL "AVERACE" function, "COUNT" function - number of repetitions, "MAX" function - maximum value, "MIN" function - minimum value of "Table 5" data.

After an average of tons per hectare, the substances recalculated as follows:

$$Z = \frac{dPV}{100} \quad \text{were,}$$

Z - Soil material reserves at depths of 0-20, 0-50, 0-100, 0-150, 0-200 cm,

d - weight of the soil volume of a certain layer,

P - Percentage of nutrients (calculated in mg-eq),

V - Soil volume of this layer, m^3/ha.

Table 5.

Calculation of mean value for light grey soils of Kura-Araz lowland to a depth of 0-20 cm

STDEVA | =AVERAGE(E57:E72)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	a8	a5	a7	a8		a	a	a13	a14	a15	a16	a17	a18	a19	a20
2	Dərinliklər	Torpaq yarim tipleri	fx - AVERACE fx - COUNT fx - MAX fx - MİN	Dərinliklər	qranulometrik tərkib, lil <0,001	qranulometrik tərkib, gil <0,01	hiqroskopik nemlik	humus	ümumi azot	ümumi fosfor	CO_2	$CaCO_3$	Udulmuş əsasların cəmi mq/ekv	Udulmus əsasların cəmi,%-lə	Quru qalıq, %-lə
57	0-20	Aciq boz		0-20	28.64	60.60	5.50	1.52	0.10		4.25	9.66	27.53	3.63	1.600
58	0-20	Aciq boz		0-20	31.48	68.96	3.40	1.07	0.07		7.65	17.38	16.63	6.01	0.278
59	0-20	Aciq boz		0-20	36.06	64.18	4.53	1.75	0.11		5.83	13.24	20.75	4.97	0.377
60	0-20	Aciq boz		0-20	35.64	46.76	5.20	1.20	0.08		8.96	20.36	24.05	3.33	0.520
61	0-20	Aciq boz		0-20	11.52	53.00	5.70	1.10	0.08		3.92	8.91	17.85	3.92	0.570
62	0-20	Aciq boz		0-20	16.08	51.28	5.80	1.70	0.11		3.03	6.88	20.75	3.39	1.949
63	0-20	Aciq boz		0-20	22.00	54.00	5.30	2.12	0.10		3.69	8.38	24.28	2.68	2.600
64	0-20	Aciq boz		0-20	11.76	46.04	4.13	0.97	0.08		3.73	8.47	15.63	6.52	0.925
65	0-20	Aciq boz		0-20	14.20	43.16	4.10	0.97	0.06		8.59	19.52	19.40	4.64	0.550
66	0-20	Aciq boz		0-20	14.00	36.16	2.50	1.21	0.08		6.21	14.11	12.30	8.94	0.420
67	0-20	Aciq boz		0-20	28.00	46.07	4.24	1.56	0.10		5.21	11.71	19.57	5.82	0.570
68	0-20	Aciq boz		0-20	17.33	32.62	2.51	1.63	0.10		5.21	11.84	18.95	5.86	1.565
69	0-20	Aciq boz		0-20	3.12	16.75	5.55	0.98	0.06		4.29	9.75	10.93	8.24	0.795
70	0-20	Açıq boz		0-20	16.68	55.44	5.60	1.90	0.12	0.09	3.73	8.48	31.90	3.14	0.122
71	0-20	Açıq boz		0-20	14.28	57.28	3.80	1.52	0.15	0.10	3.17	7.20	20.88	5.27	0.252
72	0-20	Açıq boz		0-20	3.08	31.20	1.50	1.79	0.10	0.10	1.53	3.46	12.60	3.73	0.190
73	0-20	Aciq boz	orta	=AVERAGE(E57:E72)		47.72	4.33	1.44	0.09	0.10	4.94	11.21	19.62	5.01	0.83
74	0-20	Aciq boz	təkrarlar	0-20	16.00	16.00	16.00	16.00	16.00	3.00	16.00	16.00	16.00	16.00	16.00
75	0-20	Aciq boz	max	0-20	36.06	68.96	5.80	2.12	0.15	0.10	8.96	20.36	31.90	8.94	2.60
76	0-20	Aciq boz	min	0-20	3.08	16.75	1.50	0.97	0.06	0.09	1.53	3.46	10.93	2.68	0.12

The table shows the calculation of humus reserve for light grey soils of the Kura-Araz lowland by the above formula using the formulas and functions of EXCEL "Table 6".

Table 6.

Calculation of tons of light grey soils in the Kura-Araz lowlands to a depth of 0-20 cm

STDEVA | =(G6*F6*2000)/100

	A	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
2	Torpaq yarim tipleri	Dərinliklər	Torpaq yarim tipleri	Torpaq yarim tipleri yeni	Sıxlıq	humus	t/ha humus	əsas şkala humus	ümumi azot	t/ha azot	əsas şkala azot	ümumi fosfor	t/ha fosfor	əsas şkala fosfor	Udulmuş əsasların cəmi mq/ekv	əsas şkala UƏC mq.ekv/ha
3								0-20			0-20			0-20		0-20
4	Tünd boz-çəmən	0-20	Tünd boz-ç	Tünd boz-ç	1.19	3.60	85.68	100.00	0.20	4.76	100.00	0.27	6.426	100.00	26.49	100.00
6	Aciq boz	0-20	Aciq boz	Aciq boz	1.25	1.44	=(G6*F6*2000)/100		0.09	2.25	47.27	0.10	2.500	38.90	19.62	74.07

The formula here is for calculating 0-20depths =(G6*F6*2000)/100. In the same way, the amount of nutrients per hectare calculated for 0-50cm and 0-100cm, for perennials, also for 0-150 and 0-200cm "Table 7-8".

Table 7.

Calculation of tonnes on hectares of light grey soils 0-50cm depth

STDEVA | =(E5*D5*5000)/100

	A	C	D	E	F	G	H	I	J	K	L	M	N	O
1	a5	a8		a13			a14			a15			a18	
2	Torpaq yarim tipleri	Dərinliklər	Sıxlıq	humus	t/ha humus	əsas şkala humus	ümumi azot	t/ha azot	əsas şkala azot	ümumi fosfor	t/ha fosfor	əsas şkala fosfor	Udulmuş əsasların cəmi mq/ekv	əsas şkala UƏC mq.ekv/ ha
3	Tünd boz-çəmən	0-50	1.27	2.89	183.52	100.00	0.16	10.16	100.00	0.22	13.97	100.00	25.82	100.00
5	Aciq boz	0-50	1.3	1.31	=(E5*D5*5000)/100		0.08	5.20	51.18	0.09	5.85	41.88	18.72	72.50
6	Acıq boz-qəhvəyi	0-50	1.26	1.42	89.46	48.75	0.10	6.30	62.01	0.18	11.34	81.17	23.96	92.80

The formula for counting tone per hectare for 0-50cm =D5*E5*5000/100.

Table 8.

Calculation of tons per hectare of light grey soils in the Kura-Araz lowlands to a depth of 0-100 cm

STDEVA =H6/85.68*100

Torpaq yarim tipleri	Dərinliklər	Torpaq yarim tipleri	Torpaq yarim tipleri yeni	Sıxlıq	humus	t/ha humus	əsas şkala humus	ümumi azot	t/ha azot	əsas şkala azot	ümumi fosfor	t/ha fosfor	əsas şkala fosfor	Udulmuş əsasların cəmi mq/ekv	əsas şkala UƏC mq.ekv/ha
							0-20			0-20			0-20		0-2
Tünd boz-çəmən	0-20	Tünd boz-ç	Tünd boz-ç	1.19	3.60	85.68	100.00	0.20	4.76	100.00	0.27	6.426	100.00	26.49	100.0
Aciq boz	0-20	Aciq boz	Aciq boz	1.25	1.44	36.00	=H6/85.68*100		2.25	47.27	0.10	2.500	38.90	19.62	74.0
Açıq boz-qəhvəyi (şabalıdı)	0-20	Açıq boz-q	Açıq boz-q	1.2	1.60	38.40	44.82	0.12	2.88	60.50	0.20	4.800	74.70	24.62	92.9

The formula to convert tons per hectare for 0-100cm =H6/85.68*100.

After conversion per ton of hectare, the average scores for 0-20, 0-50,0-100 "Table 9-11" calculated.

Table 9.

Calculation of the average score by depth 0-20 cm

STDEVA =(E6+H6+K6+N6)/4

№№	Torpaq tipleri	humus, t/ha, 0-20	humus, t/ha, 0-50	humus, t/ha, 0-100	azot, t/ha, 0-20	azot, t/ha, 0-50	fosfor, t/ha, 0-20	fosfor, t/ha, 0-50	UƏC mq.ekv/ha	UƏC mq.ekv/ha	UƏC mq.ekv/ha	Orta bal 0-20	Orta bal 0-50	Orta bal 0-100	Yekun orta ballar
1	Dərinliklər	0-20	0-50	0-100	0-20	0-50	0-20	0-50	0-20	0-50	0-100	0-20	0-50	0-100	
2	Aciq boz	42.02	46.40	46.64	47.27	51.18	38.90	41.88	74.07	72.50	61	=(E6+H6+K6+N6)/4		54	52
3	Açıq boz-qəhvəyi (şabalıdı)	44.82	48.75	55.66	60.50	62.01	74.70	81.17	92.94	92.80	78	68	71	67	69

The formula for calculating the average 0-20 cm depth of light grey soils in the Kura-Araz lowland =(F6+I6+L6+O6)/4.

Table 10.

Calculation of the average score 0-50 cm depth

STDEVA =(F6+I6+L6+O6)/4

№№	Torpaq tipleri	humus, t/ha, 0-20	humus, t/ha, 0-50	humus, t/ha, 0-100	azot, t/ha, 0-20	azot, t/ha, 0-50	fosfor, t/ha, 0-20	fosfor, t/ha, 0-50	UƏC mq.ekv/ha	UƏC mq.ekv/ha	UƏC mq.ekv/ha	Orta bal 0-20	Orta bal 0-50	Orta bal 0-100	Yekun orta ballar
1	Dərinliklər	0-20	0-50	0-100	0-20	0-50	0-20	0-50	0-20	0-50	0-100	0-20	0-50	0-100	
2	Aciq boz	42.02	46.40	46.64	47.27	51.18	38.90	41.88	74.07	72.50	61	51	=(F6+I6+L6+O6)/4		52
3	Açıq boz-qəhvəyi (şabalıdı)	44.82	48.75	55.66	60.50	62.01	74.70	81.17	92.94	92.80	78	68	71	67	69

The formula for calculating the average score 0-50 cm depth of light grey soils in the Kura-Araz lowland =(F6+I6+L6+O6)/4.

Table 11.

Calculation of the average score 0-100 cm depth

STDEVA =(G6+P6)/2

№№	Torpaq tipleri	humus, t/ha, 0-20	humus, t/ha, 0-50	humus, t/ha, 0-100	azot, t/ha, 0-20	azot, t/ha, 0-50	fosfor, t/ha, 0-20	fosfor, t/ha, 0-50	UƏC mq.ekv/ha	UƏC mq.ekv/ha	UƏC mq.ekv/ha	Orta bal 0-20	Orta bal 0-50	Orta bal 0-100	Yekun orta ballar
1	Dərinliklər	0-20	0-50	0-100	0-20	0-50	0-20	0-50	0-20	0-50	0-100	0-20	0-50	0-100	
2	Aciq boz	42.02	46.40	46.64	47.27	51.18	38.90	41.88	74.07	72.50	61	51	53	=(G6+P6)/2	
3	Açıq boz-qəhvəyi (şabalıdı)	44.82	48.75	55.66	60.50	62.01	74.70	81.17	92.94	92.80	78	68	71	67	69

The formula for calculating the average 0-100 cm depth of light grey soils in the Kura-Araz lowland =(G6+P6)/2.

For statistical analysis of the soil data under study, we also used Excel functions - "AVERAGE", "COUNT", "DEVSQ", "SQRT", "MIN" and "MAX".

CONCLUSION

The mathematical processing of the soil data for soil appraisal conducted using the capabilities of Microsoft Excel spreadsheets. The mathematical-statistical analysis conducted using the existing mathematical-statistical formulas and the inbuilt Excel functions. By the program average numbers of soil indicators, conversion of substances in tons per hectare calculated, average scores for layers 0-20, 0-50, 0-100 calculated. In the mathematical-statistical analysis used Excel functions. - "AVERAGE", "COUNT", "DEVSQ", "SQRT", "MIN" and "MAX". Developed a calculation method using formulas and built-in Excel functions - arithmetic mean, M, % , number of observations, n, maximum value of observations, minimum value of observations, maximum deviation from arithmetic mean, minimum deviation from arithmetic mean, sum of squared deviations from arithmetic mean, sum of squared deviations under the root, standard deviation, δ, error of arithmetic mean, m, error of arithmetic mean, m, coefficient of variation, C, precision index P, %, degree of reliability, t.

RESULTS AND DISCUSSION

To create an information database on soils of the Kura-Araz Lowland, we have collected the results of soil analyses in MS Excel tables. The database includes the following parameters: country, region, districts, soil types, soil sub-types, soil section number, geographical coordinates of soil sections, depth of soil sections in centimeters by genetic horizons and results of soil analyses: granulometric composition, %, including silt, <0.001mm, physical clay, <0.01mm; hygroscopic moisture, %; humus, %; gross nitrogen, %; gross phosphorus, %; CaCO3 by CO2, %; pH of water suspension; N/NH3, mg per 1 kg soil; N/NO3, mg/kg 100g soil; absorbed Na, mg-eq. , volumetric whole soil - g/cm3, specific whole soil - g/cm3, porosity of soil, %; gross potassium K2O, %; CO3, mg-eq. per 100g of soil; CO3, %, HCO3, mg-eq. ; HCO3, %, Cl, mg-eq. per 100 g soil; Cl, %, Na+Ka, mg-eq. per 100 g soil; Na+K, %; solid residue, %; dry residue, %; sum of absorbed bases Ca+Mg, Ca, Mg, mg-eq. ; dry residue, %.

The soil information database used to decide stocks of fertility indicators, integrated agronomic characteristic, fertility modelling, yield forecasting, appraisal, agroecological assessment, soil fertility management and correct crop placement. Data processing using Microsoft Excel spreadsheets for Windows gives soil data an informational, dynamic, up-to-date and mobile character, as well as accessibility for spatial analysis and GIS mapping.

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ENVIRONMENTAL ASSESSMENT STUDY OF LAKE MASAZIR

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The natural resources that nature provides to us meet the needs of human beings. Generally, natural resources are components of nature that humans use in their life and economic activities. How much of our natural resources are useful today? But can such wealth be preserved today? Unfortunately, the answer is no. Such resources must be protected and passed down from generation to generation. However, our natural resources, rivers, and lakes are being polluted, drained, and destroyed day by day. We know that reservoirs are destroyed because of heavy pollution of rivers. At present, the water quality in the lakes is quite low, even not suitable for meeting technical needs. According to the chemical composition and types, pollution of groundwater and lakes occurs by bacteriological, radioactive and thermal ways. These include household waste and wastewater. Thus, in order to prevent the pollution of the Caspian Sea, lakes and water bodies, which are the natural resources of the Republic of Azerbaijan, a large number of projects are needed to carry out cleaning works by applying modern technologies in the world.

Keywords: *contaminated area, environmental protection, mud bath, salt reserve, unsanitary, wealth in the lake*

INTRODUCTION

One of the treasures of Azerbaijan is the Salt Lake near the village of Masazir, located 21 kilometers from Baku, on the Absheron Peninsula. This area is known as Masazir Lake. It has a pretty view. The pink salt lake, which attracts tourists in Azerbaijan, is charming. As this lake is located on the Absheron peninsula, close to Masazir village, it is a convenient place for tourists. From this point of view, visitors to Azerbaijan are more likely to visit the lake. There is no flora and fauna in the lake because of the high level of salt in the water. But, let's take a look at this lake.

Masazir Lake, located in Absheron, is known as a rich source of cooking salt from ancient times and has been extracting salt from it since the nineteenth century. This lake is often called “Dead Sea of Azerbaijan” and it is not surprising – because it is the most salty lake in Azerbaijan. The lake is unusual in appearance - the water in it is bright pink (due to its high chloride and sulfate concentration) and the entire coast is covered, as if, with white snow, in fact it looks like it is covered with numerous salt crystals. Because it is so salty, it has no flora and fauna, no beaches unlike the Dead Sea, and no therapeutic salt baths. There are only nine such salt lakes in the world, and so Masazir Lake, with a depth of about 1735 million tons of salt reserves, is unique. And it can rightly be considered a national wealth! Previously, salt was produced here by a semi-artificial method, but recently a salt production plant has been operating on the shore of the lake (production is estimated at 90,000 tons per year).Recently, ecologists in Azerbaijan have started to get excited - sewage water from nearby residential villages as well as waste water from various enterprises built on the edge of the lake are flowing into the lake. Our research team was interested in the environmental and the truth of this problem affecting the health of our citizens. After researching it, we found a real problem (sewage drains, very polluted beach, liquefied black mud). We regularly took samples throughout the year, gave water tests and received results that exceeded MPC standards very well. For example, this indicator exceeded the norm in oil and oil products by 1.5-14 times, in phenols by 3-32 times, in detergents by 2 times, and by surfactants by 3-4 times. Biochemical changes are reflected in 2-4 times of ammonium nitrogen, 2-5 times of nitrites, 1.5-5 times of phosphates, and 1.5-7 times of ammonia.COD lakes' oxygen regime is also not satisfactory. Based on the review and our laboratory studies, we propose a method of purification of water contaminants by combined cleaning: Al2 (SO4)3 coagulation and photocatalysis with TiO2 titanium dioxide nanoparticles. [1,2,3,4,5]. Titanium oxide generates light (ultraviolet), free-load carriers - negative electrons and positive cavities (holes) while absorbing light quantum energy of more than 3.2 eV (this is light that wavelength is less than 385 nm-ultraviolet light). The electrons and holes that enter the surface of TiO2 enter into oxidation-growth reactions with water and form strong oxidizing agents (O2-, -OH and radicals). The formation of such particles turns the surface of TiO2 into a very strong oxidizing agent, which allows to break down harmful substances into harmless H2O and CO2 through photocatalytic oxidation. In order to obtain photocatalytic properties, TiO2 must have a nano-sized structure. TiO2 is a non-toxic, environmentally clean, economically accessible and cost-effective functional material with a wide range of applications. In its pure form, it occurs in nature as rutile, anatase and brookite minerals. Significant: There are deposits of rutile crystal in Azerbaijan (Kaputjugh mountain, Zangazur range). Every year, as the lake dries during the summer season, the color of the lake turns into pink due to the high content of salt, chloride and high concentration of sulfate. The salt produced here is obtained by natural methods, through various stages,and come to our table. This lake also has healing mud. There are many mud volcanoes in Azerbaijan. Some of them are in Gobustan, Absheron peninsula, Absheron archipelago, Southeast Shirvan plain, Shamakhi district, lower suburbs of Agsu river, Siyazan and Shabran districts. There are more than 350 sources of mud volcanoes in Azerbaijan. Mud volcanoes are also natural resources, as they are rich in chemical and organic composition, they are used for treatment purposes. Certainly, not all volcanic mud can be used for treatment. Treatment mud is mainly silt mud. The mud is considered suitable for treatment, if the amount of compounds as iodine, bromine, hydrogen sulfide, naphthylene is too much, The muds of Masazir and Zigh lakes, hill (volcanic) muds are healing muds. Nine of the volcanic muds in Azerbaijan have been confirmed to have therapeutic properties, but they are rarely used for treatments.

Mud bath

The mud can't be pre-packaged and stored because it gets dry the next day. If you want a mud bath, you have to order half an hour in advance. You can't take a bath with every mud. A sample of the mud is taken and inspected in the laboratory for the mud bath. Iodine is added to the recommended mud. Mud is kneaded with iodine and poured into baths. Depending on the desire, it is possible to lie in the baths for hours or sunbathe by rubbing the mud on the body. Masazir Lake has been used extensively in the treatment of resorts for nearly 40 years, but in the past 10 years, the treatment process has ceased since salt was produced in the lake.

Spring enriched with iodine

There is a spring, rich with iodine, about 100 -150 km away from the lake. Iodine water boils out of the ground. However, the water is cold. Water is useful for sore throats, pharyngitis, goiter and asthma. The water of the spring flows into the holes. Those who go to "Salt Lake" can visit the spring and drink its water.

Salt lake

The salt lake is surrounded by 7 hectares of land. 300 tons of salt per day and 50,000 tons of salt per year are processed from the salt lake. The salt reserve of Masazir lake is about 1735000 tons. An additional road was built from the Masazır - Novkhani highway to the factory to transport the salt produced from the lake. Blocks along the coast have been arranged in order to protect the soil layer and facilities from water.

Salt processing plant

Table salt is extracted from the Masazir Salt Lake in an artisanal way. Lake Masazır is located between Novkhani and Masazir villages. Masazir Salt Refinery was built here. If we take a look at this lake, we will see that the coast of the lake, which is red in color, is covered with white salt. From 1813 until today, salt has been regularly extracted from the Masazir lake. Since the 19th century, it has been famous for its large salt deposits. Previously, salt was obtained by artisanal method. But later, a salt extraction plant started processing in the area.

Pollution and unsanitary

We know that the "Salt Lake" located on the side of the Hovsan-Zigh highway has become a source of disease. The "Salt Lake", which is our source of healing, is now also known as the source of disease. It is unavoidable to get skin disease after bathing and mud bathing in the salt lake.

Humans are one of the factors that pollute the lake. Because people throw non-perishable water containers and cellophane bags into the lake area. There are those who go to Salt Lake and face with problems. Since the baths are rusty, delays in cleaning the baths and infectious diseases are unavoidable due to the large number of people standing in the queue.

The lake along Masazir-Novkhani road has been fenced, but there is no protection in the lake on the side of the salt plant from “Kurtulush-93” and “Zangilan” settlements. Therefore, any person can easily approach the shore of the lake and be in contact with it. And people are coming to the lake for treatments during the summer. There is no antisanitarianism in getting people to the lake and walking for 10 to 15 minutes into the water up to the knee. However, the factory managers have forbidden to approach this lake, to enter it and to swim. 17 sewage lines have been opened from the nearby houses and the factory to the salt lake, the sewage is discharged into the lake, and the salt is processed and sold, and reaches our tables from here. It is true that people are forbidden to enter the lake by calling it antisanitary, but the sewage discharged into the lake is not viewed as a source of antisanitary water. Wastewater is continuously discharged into the lake from the residential areas “Zangilan” and “Three Storeys” called “Kurtulush (Salvation)” near the lake, There is no sewage system in this area, because the construction of the sewage line requires financial resources. This situation causes serious concern both from the point of view of ecology and the safety of salt. It seems that it is impossible to happen in the next few years. Analysis is taken from that salt lake per hour and analyzed in the laboratory of the plant. If that salt meets the standard, it is processed, if it does not meet the standard, it is poured back into the lake as raw salt. As a result, the water of the lake is considered polluted due to the sewage discharged into the lake. Lake Masazır, which has an area of

10 km², belongs to the group of brackish lakes due to the mineralization of its water. The salt reserves of the lake are about 1735 million tons.. Until about 100 years ago, many of the lakes were salt depositors and the bottom sediments had balneological importance for the treatment of certain diseases. However, today, the production of table salt and the use of bottom sediments for balneological purposes are mainly present in Lake Masazir. Other lakes are considered to have lost their mentioned qualities due to their pollution. Chemical analysis and scientific research revealed that since the Masazir lake has been gradually polluted in recent decades, its ecological conditions are getting worse. The water in the lake smells strongly of sewage and the water is black, the water in the salt lake continues to dry up. There is a very strict control over the removal of salt from the lake, but there is no control over the cleanliness and protection of the lake from sewage.

2.Experimental details

The purpose of the work: Purification of the water of Lake Masazir, which is a source of edible salt, from pollution of domestic and industrial wastewater by photocatalysis based on titanium dioxide (TiO2) nanoparticles.

Research progress: The work process used: - 2% aluminum sulfate solution (Al2(SO4)3); - titanium dioxide powder TiO2 P25 with a particle diameter of 21 nm, crystal structure and surface area of 50 m2/g; - magnetic stirrer; - UV lamp (Horoz HL 160)

Coagulation process was carried out by adding 10 ml of 2% aluminum sulfate solution to 1000 ml of test water and stirring continuously for 30 minutes (at a speed of 420 rpm). After coagulation, the water is filtered through membrane filters (membrane 0.45 μm) to remove residual impurities.

Titanium dioxide TiO2 P25 (from 15 to 200 mg) was added to a 300 mL volume of obtained water sample (from 15 to 200 mg) with constant stirring on a magnetic stirrer at 420 rpm. The water was then purified by photocatalysis (UV lamp) for a previously found optimum time of 240 minutes. After the indicated irradiation time, the samples were kept for 1 day to settle the solids and analyze the concentration of organic compounds in the liquid. [cm. badge. 1.2]

Results:

1. Cleaning, using Al2(SO4)3 coagulant, effectively reduces parameters such as electrical conductivity, salinity, TDS, TSS, COD and especially turbidity, making the polluted water of Masazir Lake more suitable for further treatment.
2. Time is arranged to ensure the optimal concentration of TiO2 and the increased formation of hydroxyl radicals.
3. Water purified from organic pollutants up to 85 percent at a concentration of TiO2 (0.5 g) under the influence of ultraviolet light for 240 minutes.
4. Our method is more efficient and environmentally cleaner than other cleaning methods!
5. The laboratory application of combined cleaning (coagulation and UV/TiO2 photocatalysis) of polluted water has shown suitable prospects for water purification in other water objects of Azerbaijan.

CONCLUSİON

Protecting the ecological balance of the lake is important for us, and we must implement important projects to save the lake.

Special containers are needed for litters on the edge of the lake. There is a need for strict supervision, a sanatorium-type center, a large number of cleaners, and manpower.Water and mud have their own expression. That's why, both water and mud need to be studied. All patients should be infomed in details.

Masazir Lake is the treasure of Azerbaijan people, ecological pollution of the lake, which has such unique natural resources, cannot be allowed.

There are no signs prohibiting entry to the area, but this is a state reserve, state reserves are usually provided with warning signs.

Recommendations:

- cleaning the shoreline of the lake from garbage and sewage;

- compel every industrial enterprise to carry out its own treatment of waste water discharged into the lake as per MPC standards;

- to build a centralized sewage system for domestic waste water from nearby settlements.

- finding an opportunity to use purified water for technical purposes (watering plants, washing cars, extinguishing fires);

- to study the natural (chemical) composition of the salt of the lake in order to create a treatment-health complex on its shore.

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THE PROBLEM OF ESTABLISHING A SOIL QUALITY MONITORING SYSTEM IN AZERBAIJAN

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A new model of agrochemical service and soil quality monitoring systems, which are completely out of order due to the collapse of scientific-methodical and organizational bases in our country, should be developed in accordance with modern world experience and international standards. The most unpleasant situation in land use in the country today is that extensive soil surveys and analyzes have not been carried out in any region or district for the last 30-40 years, fertilization studies are carried out blindly without any scientific basis. This ultimately increases the concentration of any element that enters the soil through fertilizer, leading to soil pollution or weakening of the soil's nutrient regime due to its scarcity. The large scale of this process is very dangerous in terms of maintaining soil fertility.

Key words; *Soil monitoring, nutrients, Soil fertility, certification.*

INTRODUCTION

In today's world, preservation of soil resources and increase of soil fertility is of not only local but human importance. Despite the fact that the volume of all land areas used in agriculture is 10% of the dry part of the Earth, the quality of 70% of these lands has deteriorated and needs reclamation.

A similar situation is typical for our country and a decision should be made to establish a State Soil Monitoring system in the country. A new model of the land control system developed on scientific basis can be the basis for making this decision.

Azerbaijan is one of the countries in the world with limited land resources. Although the total area of the country's agricultural land is 4756 thousand ha, only 1808 thousand ha of it is suitable for cultivation. Solving this problem requires a serious scientific and organizational approach.

The area of saline soils in the country is about 1.5 million ha, and it appears that about 50% of it is agricultural land. On the other hand, 584,000 hectares of land in the territories occupied by the Armenian invaders had been out of agricultural circulation for more than 25 years.

In the last 30-40 years, there has been a reduction of humus in the planting layer of our soil (about 20-30%), and the density of the planting layer has decreased to a depth of 0.2-1.5 cm. Fertility decreases rapidly as the amount of nutrients removed from our soil is not "compensated" every year. According to the research data, in the last 20-25 years, the amount of humus in the 1-meter layer of our soil has decreased by 15-25%, and there has been a great shortage of elements assimilated in the food regime. [Babayev V.A., 2018. p. 41-57]

The most unpleasant situation in land use at the country level is that in no region or district in the last 30-40 years have large-scale soil studies and analyses been carried out, so fertilizing works are carried out blindly, without any scientific basis. This ultimately leads to soil pollution by increasing the concentration of any element that enters the soil through fertilizer, or to the impoverishment of the soil's nutrient regime due to its scarcity. [Zamanov P.B. 2013, p. 26-27]. The large scale of this process is very dangerous in terms of soil fertility protection. Therefore, it is one of the strategic issues to carry out comprehensive agrochemical research without delay on the national scale, and to certify the land areas under crop rotation. The basic data of the new model should include the following aspects: [Babayev A.H., 2012, p. 188-202]

• Studying the level of provision of nutrients;
• Assessment of soil fertility factors;
• Evaluation of ecological-toxicological condition;
• Assessment of the sanitary condition;

• Preparation of the current and long-term management plan of land fund use in the region based on the research results;

After drawing up the passports of cultivated areas, land management plans should be developed.

1. Brief analytical analysis of the proposed problem

Soil fertility control is a matter of strategic importance in the developed countries of the world. Institutions dealing with soil fertility management in these countries regularly implement a single scientific and technical policy to control the quality of soils in the country.

After the adoption of the Law "On Soil Fertility" in the Republic of Azerbaijan in 1999, although the work to be done in the direction of restoration, increase and protection of soil fertility is assigned to the State Land and Mapping Committee, the Ministry of Agriculture, the Ministry of Ecology and Natural Resources, and the Reclamation and Water Management Agency by the order of the country's president, there is no precise distribution of authority functions between them and the lack of special purpose soil laboratories under these executive bodies has not changed the current situation at all. [Babayev A.H. 2019, pp. 412-425]

Some studies have been carried out on the nutrient status of soils under different agricultural products and fertilization methods in different regions. The conclusion of the scientists is that the agricultural system of the former Soviet republics after the agrarian reforms had the following similar features: [Babayev A.H. 2019.p. 412-425.]

1. Weakening of the material and technical basis of the agro-industrial complex;
2. Degradation of land resources;
3. Poor chemicalization of agriculture;
4. Infrequent use of organic fertilizers and organic wastes in agricultural practices;
5. Deterioration of the top layer of soil cover by mechanical effects as a result of various construction and repair works;
6. Removal of large amounts of land from agricultural circulation.

If we compare the main indicators of agriculture in Azerbaijan in 1981 with those of 2010, we will see that responsibility and total production have decreased many times. (1150.8 thousand tons of wheat; 831.2 thousand tons of cotton; 1million 707.3 thousand tons of grapes; 849.5 thousand tons of vegetables; 96.4 thounsand tons of melon plants; 26 thousand tons of green tea, and etc.) Thus, in 2010, compared to 2005, despite the 20.5% increase in the cultivated area of grain, the production decreased by 5.9% due to the 21.8% decrease in productivity. During this period, the cotton cultivation area was 73.1%, production was 81.6%, productivity was 27.4%, these indicators of tobacco are respectively 51.8%, 54.9%, 6.6%, for potatoes, it decreased by 6.9%, 11.9% and 2.7%. [Mammadov G.Sh., Khalilov M.Y., Mammadova S.Z. Agroecology. Baku, 2010, part p. 154-167]

The conducted analysis shows that the main reason for the decrease in total production and productivity in agriculture (along with the combined effect of other factors) is related to the decrease in soil fertility in the conditions of small and small land use in the country and the existence of primitive technologies in land use that are not based on scientific foundations. [Ismayilov T. 2009, p. 101-105.]

2. Scientific-methodical approach to solving the problem

The task of ensuring the sustainable development of human society in the modern world depends primarily on the solution of the strategic problem of ensuring the efficient use of existing land resources, protection and restoration of land cover.

Taking this as a basis, the concept of soil monitoring should be developed for the purpose of protecting other categories of land resources, whether important for agriculture or organically related to this production area in terms of developing agriculture. The main essence of this concept should be based on the creation of a state monitoring system for all aspects mentioned below: [Mammadov G.Sh., Mammadova S.Z., Shabanov C.A. 2017, p. 161-164.]

- To create a data bank related to all the land construction works;
- Data from large and medium-scale soil surveys;

- The relevance of digital topographic maps in vector (arrow) format;

- Information about the use of fertilizers and chemical reclamation in land areas;

- Agrometeorological data reflecting the dynamics of climate change and the bioclimatic potential of soils;

- Data of the remote control system through the Earth's Artificial Satellite;

Necessary information regarding the condition of agricultural land should be as follows:

- Indicators of soil fertility;

- Information about the state of land use;

- Information about soil contamination with heavy metals, pesticides, oil products, radionuclides and other pollutants;

- Information about the negative processes occurring in the soil (erosion, salinization, desertification, etc.);

- Information about the implemented agrochemical, reclamation and agrotechnological operations;

- Information about the results of state land control to ensure soil fertility.

On the basis of all this database, the most efficient method to implement state land control is land certification.

During the years of the Soviet Union, land degradation developed rapidly in all republics, since no measures were taken towards land passport and certification in the state control system based on a certain amount of soil and agrochemical research.

In civilized countries, a land passport serves the following purposes: [Фомин Г.С., Фомин А.Г. Почва. 2014, стр. 17-38.]

- Controlling the level of soil pollution and degradation;

- Implementing precise measures for land protection;

- İncreasing the fertility of the lands and using them effectively.

Certification is a guarantee of how to fulfill the technical regulations and contractual conditions required within the legislative acts of land use, and according to this legal act, all aspects of soil quality preservation (agrochemical-agronomic, technological, ecological, sanitary-epidemiological, etc.) are controlled.

After certification of the land is completed, a land management plan is drawn up for the plots to increase soil fertility and ensure normal nutrition of plants. In this plan, it serves the purposes of providing better conditions for the development of agricultural plants, preventing soil degradation and eliminating the causes of environmental pollution. The entire complex of current and prospective measures should find expression in this plan. [Babayev A.H. 2012, p. 188-202.]

It is important to apply the quality management system to the business practice of analytical services. It has already become the norm in most developed countries. Government bodies of these countries encourage the implementation of ISO 9000 standards. The number of independent audits in enterprises with ISO 9001 compliance certificate is drastically reduced.

ISO 10381-1 specifies the basic principles that should be followed when designing sample selection programs for the following purposes:

a) Control of the quality of the known soil system for the adoption of operational measures to prevent pollution;

b) Soil quality control to detect long-term changes;

c) Identification of pollution sources.

Before applying the sample selection program, the location of the samples, the number of replicates and the processing methods should be determined by defining the selection tasks, as well as the decision on the selection of the equipment for the analysis should be made. It is necessary to take into account the desired level of accuracy, as well as the method of recording results, maximum and minimum results. In addition, it is necessary to specify the list of parameters to be determined. At the same time, methods of conducting analyzes should be determined, which in turn interact with safety techniques for sample selection and analysis preparation technology.

As a rule, the selection of soil samples is carried out in the study area with the same level of pollution. If necessary, field imaging of samples is carried out in accordance with the standard. In the case of general contamination of the soil, the selection locations, numbers and coordinates of the samples should be marked on the coordinate grid.

Sampling locations on the same level of contaminated soil are marked with the same distance coordinate grid. If there is a possibility of uneven soil pollution, in this case, marking is done taking into account the distance between the grid lines, the distance from the source of pollution and the dominant direction of the wind.

4. The expected results

Creation of the State Quality Monitoring System of agricultural lands in Azerbaijan is of practical importance in terms of the aspects mentioned below: [Babayev A.H., 2012, p. 188-202]

- implementation of a single scientific and technical policy towards soil conservation, efficient use of soils, preservation of productivity, protection of ecological security of soils;
- development and implementation of projects of national importance to increase the productivity of agricultural lands;
- to conduct soil-pesticide, phytosanitary and ecotoxicological research on all land categories suitable for agriculture;
- development and implementation of recommendations for the implementation of agrochemical, phytosanitary and reclamation measures for land users, farmers and land tenants;
- establishment of quality monitoring of agrochemical, phytosanitary and breeding measures carried out at the country level;
- organization of monitoring to control the environmental safety of fertilizers and toxic substances used in agriculture in the country;
- organization of information-consultancy studies on the protection of soils, increasing their productivity and the use of agrochemical tools within the country;
- to organize the work of soil-agricultural chemicals laboratories in the regions and to lead agricultural chemicals researches.
- a suitable environment will be created for the development of personal entrepreneurial tendencies;
- creating a moral and psychological mood, such as close commitment to agriculture and its profitability, will promote sustainable development of rural areas;
- the employment level of the rural population will increase, migration to cities and abroad will decrease at a reasonable rate;
- the correct and scientific use of land areas will increase yields per hectare and create favorable conditions for soil fertility improvement and conservation;
- training of land users and small farmers will create conditions for the restoration of ecological stability in the region and the region, as well as form the habits and skills of producing products within the framework of uniform state standards;
- In addition to improving the presentation of quality and environmentally friendly products to the population, the competitiveness of domestically produced products will increase, and the products exported to the foreign market will increase the income of the producers by 30-70%.

Summary

Implementation of the new system in the territory of the country following the relevant decision of the AR Council of Ministers is aimed to the management of agricultural land productivity, protection of soils from adverse processes (erosion, salinization, pollution, graying, lack of nutrient balance, drying of the crop and subsoil layer, etc.), environmentalization of agriculture will create new opportunities in the implementation of state control for the AR Ministry of Agriculture, Ministry of Ecology and Natural Resources, State Property Committee and other management bodies to manage strategically important issues such as regulation of biological cycle in different natural-climatic zones.

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IN CITY AND REGIONAL PLANNING PROBLEMS APPLICATION OF REMOTE SENSING DATA

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With the development of information technologies, means of communication, the automation of the processes of performance of their functions by territorial bodies, the idea of the information system as an independent management tool is formed. The number of information systems used to manage urban areas in Azerbaijan has increased significantly since the beginning of the 20th century. On a global scale, this phenomenon is connected with the transition of human civilization from post-industrial society to information society in the process of development.

In a broad sense, the information circulating in the city as a complex system constitutes an additional information sphere of the city's culture, economy, and everyday life. Information organized through computer, mobile, radio-electronic and other technologies participates in all urban processes.

Key words*: geographic information systems, map, urban planning.*

INTRODUCTION

Monitoring of infrastructure development and land use in the region (including the city) is necessary to assess the population, plan directions for the development and expansion of the city, and determine the zones of existing and potential environmental violations.

High-resolution satellite images solve many problems of studying and mapping cities. First, they are used to account for the rapidly changing dynamics of urban boundaries, the increase in the area of cities and the development of highways, and the growth of urbanization in many parts of the planet. Attempts are made to determine the population in cities on the basis of empirical relationships between the number of population and the area of different types of cities, and the use of urban land is studied.

According to the classical understanding of the role of information in the management process, any management decision is made based on the collection and analysis of certain information. The quality, reliability, and sufficiency of information determine the quality of the decision. In this regard, information provision is the most important direction of management activity.

In most cases, the information system is a database maintained by the territorial body through a special department, institution or a group of specialists of the existing department. The structure of the information system includes:

1) Administrators;
2) Users;
3) Information consumers (customers);
4) Database (set of files);
5) Software (database management system - DMS) and technical equipment (computer and other office equipment);
6) Archive of documents;
7) Technological relations between them.

Administrators deal with tuning technological processes, users work directly with DMS. Information consumers who create requests to the system, submit documents for placement in the system, and all persons who interact with the system can be considered external subjects, not part of the system. However, in most cases, access to the information system is a legal obligation or economic necessity for consumers, as well as created by normative legal acts.

MATERIAL AND METHODS

General classification of urban information systems is an actual scientific problem, but its solution is unlikely to remain complete for a long time. Information systems related to the urban area are constantly developing, there are mechanisms of interaction between them, the functions, structures and names of the systems are changing. They also talk about the life cycle of the information system, which includes the stages from the formation of the system to its termination, comparing it to the life cycle of the project. Currently, the main information systems operating in the cities of Azerbaijan include the following: (Babaea A. D., Huseynov A. I., 2019.; Babaea A. D., Huseynov A. I., 2019)

1) at the level of state territorial administration:

– State Cadastre of Immovable Property (SCİP);

– Unified State Register of rights to immovable property and transactions with it;

- the state fund of information obtained as a result of land management;

2) At the regional level of territorial administration:

- Regional information systems (by decision of the authorities of the Republic of Azerbaijan);

3) At the local level of territorial administration:

– Information system for urban development activity (İSUDA);

- Information systems of municipalities (by decision of the municipality).

Traditionally, information provision tasks for territory management were solved with the help of cadastral information systems. In this system, when the entire data set on the territory is divided into blocks for each object, it is characterized by data-object organization. (Babaea A.D. Huseynov A.I.. 2019,)

Information systems providing urban planning activities are a repository of approved urban planning documents for the territory of the municipality. Before that, the executive power bodies of the constituent entity of the Republic of Azerbaijan conducted the state urban planning cadastre, which differed in object-by-object accounting - the objects of urban planning activity were taken into account. (Chandra A. M., Gosh S. K. 2008)

"About information support for urban planning activities" determines the structure, formation and storage procedure, as well as the procedure for presenting the information contained in the information. (Ismailov A.I. 2004). Based on the request of state bodies, local self-government bodies, individuals and legal entities, the system structure includes 9 main sections:

1) territorial planning documents of the Republic of Azerbaijan in the part related to the territory of the municipality.

2) territorial planning documents of the subject of the Republic of Azerbaijan in the part related to the territory of the municipality.

3) Territorial planning documents of the municipality, materials on their justification.

4) Land use and development rules, changes to them.

5) Documents on territorial planning.

6) Study of natural and man-made conditions.

7) Acquisition and reservation of land plots for state or municipal needs.

8) built and to be built plots of land.

9) Geodesy and cartography materials.

The following procedures are implemented in the process of maintaining the information system in order to ensure urban planning activities:

1) accounting of urban planning documents.

2) registration of urban planning documents for placement in the database.

3) placement of urban planning documents in the information fund.

4) providing information to interested parties.

The duty of local self-governing bodies is normatively defined, but unlike the State Real Estate Committee, the need to automate technological processes has not been defined. At the same time, it is necessary not only to store automated documents in electronic form, but also to automatically process various requests for documents, distinguish the right to access information, computer analysis of decisions recorded in documents, etc. (Mammadov Q. Sh, 2013.; Mammadov Q. Sh, Gojamanov M.Kh. 2013.)

Local governments can create an information system at their discretion, using local budget funds and independently determining functional, organizational, software and technical solutions. In a number of municipalities with a low application flow intensity (due to a generally low level of urban development activity), automation may not be economically feasible. The creation of an information system in the largest urban areas is justified by a significant reduction in labor costs, prevention of violations and errors. (Mekhtiev A. Sh. 1996.; Tsvetkov V.Ya. 1998.)

The development of the automation project should ensure that the system is self-sufficient at the end of a certain period of time due to the income obtained from the provision of data. As a rule, maintenance automation works are carried out by scientific and industrial commercial organizations specializing in the development of specialized software.(Pobedinsky G.G., Erukov S.V. 2004.; Serbulov Yu.S., Pavlov I.o, et al. 2005.).

In some cities, various municipal information systems used in management are currently operating. The need for their creation is determined by local authorities according to local needs and opportunities.

Creation of information systems of municipalities is carried out in the following order. The local self-governing body makes a decision on the creation of the system, determines its structure and functionality. Then, a program for creating an information system is prepared, including a description of the necessary measures, their implementation period, required resources, financial sources and responsible executives.

The main activities of the municipal information system creation (implementation) program include the following:

– development or acquisition of software;

- acquisition of necessary equipment and computer technologies;
- selection and training of personnel;
- development of technology of internal and external interaction of the system.

In the field of urban area management, it is difficult to imagine municipal and other information systems that contain information about the city in the form of maps without using geographic information (geoinformation) systems (GIS). (Rhind D. W. “1988.; Shaitura S. V. 1997.).

GIS are programs designed to process spatial data, i.e., data reflecting the position of objects or events in the urban area. GIS is not an information system in the above sense, but rather a technical solution that implements a territorial-spatial approach. In GIS, each object on the map corresponds to a record (line) in the table containing its characteristics. The use of GIS is especially important in information systems where real estate data is processed, because the most important feature of any real estate object is its location.

Each object drawn on an electronic map is represented as a point (symbol), line or polygon (polygon) defined in the vector field with its coordinates. This classification corresponds to the geographical classification of symbols on maps. The use of GIS is mainly related to geodetic work to determine the position of points and lines on the ground

The main purpose of Territorial zoning in urban planning projects is to regulate the use of land in cities and other residential areas, to shape the orderly development of cities, to eliminate overcrowding of the population and industrial areas, and to determine construction rules in this regard. Taking into account all the above, the following territorial zones have been defined:

1. Residential zones;
2. Social-business zone;
3. Recreation zone;
4. Production (industrial, scientific-production, utility-storage) zones
5. Transport infrastructure zone;
6. Engineering infrastructure zone;
7. Agricultural zone;
8. Special purpose zone;

9. Military and other regime zones;
10. Zones used under special conditions;
11. Special protected areas;
12. Reserve zone.

Table 1.

The scale of construction permitted in territorial zones is determined according to the following table

Territorial zones	Construction factor of the area	Building density factor of the area
Residential areas	0.4	1.2
Multi-storey, multi-apartment residential buildings, including:	0.6	1.6
Rebuilt	0.4	0.8
Medium-rise apartment buildings	0.4	0.6
Low-rise apartment buildings	0.3	0.6
There are plots of land next to the apartment	0.2	0.4
blocked residential buildings		
Private residential houses with plots of land in the yard	1.0	3.0
Social-business zone	0.8	2.4
Multifunctional construction		
Specialized public construction	0.8	2.4
Production zone	0.6	1.0
Industry	0.6	1.8
Scientific production	0.4	1.2
Utility-storage	0.6	1.6

Note: the construction coefficient of the area is the ratio of the area under buildings and facilities to the total area of the planned area (neighborhood); building density coefficient of the area - the ratio of the area of all the above-ground floors of buildings and facilities to the total area of the planned area (neighborhood).

Like the geographic feature in the figure below, the streets intersect to form a grid. The description of this network through GIS is important for the modeling of transport routes. The following figure shows the different objects with a new purpose, formed at the intersection of each street with the other, as a geographical object (Fiq.1).

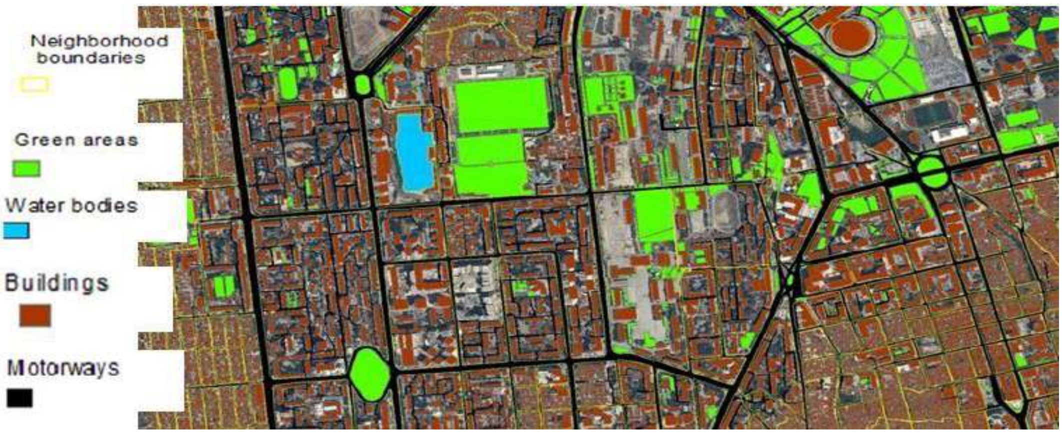
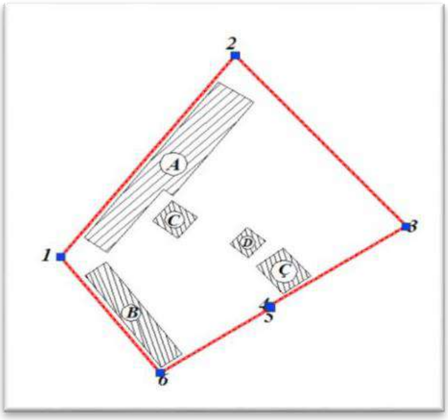


Figure 1. Communication lines on the map as a discrete linear object.



Loop Points	Loop of the boundaries of the territory coordinates of points		Corner points of boundary lines	Distances
	X	Y		
1	590311.6823	4527303.6708	1-2	90.5
2	590367.0156	4527375.2829	2-3	81.7
3	590420.1453	4527313.2432	3-4	51.6
4	590377.4311	4527284.2935	4-5	1.0
5	590378.0018	4527283.4723	5-6	41.55
6	590343.7395	4527259.9670	6-1	52.2

Figure 2. İnteraction of digital maps and tabular data in cadastral maps

GIS data includes not only geographic images, but also tabular data describing geographic objects. Some table data have a direct relationship with geographic objects and have the same field in the database. Such tables are of decisive importance in the description of geographical objects. For example, this situation is typical in the real estate cadastre. Thus, in cadastral maps, the interaction of digital maps and tabular data is necessary .(Fig.2)

Designation of underground communication lines

Designation and planning of underground communication lines as an integral part of topography and geodetic services is a very necessary work process in various cases. Before constructing buildings and structures, it is very important to know exactly where these or other underground communications are located in order to avoid large costs that may arise later. In addition to the huge costs that will arise due to inaccurate information about the locations of water pipelines, electric cables, gas pipelines, communication lines, heating networks, etc., emergency situations are also inevitable. (Babaeva A. D., Huseynov A. I., 2019).

Let's consider some features of the work of planning underground communications. These types of searches are carried out with specialized equipment. Such equipment includes high-precision measuring instruments (tacheometers, geodetic satellite receivers, levels, track finders, measuring tapes, laser distance meters).

The location of engineering networks depends on the density of the building area and the number of floors. In addition, the placement of communications depends on the size of the settlement and its design. The future development perspective of the residential area and the level of development of infrastructure facilities also affect this plan.

Using modern technologies to create a 3D map - The development of technology allows three-dimensional information about buildings to be "quickly" extracted from a satellite image. Using this technology, it is possible to create a 3D map of structures for any area on earth.

Showing the density of buildings, landscaping of residential areas, industrial zones in photographs allows to give an objective ecological assessment to urban areas.

Figure 3. It is a 3D map with the shape and height of the buildings

It should meet the demand of other institutions providing telecommunication services. Cable-sewage facilities should cover existing, reconstructed and newly built residential, social and business zones, including all main and intermediate streets. In the main streets and avenues, main cable-sewage facilities should be built or existing facilities should be reconstructed. Distribution cable-sewage network should be built in intermediate streets or existing facilities should be reconstructed. This will make it possible to create multiple alternative and circular networks over newly built facilities. At the same time, the devices should enable the operation of the networks necessary for the city's transportation, mass information of the population, video surveillance, video surveillance, security systems and the provision of various electronic services to the population in the future.

In order for the city to benefit from stable telecommunication services and to create a wider use of various services, the construction of CSF (cable-sewage facilities) should be circular and alternative.

During the construction of CSF, it is appropriate to consider the following:

1. When designing the grounding of line devices, it should be based on the norms.
2. Safety equipment and labor protection
3. The construction of cable-sewage facilities should be based on the instructions.
4. Norms of approach of CSF with other communication devices

Table 2.

Norms of approach of CSF with other communication devices

R/n	Other devices	At the horizontal level, meters	At the vertical level (at intersections), meter
1	With a sewage system	0,5	0,15
2	With drainage and water flow	0,5	0,15
3	With a heating system	1,0	0,15
4	With water system (diameter up to 300 mm and above 300 mm)	0,5 və 1,0	0,15
5	With gas line (different pressure)	1,0 – 3,0	0,15
6	With electric power cables	0,5	0,25-0,15

Table 3.

Norms of crossings for railways and highways

Types of pipes according to the material	The minimum distance from the ground surface (road surface) to the top of the pipe, meter		
	Under the tracks of the tram line	Under the tracks of the railway line	Under the highways
Asbestos and polyethylene	1,0	By pressure method, with horizontal drilling - 2,0	1,4
concrete	1,0	By making a hole -2,5м	-

Note: 1. Additional mechanical protection with the help of concrete slabs should be taken into account when laying the pipes under the railway, tramway and highway in an open method up to a depth of 0.5 meters.

2. It is not allowed to lay Polyethylene pipes on the traffic section of the streets without a protective cover.

3. The depth of the cable sewer trenches should allow to increase the capacities in this direction in the future.

Table 4.

The types of telephone wells to be used in the construction of cable sewers are indicated

Well type	The maximum capacity of the pipe blocks connected to the well	The number of channels included in the block
CSS-1	1	1
CSS -2	2	2
CSS -3	6	2
CSS -4	12	234
CSS -5	24	46
Station well CSS -1	36	-
Station well CSS -2	48	-

CSS-cable sewer stations

Note: The distance between wells should not exceed 150 meters.

In order to effectively use satellite images in GIS, it is necessary to be able to obtain information from those images. Thus, space images do not have ready-made results, these results are obtained after a certain processing process. This process of processing (interpretation) and analysis mainly consists of identification of the observed object or measurement of its parameters. Any object visible on the image and having certain characteristics can be the target of remote sensing. Here, when we say a certain feature of the object, the following is meant:

- objects can be represented as points, lines or polygons, that is, they can be of any shape;
- the objects should be distinct from each other, that is, the image should have contrast.

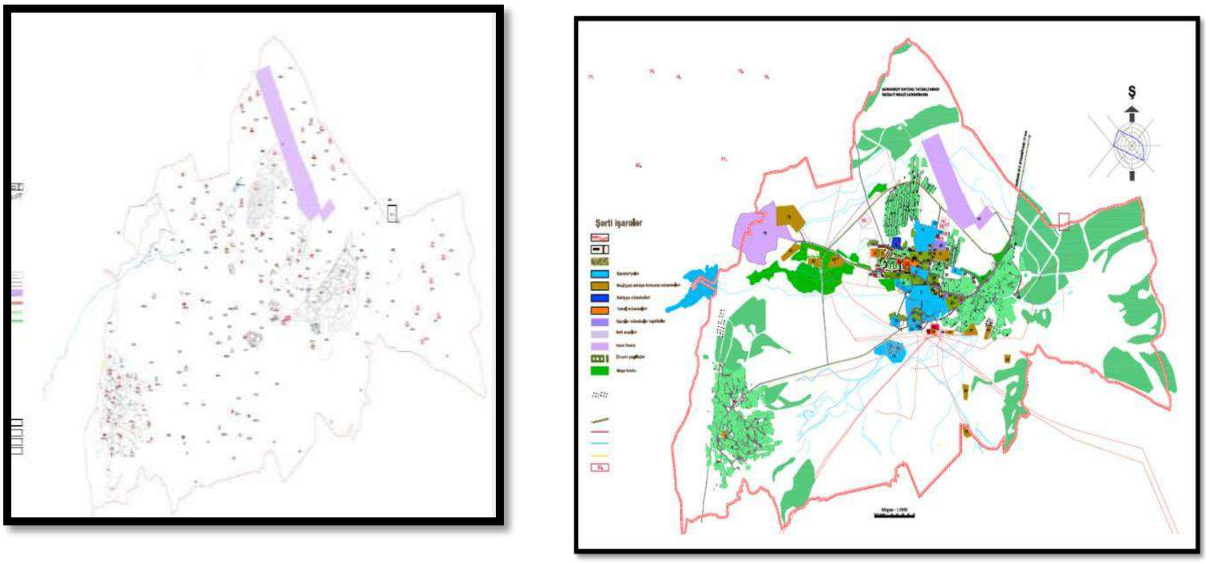


Figure 4. The scheme of division into cadastral units by city

RESULTS AND DISCUSSION

It is known from experience that most of the interpretation and identification work is done manually, but when the data is in digital format, the operations are done by computer. Digital format data processing allows to automate the process and ultimately minimize human intervention in object recognition. Manual data analysis is carried out from the initial stages of remote sensing and does not require special, expensive equipment. For digital processing, it is necessary to have equipment with expensive and professional functions.

Figure 5. Monitoring the state of execution of master plans (Mingachevir city)

The thermal effects of cities on the surrounding areas are studied using thermal infrared images. The development (and consequent expansion) of cities, which is an unconditional indicator of economic development and industrialization, has a negative impact on the environment of the region as a whole. The economic development of the city affects both suburban agriculture and forestry, as well as the general ecological situation in the city and region.

CONCLUSION

Using remote sensing methods in the field of urban infrastructure development monitoring, the following tasks can be distinguished:

- determination of zones of environmental violations (pollution of soil, atmosphere, water bodies);

- monitoring of restoration of disturbed natural landscapes as a result of industrial use;
- monitoring of separate objects of the city infrastructure (roads, bridges, industrial objects);
-identification of waste disposal facilities and consumption;
- determination of the condition of underground facilities;
- urban planning, construction, transport, housing and communal services;
- cadastral work;
-regional cartography.

Using remote sensing data, monitoring the actual use of municipal land for municipal management and urban development, including obtaining information about the condition of the area, improving existing buildings and reconstructing multi-story and individual housing funds, determining the exact boundaries of development, etc. possible.

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DESICCATION OF SOIL AND VEGETATION IN THE SOUTHEASTERN PART OF THE GREATER CAUCASUS AND THE IMPACT OF DEGRADATION ON ECOLOGICAL CONDITIONS

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At the stage of modern development of human society, the purity and cleanliness of the environment is the most valuable and important resource for people's life and production activities. That is why, when using individual territories, natural endogenous and exogenous processes occurring there - water erosion, deflation, irrigation erosion, pasture erosion, as well as the influence of soil-vegetation pollution to one degree or another as a result of human economic activity, detection, research and forecasting of very dangerous areas from an ecological point of view is of particular importance. In order to prevent negative processes occurring in the environment, the study of the ecological environment should be carried out in a comprehensive manner.

It should be noted that the constantly increasing aridity in the southeastern region of the Greater Caucasus is subject to ecological changes as a result of the intensive activity of natural and anthropogenic factors affecting it. In particular, the anthropogenic impact on the natural environment is increasing day by day. In such a case, the ecological potential of each ecosystem and the future of the anthropogenic landscape, which has been used intensively for a certain period of time, are undoubtedly in danger. This should especially apply to the soil-vegetation cover of the steppe zone.

Key words: *plants, erosion process, degradation.*

INTRODUCTION

Since the last decades of the 20th century, rapid changes in the ecological environment and its forecast have been in the focus of attention in many countries of the world [2].

Controlling the ecological changes occurring in the landscape within each natural-economic region is not an easy task. In the solution of these successes, agricultural farms as well as national economic enterprises should act in the field of prevention of environmental damage.

It should be noted that the solution of the problem requires the development of the methodology of stationary studies and observations on matter circulation, transformation, and energy in the areas where the ecological environment is subject to intense changes.

Therefore, the mechanism and speed of transformation of contaminated substances from one physico-chemical state to another should be studied by the number of specialists in the field of solving that problem. It is in this way that it is possible to clean the ecological environment from various wastes, especially chemicals.

One of the main decisive issues intensifying the violation of the ecological balance is the inefficient use of natural farm land without taking into account the ecosystems of arid areas. It should be noted that the violation of the ecological balance in turn leads to the degradation of soil-vegetation cover, underground water, and even atmospheric components.

Excessive plowing of dry steppe lands, which are intensively used in arid farming, in arid and nearby areas, under stress, greatly increases the evaporation process, creates a disproportion between rainfall and evaporation, resulting in a desertification coefficient of 0.25-0.30. The water erosion and deflation processes of the aridification zones develop and lead to the destruction and destruction of the soil-vegetation cover in the natural-farming areas.

ANALYSIS AND DISCUSSION

In the arid and subarid areas of the region, the natural biological cycle has almost been disrupted in most of the intensively cultivated lands.

In order to protect the fertility of the soil, to optimize its parameters, to get a good harvest from it, extensive soil protection agrotechnical measures should be applied, and various mineral fertilizers should be given.

In order to protect soil and vegetation in the steppe zone of the region, there should be solid information about technogenic products. Otherwise, it is impossible to protect the natural environment. The understanding and registration of natural laws is of great importance in preventing the negative changes that occur under anthropogenic influence on the natural environment, especially the soil-vegetation cover. In the fight against these negative changes, especially in the development of the forecast, it is important to determine the most optimal ratio between irrigation, irrigation farming and pasture livestock in accordance with the ecological potential of each area when using the soil-vegetation cover of each area.

THE RESULT

During the transition to the modern market economy, the economic prosperity of the mountain farming zone is gradually increasing in all regions. But this growth is due to the extensive use of natural resources. If the use of natural resources is not regulated, then such a situation can lead to ecological activity not only in the distant future, but also in the near future.

In the southeastern part of the Greater Caucasus, the erosion process has developed widely as a result of the combined effect of natural conditions and anthropogenic influence. Due to intensive aridification in eroded lands, the soil-vegetation cover is degraded, as a result of which the ecological balance is disturbed.

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PROBLEMS OF RESTORATION OF THE OIL-POLLUTED ECOSYSTEMS IN THE ABSHERON PENINSULA

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The article reyiect inftuence of oil componeuts to ecological systems of soil in base of lonqterm researches about soils of Ahsheron peninsula it have given the principle factors wieh sadden to toxicity and own cleaning soils in conditionts of arid elimate of Apsheron.

For many year, extensive development of oil fields, improvement of production, lack of introduction of introduction of new technologies and equipment, irrationality in management, deterioration of the financial condition of oil extraction mines and, therefore, sufficient funds for maintaining stable oil production and drilling operational wells, which is the basis of the development of this field did not allow them to allocate the funds. As a result of this, during the last years, the production in “Surakhanineft” NGCl decreased year by year as in other mines. Most of the problems remained from the past years and the reason was the wrong ideology regarding the extensive development of the field. The long-term and intensive development of the oil extraction industry also postponed the problems of environmental protection during the exploitation of oil fields of oil fields before and after the Great Patriotic Was. As a result, a result, a large part of the lands is curently highly polluted with oil, layer-sewage and deep-well rocks, the hydrological regime of the area has deteriorated, the soil structure has been disturbed, and its physical and chemical properties have changed.

Key words: *technoloji, development, exploitation, structure, hidroloji.*

INTRODUCTION

The recultivation methods of technogenic disturbed and oil-polluted soils are large in the world countries. These methods depend on ancient and recent oil-pollution of soils, surface (shallow), moderate and very deeply contamination, soil saltness, closeness of groundwater to the surface, contamination relief and other reasons. Mechanical (physical-chemical), biological, chemical, thermal and biotechnical methods are applied in the method period in order to normalize the soils contaminated with oil and oil products. 27 forms of soil recultivation were worked out and applied on the basis of mutual combination of these methods in the world countries.

Formation, development of recultivation firstly related to production of minerals by open methods. Restoration of the soil productivity contaminated by the industrial production and the first attempts of greening of the same areas were begun at the end of the XIX century. So, direct and indirect effect of the natural complexes of the industry was resulted in expansion of small areas to include large areas, this has become a global problem beyond the scope of one country.

The problems of protection of the soil productive layer must be solved by the recultivation method. Great funds and time are required for restoration of the soil biological productivity.

Development of realistic plans about recultivation and successful completion depend on how you know the quality and quantity of disterbed soils and execution of the further work. Extraction and processing of minerals and peat leads to one-time loss of valuable soil. It is necessary to preserve and increase biological productivity of these areas (resources) in order to make productive use of most of the disturbed area. This must be belonged to oil-polluted soils and primarily developed peat deposits.

Mineral raw material quarries used in construction are located in the soils useless for agriculture. The sand massives, lowlands and foothill zones along these rivers. After recultivation measures these quarries can be turned into more productive areas than before. Only such values can play objective basis role in planning, predicting of recultivation works and also improvement of the material and technical reserves [1,2]. It is necessary to inventorize, map and evaluate it economically in order to recultivate the disturbed soils. The long and intensive development of oil extraction industry in Absheron, exploitation of oilfields before and after the Great Patriotic War delayed problems of the environment protection for a long time. As a result, a great part of the soil were sufficiently polluted with the oil, layer-waste water and depth-well rocks were contaminated, hydrogeological regimes of the zone deteriorated, the soil structure disturbed, its physical and chemical characters changed. Density of the polluted layer of soil is found around the former “Black City” from 0.4 m to 1.5-2.1 m. The reason is dependence of the mechanical structure of the zone rocks on light aggregates.Many areas were contaminated with the life, various industrial wastes and non- operational communication devices. Consequently, a negative effect happened in the environment protection as in other mines in recent years. Most of the problems remained from last years and its reason was wrong ideology in connection with the extensive development of the area.

İn accordance with the requirements of nature protection, drilling slimes should be placed in special hermetic capacities or in soil pts isolated with a special film, these waste slames should be transported to special neutralization places, but in fact, since oil exploiters and related organizations don’t ignore these requirements, the slame waste was shed to areas with low geometric elevation or at bes, to the pits around the well. Exclusion of the same waste from zones or recultivation and remidation by different methods are expected. As a result, either in the currently operating oil fields or outside them, as a result of the drilling work carried out for the purpose of exploration, the drilling waste remainedin the areas and became sources of ecological tension.Such areas are found in the exploration zones of the agreement territory where oil reserves are assumed.

Oil-polluted rate of the soils in the Absheron peninsula

Degree of soil disturbance	Amount of oil-pollution in soil
Non oil-polluted	<1.5 (0.15 %)
Weakly polluted	1.5-4 (0.15-0.4 %)
Moderately polluted	4-13 (0.4-1.3 %)
Strongly polluted	13-25 (1.3-2.5 %)
Very strongly polluted	>25 (2.5 %)

The published available classification schemes of the oil-polluted zones and the oil-polluted zones are divided into the following sorts (categories) based

- Fuel-polluted soils;
- The soils polluted by the industrial, construction, welfare waste ;
- Contaminated by the depth-well rocks (drilling slame), soils impregnated with oil and chemicals;
- Soils contaminated with oil-refinery waste;
- Swamped soils and soils contaminated with fuel ;
- Flood soils and soils contaminated with oil-field and sewage water;
- Soils contaminated with oil in ash (around the drilling well) [3].

MATERIALS AND METHODS

At present there is not a standard model of the recultivation technology of the oil-polluted soils in the world countries. The reason is location of oil and gas extraction in different zones. Selection of the specific method depends on contamination level, oil composition, pollution period, physical-chemical and water-physical characters, landscape and climate condition and so on. Before substantial reclamation measures are implemented in areas contaminated with oil more than 5-10 %, the work related to the removal of residual oil products from the field should be performed.

The experiment shows that it is possible to separate 1-2 tons of oil from each hectare of soils with a pollution degree of 10-20 % in this way. For example, the canals (collectors) are built in the area with a pollution degree of 10-20 %, the substances (soapstock solution, synthetic surfactant solution heated up to 45^0 C) possessing high washing ability are injected to soil from vertical pipes in peripheral zones. These substances wash the soil particles from oil, the waste extracted from soil layer flows to the canals and runs into canals, gathers in the containers and they are sent to the processing stations. After the reserve oil quantity is extracted from zone by this way, the recultivation measures are planned.

ANALYSIS AND RESULTS

The recultivation work is performed in the places disturbed with the production of coal, construction materials, mountain chemical raw, oil and natural gas in the industrially developed countries of the world and as a result, pollution of the environment and air occurs. Of course, the pollution processes that occur during the activity of factories and the consumption of waste remain relevant. Prevention of these problems and work quality are growing quickly when all these works are included in the technological project of enterprises. Development of the reclam ation works in the different countries depends on natural condition, type of the disturbed soils, economic purposefulness, social effects. Reasoning of economic and rational directions depends on generalization of all the disturbances. Of course, when the soil is polluted, its direct effect on the air and the increase in the ongoing pollution process must also be encouraged. So, special programs and classifications were worked out in relation with recultivation in Poland, England, USA and other countries. In some countries the aerial photos and satellite images are used to study and classify disturbed soils and contamination of the environment, specially, air. If we take into account increase of population's need for soil and minority of soil per capita, importance of use of reclamation under agricultural plants becomes clear. More funds are allocated for these directions in all the countries of the world. Very thick (sometimes till 1m) potential and humus soil layer is scratched and shed for restoration of productive layer in technical and biological reclamation. Most of the allocated funds are spent on technical reclamation work. But the legumes are preferred in biological reclamation (Lucerne, pea,etc). If the rock structure on the surface cover and natural condition gives a chance, the reclamation of the disturbed soils can be preferred oil reclamation. Development of this direction is mostly preferred in the European countries and the former Soviet Union. More parts of disturbed soil reclamation were separated into good areas for sowing in Germany.

It is necessary to differ, i.e. to separate the following directions of the disturbed soil reclamation depending on its subsequent use:

1. Agricultural directions of the reclamation – under sowing, meadow, hayfield, pasture and use under perennial plants.
2. Afforestation direction of reclamation- to use in forest industry and special purposely establishment of forest cover (soil protection, ecology defense, water guarding).
3. Water economy direction of reclamation - different purposely establishment of water tanks (water basins, running ponds for fish and bird farming, floods, pools).
4. Recreation direction of reclamation - park, sport pools, bathing etc.
5. Planned- architecture direction – planting of forest plants, meadow plants, filling the depressions with water as an important element of reclamation etc.

It is possible to perform reclamation of the oil-polluted soils by the technical, agro-meliorative, agronomic, ameliorative, thermal (with evaporation), biological, microbiological and chemical methods.

The mechanical (physical-chemical), biological, chemical, thermal and biotechnological methods are applied to normalize the polluted soils with oil and oil products in modern period. At present prevention of pollution with oil-gas waste must be performed in parallel with land reclamation. So, more parts of allocated funds should be spent on technical reclamation works and mainly the biological means must be used. This includes the use of alfalfa, peas, etc. plants, as well as the greening of large areas. The European countries can be taken as an example. More than 50 % of areas are allocated for afforostation (on the slopes and terraces).

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SOME ASPECTS OF ENVIRONMENTAL DAMAGES OF SOIL RESOURCES IN AZERBAIJAN

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The subject of the paper covers one of global issues – ecologically safe aspects, including environmental balance, elimination of pollution, prevention of soil degradation due to contamination of natural components of ecosystems.

Azerbaijan – is the South Caucasian state with unique natural potential, enormous quantity of resources, distinctive tertiary floristic and abundant faunistic diversity, as well as compact, but fertile soil funds.

Author emphasizing major affairs of recovering liberated areas of Azerbaijan and building of environmentally friendly habitat for society and biodiversity. The region of Karabakh and adjacent areas were about 30 years under illegitimate occupation by neighbor state, and these caused violation towards our nature. Immediately after Historical Victory in 2020 Azerbaijan started rehabilitation of natural landscapes, counting soil assets.

Another topic is Sustainable Development on national scale for present and future generations of citizens of Azerbaijan to meet their needs in comprehensive meaning.

Dual relations between Nature and Society have considerably extended history, covering millenniums and current conditions of natural ecosystems have not the best level of quality; outer world has huge influence to the wildlife. We can name this impact ‘anthropogenic pressing’ due to incredible tension.

Keywords: *Azerbaijan, Environmental issues, Karabakh, Nature, Pollution, Soil resources*

INTRODUCTION

The dependence of people on the natural surrounding environment has been observed in all historical times - not only during epochs, but also in modern times, it's one of the factors that ensure the foundations of life as well as economic and political development of society. The natural environment is the factor, created initial conditions for the evolution and evaluation of biological-beings. The natural environment, its’versatility and diversity played and continues to play fundamental role in maturing of society. The environment is the decisive resource that determines fulfillment of empirical biological, economic and social needs of humanity. By studying the natural environment, its’organic and mineral components, improving human knowledge, directing the development of society and individuals, one achieves higher intellectual levels.

MATERIAL AND METHODS

Research methods: comparative – analytical method; statistical method and modeling method; historical analyze method; philosophical approach method.

Realization of socially oriented policy under conditions of environmental richness became one of the main factors affecting the continuity of development and the improvement of the welfare of members of society. Even at the modern phase of the development of civilization, the dependence of man on nature is undeniable. Global climate changes, natural disasters, technological accidents, humanitarian crises, resulting losses and deprivations that've occurred during recent years, proves that man is still directly dependenting on nature. As result of natural disasters in the Pacific Ocean, man-made output of the accident at Japan's nuclear power plant can be reliable example of it. The large-scale technological crisis unfolding in the Gulf of Mexico attracted attention with its’ unprecedented consequences for humanity and large-scaled damages to nature. Even in these countries with supreme technological achievements and outstanding degree of economic development have reached respected levels, there are powerless in the face of natural disasters and their consequences. For these reasons, people should consider such important parameter as environmental management by planning development strategies. The urgency of day is that natural environment and social environment should not be isolated, and that there should act as the united front within different political management systems.

Conceptually, one of the important modules of sustainable development is an environmental component; sustainable development, from an ecological point of view, is an important indicator that ensures the biological and physiological sustainability of natural systems. Facts such as the instability of national economies and visible increase of economic and political crises are the situations that the world' countries often face during the last two centuries.

Nature's resources, considered inexhaustible and exploited to the maximum extent, have covered all the countries of our world and led to the agenda of number of global environmental problems which are difficult to solve. We should also mention one more issue - the ecological aspects of the modern era, which is listed as the second global matter directly after the problems of war&peace in the system of global trends. Environmental problems involve human dimensions. Environmental aspects are an objective factor in development of civilization, the aggravation of these problems slows down the progress and exposes the culture afore the danger of destruction. Adequate analysis of ecological concepts includes an integrative approach - joint activity of representatives of natural, technical and social sciences. Correct solution for environmental issues is possible solely by international cooperation with first-hand participation of world states.

The presence of pollution in our environment and the main overriding indicator is the soil pollution. Due to the discharge and/or disposal of chemical substances that may harm living beings, changes of the quantity and quality soil indicators, affect the nutrients, make it unsuitable for the production of agricultural grounds and food. As the result of human economic activity, certain wastes are generated and synthetic chemicals pollute these soils. These substances change composition and structure of the soil, resulting the loss of soil fertility and, a priori, poisoning of cultivated nutrients. Animals living in certain deep-layers of the soils and all plants growing in polluted soils are affected by such effects. Real disasters for biodiversity and ecosystems are caused by soil pollution.

Soil pollution is characterized by natural and anthropogenic pollution. Some examples of natural pollution are volcanic eruptions, forest fires and acid rains which increase the concentration of harmful gases of atmosphere. Soil pollution as a result of human activity is the introduction of pollutants of chemical origin into the natural environment and, thus, the natural background is characterized by serious changes. Condensation of greenhouse gases to the soils are characterized by high emission rates. The use of chemical substances in agriculture, the polluting properties of nitrogen compounds used as fertilizers for plant growth, pesticides, herbicides, hydrocarbon solvents are also the basis of the disturbance of the natural balance, as well as the pollution of surface water resources and underground water layers. Inside of each ecosystem, within the limits of each landscape type, soil pollution means a violation of the ecological balance of individual components of natural complexes.

Water polluted with various chemical substances in the process of soil infiltration has been affected by leakage process between the terrestrial environment and the water bodies. All pollutants passing through the water remain in soil layer during the filtration process. Certain percentage of industrial, agricultural, domestic and fecal wastes are discharged into the environment percolates directly to the soil, a part is eroded, and the other part accumulates in the soil layers. One of the main sources of soil pollution is the burial of toxic substances - harmful concentrates are leached from soil layers, and pollutants enter the human diet through the trophic pyramid with biological diversity components during irrigation and cause serious consequences. Another reason for soil pollution is the storage of industrial and household waste that does not comply with ISO norms. Accumulation or burial of large amounts of waste on the surface leads to numerous environmental problems, illegal accumulation of waste can occur as a result of both accidental and poor infrastructure leaks (radioactive leaks, heavy metal waste), which paves the way to irreversible disasters in structural patterns and chemical compositions of the soil.

RESULTS

Consequences of soil pollution - the loss of the quality of the soil layer leads to very serious environmental disasters, for example, the heavy metal and radioactive substance leaks that occurred in Fukushima Bay (Japan) polluted the water basin and the soils'of the surrounding areas to the level of environmental crisis and went down to human history as the global man-made poisoning - seriously affected people's health, agriculture, animal husbandry and fishing.

In the MDG (Millennium Development Goals) proclaimed on the UN level in 2000 and their logical continuation in SDG (Sustainable Development Goals), the sensitivity of global climate changes to the efficient use of land resources, the prevention of land degradation, the processes of desertification and re-desertification, is brought up as well as the protection of clean drinking water sources, are sensitive to ecosystems.

Illegal actions against Azerbaijan and our charming Nature by malicious neighbors during approximately 30 years have been terrible threat not only to our Country, but also to the entire South Caucasus region. Illegitimate activity and aggressive exploitation of natural resources during period of occupation are contrary to international law, both from the economic context and from the point of view of environmental imbalance.

DISCUSSION

Cutting and burning of our forests, polluting and poisoning of our water sources, destructing of flora and fauna diversity, looting of our mineral resources, in turn, resulted in the loss of land. The extent of environmental degradation has been worried even by representatives of Armenian environmental organizations.

In the Report of the Ministry of Foreign Affairs of the Republic of Azerbaijan entitled "Illegal economic and other activities in the occupied territories of Azerbaijan", one chapter is devoted to the ecological consequences of the illegal economic activities carried out in the occupied territories. The report presents that any international military occupation is classified as the "temporary occupation" due to its nature and does not imply that the occupying country acquires sovereignty over the occupied territory, therefore, the legal status of the territory does not change due to the fact of occupation. As a result of the occupation (annexation) of Karabakh and the surrounding territories, international legal norms were grossly violated by the occupying country, and activities contrary to the legal status of our Country took place. In documents of influential international structures, the harmful effects of the violation on nature were also on the agenda.

As it mentioned in one of the reports of the Asian Development Bank (ADB) about our Country: as a result of aggression, land areas have also been degraded.

In 2019-2020, referring to the Report "Illegal activity in the occupied territories of Azerbaijan: evidence obtained from satellites" based on the satellite images taken by AzerCosmos State Company, the extent of environmental damage to our regions is proven. During these investigations were discovered facts of burying radioactive materials, nuclear fuel waste (cesium-137) in so-called "gray zone" lands of occupied territories. Appeals to use the radioactive waste of the Metsamor NPP (built in 1976) for military purposes against Azerbaijan are also indicative of Armenia's aggressive policy. According to the Action Plan within the Framework of the Eastern Partnership of the European Union, the issue of conservation of the mentioned NPP (that does not meet the new environmental standards) which are the subjects for compensation has also been on the agenda. Even in an article published in one issue of "National Geographic" magazine, the danger related to the extreme oldness and auld operation of Metsamor NPP was investigated by international institutions.

In virtue of the Victory of Azerbaijan in the glorious 44-days Patriotic War and the restoration of the legal integrity of our historical territory, restoration of our natural resources, including our land funds, is a state priority, due to the state policy carried out in all areas of economic and social life, including the protection of the environment and the establishment of natural balance.

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DETERMINATION OF LAND DEGREDATION AND DESERTIFICATION USING MEDALUS MODEL CASE STUDY; INEBOLU WATERSHED

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Land degradation and desertification causes extinction of funcion of soil layer which is one of the most important terrasitral ecosystems and formed hundreds of years. Many studies were carried out and many kind of models have been developed. This study was performend in Inebolu Watershed and aimed to determine the zones that are sensitive for degredation by using MEDALUS Model. In first step, the indicators that are soil, climate, vegetation and management were calculated and mapped separately in this model. In second step, all indicator layers were combined to determine sensitive areas getting the geometrical average of those four index in GIS medium. According to results, environmental sensitive areas defined as critic and fragile in classification system were observed as fragile F3 and one of the important degredation C2. 35.65% of areas was classified as critic whereas, it was found that 18% of the total area was fragile.

***Key words**: Desertification, Land degredation, MEDALUS, Inebolu Watershed*

INTORDUCTION

Land degradation is defined as the reduction of biological or economic productivity in rainfed agricultural areas, irrigated agricultural land and pastures, forests and shrublands, through a combination of human and natural agents (United Nations, 1977). Desertification, a process of land degradation which is a threat to the global environment, stems from various processes including climatic variations and human activities and occurs particularly in arid, semi-arid and dry, subhumid environments in which water is the major land use limiting factor (Tavares et al. 2015). Berry et al. (2003) reported that land degradation is a process that is controllable and reversible. However, desertified land has lost most of soil ecosystem services, thus it is practically an irreversible change.

On the global level, Türkye has significant natural landscapes and biological resources, as well as agro-environmental landscapes. According to Conservation International (2005), there are thirty four global high diversity “hotspots”, three of which are located in Turkey, being the Mediterranean, the Caucasus and the Irano-Anatolian hotspots. Altogether, Turkey hosts a large array of fragile natural assets and is home to a unique merging of diversity in the Eurasia (Başak et al., 2017). However, Türkiye faces considerable land degradation and desertification risks. The risks stem from its climate, topography, geology, hydrology, level of vegetation cover, proportions of arable and non-arable land, characteristics of pasture and forest areas, rangeland grazing practices (severe overgrazing by sheep, goats and cattle), management of arable lands (leaving bare or very weak cover vegetation of soil surface) that leaves them highly vulnerable to water and wind erosion, and the impact of population growth. In the Global Desertification Vulnerability Map (NRCS, 2015), a significant proportion of Türkye is classed as vulnerable to desertification.

Several methods for monitoring and assessing land degradation and desertification have been developed since the end of the twentieth century (e.g., Chen et al., 2021; Türkeş et al., 2020). Environmental Sensitivity Areas (ESA), developed as part of the MEDALUS–Mediterranean Desertification and Land Use project (Kosmas et al., 1999), remains the most widely used approach for assessing desertification risk and has provided accurate and credible results in many countries, including China (Xu et al., 2019), India (Rajbanshi and Das, 2021), Brazil (Vieira et al., 2021), Greece (Karamesouti et al., 2018), Türkiye (Uzuner and Dengiz, 2020), Italy (Egidi et al., 2021; and Spain (Contador et al., 2009). The aim of this study is to determine the risk areas for land degradation and desertification in the basin using the MEDALUS model in the Inebolu Watershed, which has an area of about 11,000 ha and located within the Kastamonu province of the Western Black Sea Region by using the MEDALUS model.

MATERIAL AND METHOD

Field Description of the Study Area

The study area, İnebolu Watershed, founded in border of Kastamonu province geographically located in west part of the Black Sea region of Turkey is coordinated at 4636000-4648000 N and 557000-569000 E (UTM-m) and the total area is approximately 114 km^2 (Figure 1).

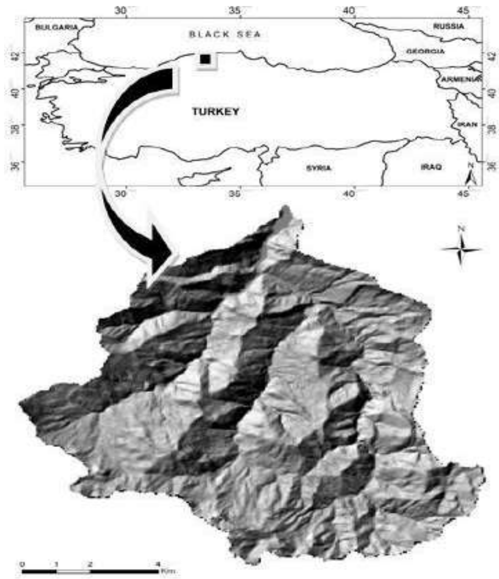

Figure 1. Location map of the study area

Mean sea level altitude of the watershed is 621 m. The mean annual temperature, rainfall, average relative moisture and evaporation are 1033 mm, 13 ºC, 75% and 680.58 respectively. According to Soil Survey Staff (1999), soil temperature and moisture regime are mesic and ustic. The study area consists of various topographic features (flat, hilly, rolling etc.) particularly includes mountainous highland areas and slope varies between 2%-45%. The underlying bedrocks within the study area consist of quartzit-quartz schist, andesine, sand stone-mud stone, and lime stone. Land use and vegetation of the study area are generally, covered by forest, arable land and pasture.

Data Processing

The main environmental and socio-economic indicators associated with vulnerability to land degradation at the regional scale in the MEDALUS model are soil, climate, vegetation cover and land use. In the model, each indicator is scored between 1.0 and 2.0 indicating a low risk and a high risk, respectively. In order to determine ESAs, environmental processes are detected by the proposed methodology at the regional or national level by means of a multi-factorial approach based on general and local knowledge.

In this study, after entering the data in the corresponding GIS database, a map was generated as a different layer for each soil category. Classification of data in these layers was based on the MEDALUS model. According to the MEDALUS model, soil quality indicators for mapping ESAs can be related to available water capacity and soil erosion sensitivity. These qualities can be assessed by using simple soil characteristics such as texture, parent material, soil depth, slope angle, drainage and stoniness that are provided in regular soil survey reports (Kosmas et al., 1999). The use of these properties for defining and mapping ESAs requires the definition of distinct classes with respect to the degree of land resilience against desertification (Basso et al., 1998). Weighting factors were assigned to each category of the considered parameters, based on the methodology of Basso et al. (2000), which was adapted from Kosmas et al. (1999).

The soil quality index (SQI), which is intimately linked to the desertification process based on Table 1, was calculated by using the following equation (1):

$$SQI = (Texture * Parent\ Material * Rock\ Material * Slope * Soil\ Depth * Drainage)^{1/6} \quad (1)$$

Table 1.

Classes and index values used in the calculation of Soil Quality Index (Kosmas et al., 1999)

Parameters	Class	Assessment	Description	Index
Texture	1	Good	L, SCL, SL, LS, C	1.0
	2	Medium	SC, SiL, SiCL	1.2
	3	Poor	Si, C, SiC	1.6
	4	Very poor	S	2.0
Parent Material	1	Good	Shale, schist, basic and ultra-basic rocks conglomerates, un-cemented materials	1.0
	2	Medium	Limestone, marble, granite, rhyolite, ignimbrite, gneiss, siltstone, sandstone	1.7
	3	Poor	Marl (marl score for perennial plants should be 1.0), pyrosilicates	2.0
Coarse Material (Rock fragments)	1	Very stony	Coarse material > 60%	1.0
	2	Stony	Coarse material 20-60%	1.3
	3	Bare and slightly stony	Coarse material < 20%	2.0
Slope	1	Very gentle to flat	< 6%	1.0
	2	Gentle	6-18%	1.2
	3	Steep	18-35%	1.5
	4	Very steep	> 35%	2.0
Depth	1	Deep	>75 cm	1.0
	2	Moderate	75-30 cm	1.33
	3	Shallow	15-30 cm	1.66
	4	Very shallow	< 15 cm	2.0
Drainage	1		Well drained	1.0
	2		Imperfectly drained	1.2
	3		Poorly drained	2.0
Soil Quality Index	1		High	<1.13
	2		Medium	1.13-1.45
	3		Low	>1.45

L: Loam, SCL: Sandy clay loam, SL: Sandy loam, C: Clay, SC: Sandy clay, SiL: Silty loam, SiCL: Silty clay loam, Si, Silt, SiL: Silty clay, SiC: Silty clay, S: Sand

The climate quality was evaluated as a parameter that influences water availability for plant growth, such as the amount of precipitation, drought and slope aspect. According to the model, annual precipitation was assigned to three classes, with the value of 280 mm adopted as a crucial value for both soil erosion and plant growth. In addition, slope aspect was divided into two classes, (a) North West and North East and (b) South West and South East, to which were assigned the indices 1 and 2, respectively. Moreover, according to Kosmas et al. (1999), the most effective measure of soil water availability is precipitation minus evapotranspiration and run-off. However, this calculation requires a large amount of data, such as soil moisture retention characteristics and vegetation growth characteristics. Therefore, the simple Bagnouls-Gaussen aridity index (BGI; Bagnouls and Gaussen, 1957) was used and is defined as follows (2):

$$\mathrm{BGI} = \sum_{i=1}^{n} (2t_i - p_i)\mathrm{k}_i \qquad (2)$$

where: t_i is the mean temperature for the month , p_i is the total precipitation for the month; and k_i represents the proportion of the month during which $2t_i - p_i > 0$. In addition, the BGI was classified into six subclasses (Table 2). Also, the climate quality index (CQI), based on Table 2, was calculated using the following equation (3):

$$CQI = (Precipitation * Drought * Aspect)^{1/3} \qquad (3)$$

Table 2.

Classes and index values used in the calculation of Climate Quality Index

Parameters	Class	Description	Index
Precipitation (mm)	1	>650	1.0
	2	280-650	1.5
	3	< 280	2.0
Drought-Aridity (BGI)	1	< 50	1.0
	2	50-75	1.1
	3	75-100	1.2
	4	100-125	1.4
	5	125-150	1.8
	6	>150	2.0
Aspect	1	North West and North East	1.0
	2	South West and South East	2.0
Climate Quality Index (CQI)	1	High quality	< 1.15
	2	Medium quality	1.15-1.81
	3	Low quality	>1.81

The vegetation quality index was determined by using plant cover, fire risk and ability to recover, degree of protection of the soil from erosion and drought resistance. The dominant types of vegetation in the Mediterranean region were grouped into four categories according to their inherent fire risk (Table 3). The vegetation quality index (VQI) was calculated by using the following equation (4):

$$VQI = (Fire\ Risk * Erosion\ Protection * Drought\ Resistance * Plant\ Cover)^{1/4} \quad (4)$$

Table 3.

Classes and index values used in the calculation of Vegetation Quality Index

Parameters	Class	Asssesement	Definition-Vegetation Type	Index
Fire risk	1	Low	Bare land, perennial agricultural crops, annual agricultural crops (e. g. maize, tobacco, sunflower)	1.0
	2	Moderate	Annual agricultural crops (e. g. cereals, grasslands), deciduous oak (mixed), mixed Mediterranean, macchia/evergreen forests	1.3
	3	High	Mediterranean macchia	1.6
	4	Very high	Coniferous forests (pines)	2.0
Erosion Protection	1	Very high	Mixed Mediterranean macchia/evergreen forests	1.0
	2	High	Mediterranean macchia, pine forests, permanent grasslands, evergreen perennial crops	1.3
	3	Moderate	Deciduous forests	1.6
	4	Low	Deciduous perennial agricultural crops (orchards and plantations)	1.8
	5	Very low	Annual agricultural crops (cereals), annual grasslands, vineyards	2.0
Drought Resistance	1	Very high	Mixed Mediterranean macchia/evergreen forests, Mediterranean macchia	1.0
	2	High	Conifers, deciduous, olives	1.2
	3	Moderate	Perennial agricultural trees (vineyards, plantations, orchards)	1.4
	4	Low	Perennial grasslands	1.7
	5	Very low	Annual agricultural crops, annual grassland	2.0
Plant cover	1	High	> 40%	1.0
	2	Low	10-40%	1.8
	3	Very low	< 10%	2.0
Vegetation quality index (VQI)	1		High quality	<1.6
	2		Medium quality	1.7-3.7
	3		Low quality	>3.7

The linking of ESAs to desertification requires key indicators related to the physical environment and to the human-induced stresses. Therefore, the fourth quality index is the management quality index (MQI) which was assessed as the product of land use intensity and the enforcement of policy for environmental protection for each class of land use. For that purpose, the information on the existing policies was collected and then the degree of implementation was evaluated and MQI was estimated using the following formula (5). Management quality of an area is then defined by the Table 4.

$$MQI = \left(\begin{matrix}Crop\ Land\ Use \\ Intensity\end{matrix} * \begin{matrix}Pasture\ Use \\ Intensity\end{matrix} * Policies\right)^{1/3} \qquad (5)$$

Table 4.

Classes and index values of different management parameters used in Management Quality Index calculations

Management parameters	Class	Assessment	Description	Index
Intensity of land use for crop land	1	Low	Low level land use intensity	1.0
	2	Moderate	Medium level land use intesity	1.5
	3	High	High level land use intensity	2.0
Intensity of land use for pasture land	1	High	ASR< SSR	1.0
	2	Moderate	ASR=SSR to 1.5*SSR	1.3
	3	Low	ASR>1.5*SSR	1.6
Policy	1	High	Complete: >75% of the area under protection	1.0
	2	Medium	Partial: 25-75% of the area under protection	1.5
	3	Low	Incomplete: <25% of the area underprotection	2.0
Management Quality Index (MQI)	1		High	1.0 -1.25
	2		Medium	1.26-1.50
	3		Low	>1.51

The final step, the production of the resulting index, was matching of the physical environment qualities (soil, climate and vegetation) and the management quality in order to define the susceptibility of the various types of ESAs to desertification. The four derived indices were multiplied for the development of the ESA index (ESAI), as follows (6):

$$ESAI = (SQI*CQI*VQI*MQI)^{1/4} \qquad (6)$$

The range of the ESAI for each class of ESA, as they were defined earlier, including three subclasses in each class, are presented in Table 5.

Table 5.

Classes of land according to ESAI values.

Class	Sub-class	Sub-class symbol	ESAI	Description
Critical	High	C1	>1.53	Mismanaged lands that threaten the areas around them (e. g. bare land that may cause high surface flow and sediment transport)
	Medium	C2	1.53-1.42	
	Low	C3	1.41-1.38	
Fragile	High	F1	1.37-1.33	Land where degradation can begin with any change in the balance that exists between natural and human influences. Example: Expected climate change will affect plant cover, increase soil erosion and ultimately cause the sensitivity level of these areas to change to "critical". A change in land use (such as switching to cereal production in sensitive areas) can cause a very rapid increase in surface flow and erosion. This will cause pollution by pesticides and fertilizers in the lower sections of the basins.
	Medium	F2	1.32-1.27	
	Low	F3	1.26-1.23	
Potential		P	1.22-1.17	If there is a significant change in land use or effects of climate change, there is the threat of deterioration
Non affectec		N	< 1.17	Land without deterioration threat

RESULT AND DISCUSSION

To determine land cover of the study area, Aster satellite image that has 15m x 15m spatial resolution was used. According to remote sensing analysis, primary land covers are bare land, sparsely vegetated area, broadleaved forest area, mixed forest area and needleleaved forest area (Figure 2). Sparsely vegetated area is the highest land cover in the study area and has about 33.01 % of the total area, followed by broadleaved forest area (27.37%), bare land (14.94%), mixed forest area (14.01%) and needleleaved forest area (10.66%).

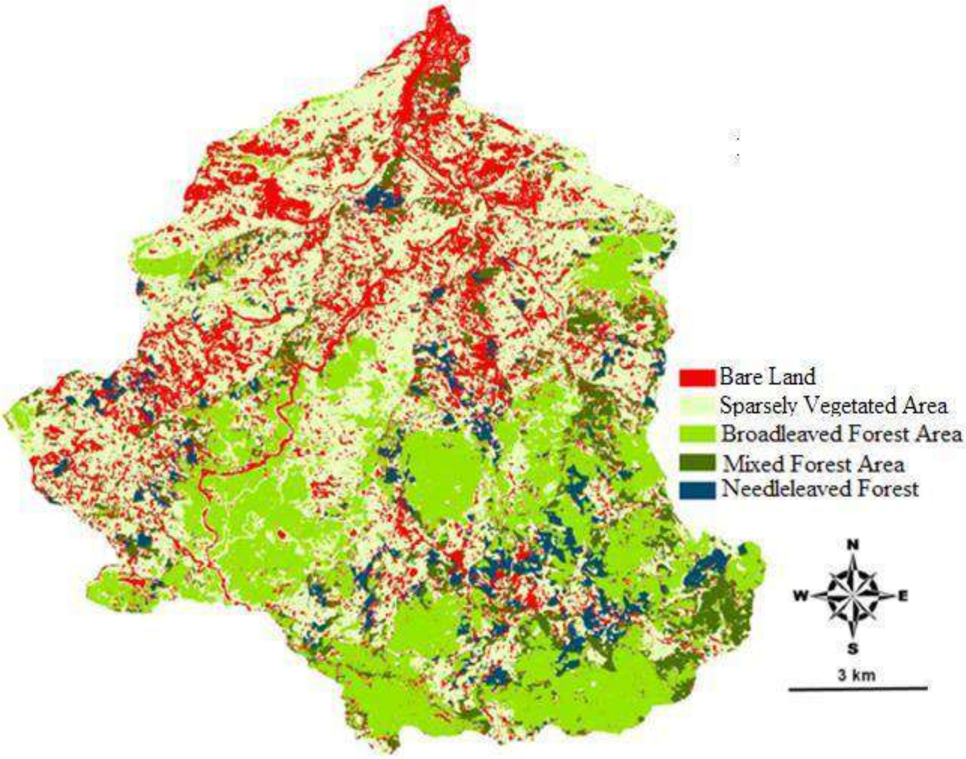

Figure 2. Land Cover maps of the study area

In this present study, the calculation of each indicator involved in the MEDALUS model was done through algebraic combination tools and by a multitude of spatial analysis functions in GIS medium.The different indexes (SQI, CQI, VQI and MQI) are represented in maps (Figures 3). In addition, the proportional distributions of their classes over the study area are presented in Tables 6. The SQI indicates that most of Basin has medium soil quality (20.1%), almost eighty percent is of low quality. As for climate quality, the spatial and proportional distributions of climate quality classes are given in Table 6 While high-quality climate classes cover 73.4% of the total area, very low climate classes constitute 20.1%. Vegetation has vital role in preventing desertification. Lahoaoi et al. (2017) stated that vegetation serves to a dual purpose by obstructing rain with foliage and by holding soil in place with its pervasive root systems. Vegetation reduces the kinetic energy of raindrops which reduces their impact on the soil surface and hence reduces the amount of soil particles dislodged and carried away in runoff. Francis and Thornes (1990) proposed 40% plant cover as the critical threshold above which accelerated soil erosion occurs. The vegetation quality index for basin shows that more than half of the study area has low and very low quality vegetation (74.1%), 22.1% is of medium quality and about 3.8% of vegetation is of high quality. Only small part of the total area have been occupied by artificial lands, water bodies and other lands. Finally, the impacts of land use and management quality on desertification are shown on Figure 3 and indicate that most of the basin (52.6%) can be classified as low quality land, about one third (27.8%) as medium quality, and 19.9% as high quality (Table 6).

Table 6.

Distribution of SQI, CQI, VQI and MQI classes in Inebolu basin

Class	Description	Area	
		ha	%
Soil Quality Index (SQI)			
2	Medium	2205,7	20,1
3	Low	9052,4	79,9
Climate Quality Index (CQI)			
2	High	8378,8	73,9
3	Medium	2879,3	26,1
Vegetation Quality Index (VQI)			
1	High	429,0	3,8
2	Medium	2500,5	22,1
3	Low	8328,6	74,1
Management Quality Index (MQI)			
1	High quality	2261,7	19,9
2	Medium quality	3151,5	27,8
3	Low quality	5844,9	52,6
Total		11258,1	100

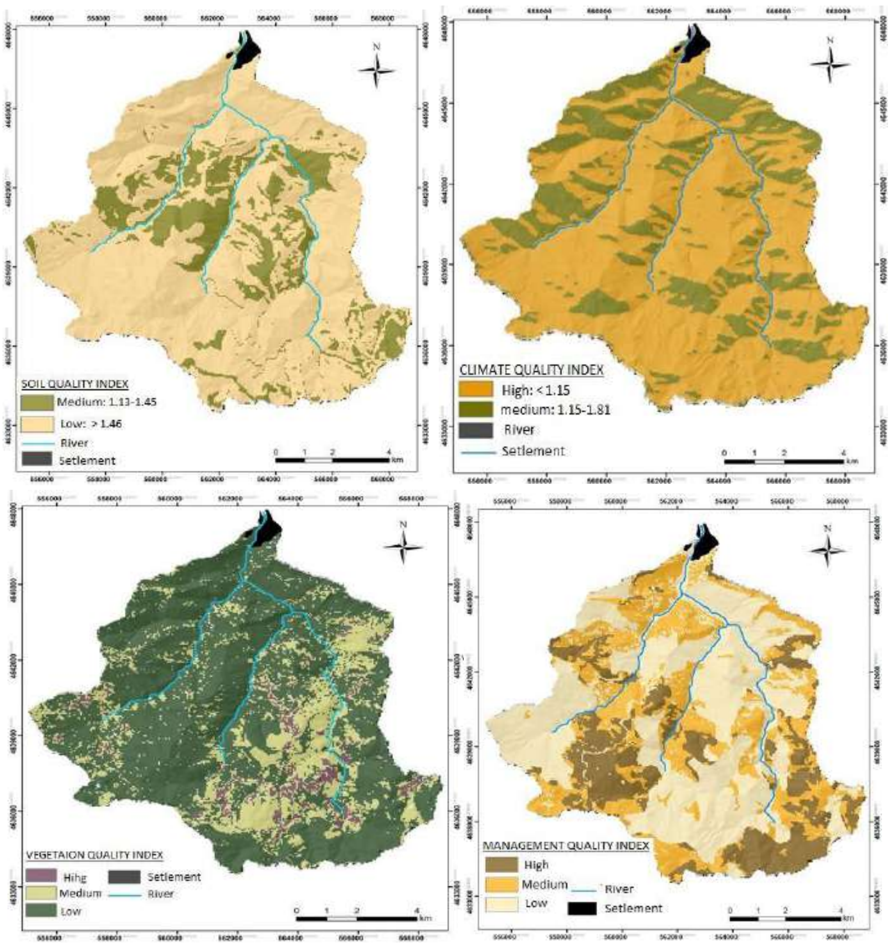

Figure 3. Distribution maps of SQI, CQI, VQI and MQI classes in Inebolu basin

After the combination analysis of the four main quality indices SQI, CQI, VQI and MQI by the MEDALUS model, spatial and proportional distributions of main classes of Environmentally Sensitive Areas (ESAs) in Inebolu basin are given in Table 7 and Figure 4. According to this result, According to this result, it has been determined that 35% of the environmentally sensitive areas of the basin in terms of desertification are moderate critical and it was found 18% are low fragile. Only very small part of the basin has non affected and potential areas

Table 7.

Distribution of main classes of Environmentally Sensitive Areas (ESAs) in İnebolu basin

Class symbol (ESA)	Description	Area (ha)	Ratio (%)
C3	Critical Area	1146	10.12
C2		4036.1	35.63
C1		1752.2	15.47
F3	Fragile Area	2093.4	18.48
F2		1476.1	13.03
F1		524.3	4.63
P	Potential Area	204.9	1.81
N	Non affected Area	24.6	0.22

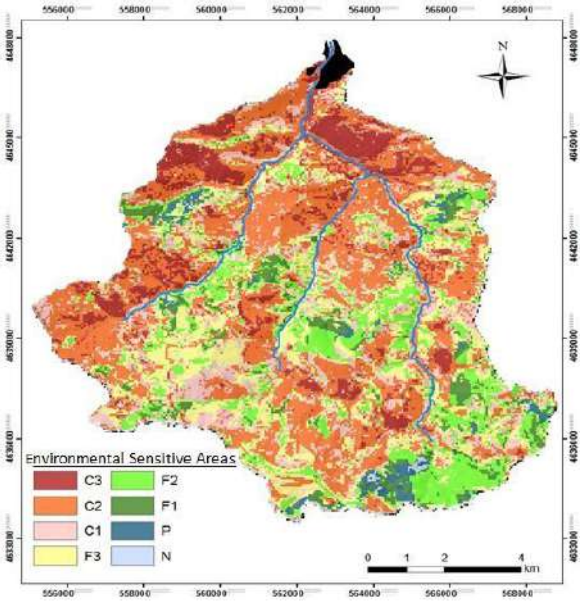

Figure 4. Environmentally Sensitive Areas of the Inebolu Basin

CONCLUSIONS

The desertification risk of Inebolu Basin's landscapes was accessed on the basis of a comprehensive set of indices originated by the MEDALUS method. They incorporated natural ecosystems, agricultural landscapes and human influence to develop a comprehensive picture of desertification at the local scale of Inebolu Watershed. The maps of the four quality indices used in the determination of ESA in the Inebolu basin and the verbal distributions of the parameters used in the calculation of these indices according to the boundary levels were produced using GIS. According to the obtained results, it was determined that the majority of the basin is both fragile and critical as risk classes interms of land degradation and desertification. These places are vulnerable to erosion, have a high risk of fire, have shalow depth and low water holding capasity, etc., which are the main causes of their fragility and criticality classes.

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GENERAL CHARACTERISTICS OF CLIMATE INDICATORS OF SHEKI REGION

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Sheki district is one of the districts included in Sheki-Zagatala administrative district. Sheki-Zagatala zone is one of the important regions for agriculture in our republic. In this region, grain growing, tobacco growing, fruit growing, grape growing and other agricultural crops are widely cultivated. The influence of climate indicators on agriculture is very important. Cultivation system designed according to soil and climate conditions ensures several operations: soil granulation and softening, mixing and leveling of the plow layer, planting of plant residues and mineral fertilizers in the soil, and measures to combat weeds and diseases.

Key words: *administrative, cultivation, climate, fertilizers, soil.*

INTRODUCTION

Sheki-Zagatala region is located in the eastern part of Azerbaijan and covers an area of 507.0 thousand hectares, which is 5.8% of the territory of the republic [7].

Sheki-Zagatala region, Caucasian mountain ranges, mainly gray-brown soils are spread in the area. There are also mountain-meadow, decaying-carbonate mountain-forest, brown mountain-forest, mountain-gray-brown, mountain-chestnut, brown and gray soils [1].

The hydrology of the peninsula in Sheki region has undergone certain changes as a result of the influence of natural processes and human activities and continues to remain so. The lack of flowing rivers, the uneven distribution of water sources and the presence of a large number of saline lakes in this area cause them to dry up and turn into typical salt marshes as a result of the high temperature and wind in the summer season. There are 8 main climate types and their 26 types of diversity in Azerbaijan [6].

One of them is the climate of the Absheron valley, and the climate of this zone differs from others due to its unique soil and climate conditions. It is included among the dry subtropical zones with hot summers, sunny autumns, and mild winters.

Climatic conditions of the region

Climate is one of the most important geographical factors that directly or indirectly shape the natural environment and determine the living conditions of all living things. It is also a system with a complex structure defined by the interactions between the hydrosphere (oceans and seas on the earth's surface), the atmosphere (gas mantle), the lithosphere (land) and the biosphere (living things).

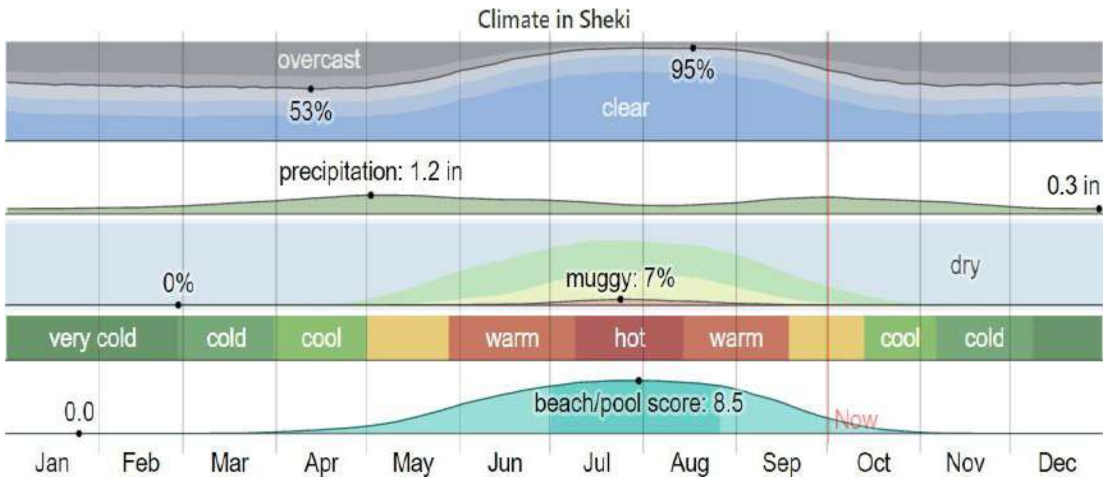
Of course, since global climate change is a very complex process, ideas about its causes are still debatable, and the main disagreement in climate change research is around the causes of warming and its predictions [3].

Climate and Average Weather Year Round in Sheki Azerbaijan

In Sheki, the summers are warm, dry, and clear and the winters are long,very cold, snowy, and partly cloudy. Over the course of the year, the temperature typically varies from 28°F to 86°F and is rarely below 21°F or above 94°F.

Based on the beach/pool score, the best time of year to visit Sheki for hot-weather activities is from early July to late August.

Scheme 1.

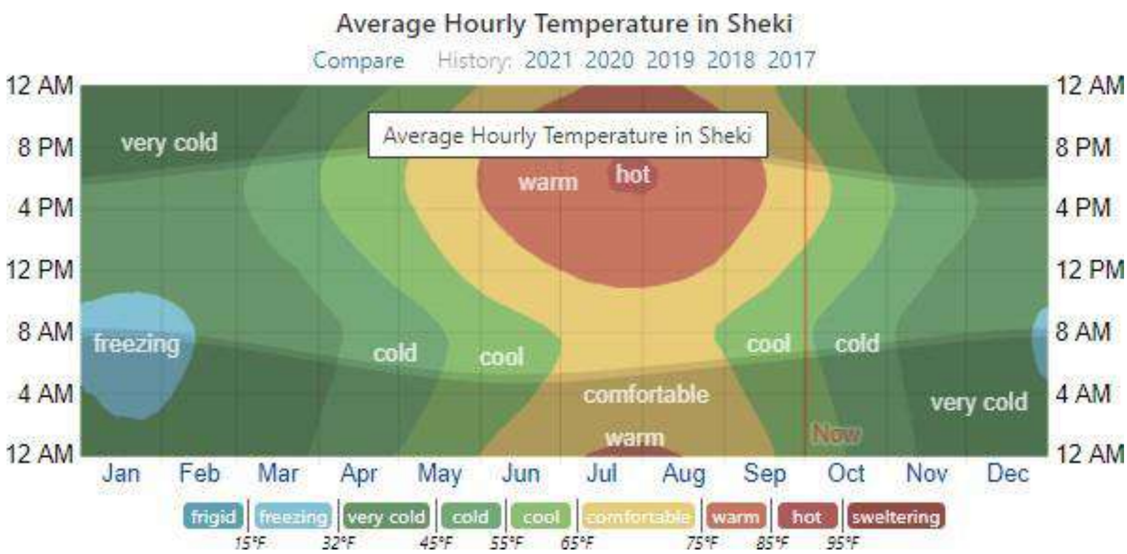


Average Hourly Temperature In Sheki

The hot season lasts for 3.3 months, from June 3 to September 12, with an average daily high temperature above 77°F. The hottest month of the year in Sheki is July, with an average high of 86°F and low of 66°F [2].

The cold season lasts for 3.8 months, from November 20 to March 15, with an average daily high temperature below 50°F. The coldest month of the year in Sheki is January, with an average low of 29°F and high of 41°F.

Scheme 2



Given day is whitin growing season

Growing degree days are measured of yearly heat accumulation used to predict plant and animal development and defined as the integral of warmth above a base temperature discarding any excess above a maximum temperature. In this report we use a base 50 ºF and a cap of 86^0 F. Based on growing degree days, alone, the first spring blooms in Sheki should appear around Aprel 11 only rarely apprearing before March 30 or after Aprel 26 [8].

Scheme 3

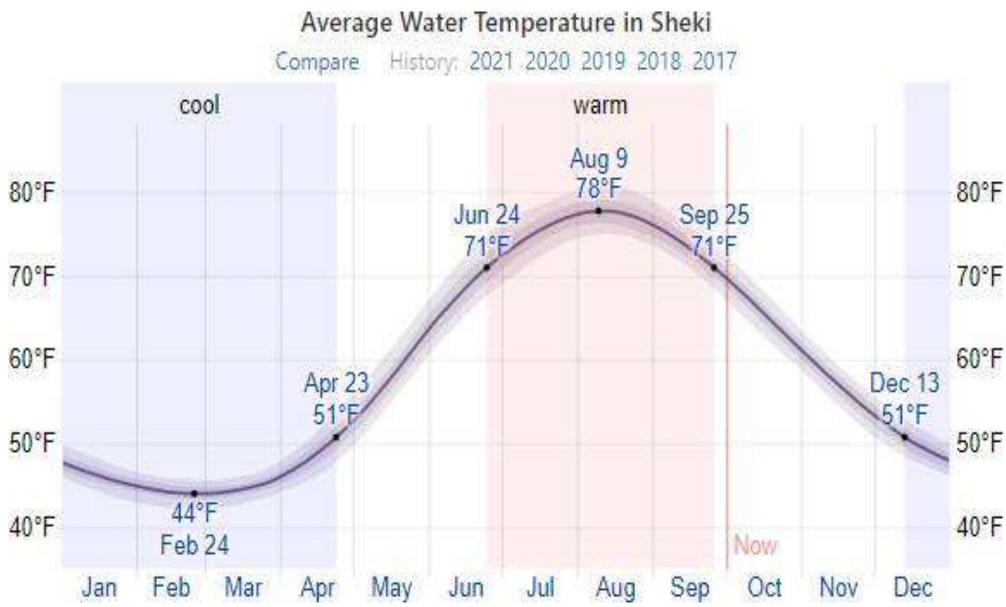
Water temperature

Sheki is located near a large body of water (e.g. ocean, Sea, m or large lake.) This section reports on the wide-area average temperature of that water. The average water temperature experiences signifacant variation over the course of the year.

The time of year with warmer lasts for 3.0 month from June 24 to September 25 within an average temperature above 71 ^{0}F. The day of the year with the warmest is August 9 with an average temperature of 78 ^{0}F [9].

The time of year with cooler water lasts for 4.3 moths, from December 13 to Aprel 23, with an average temperature below 51^0 F. The day of the year with the coolest water is February 24 with an average temperature of 44 ^{0}F.

Scheme 3



CONCLUSİON

It can be seen from multi-year hydrometeorological data that the studied area is included in the third agro-climatic region and its climate is characterized as dry, subtropical and moderately hot. The average number of hot days varies between 90-95 during the year. The average annual air temperature is 14.20C [5]. The average annual amount of atmospheric precipitation is 267.1 mm, mainly in the spring and autumn months of the year. The lowest air temperature is in January, and the highest temperature is 26.30C in July and August. The average annual total of the active temperature fluctuates between 3500-40000C. The average relative humidity of the air varies mainly between 60-73% depending on the year.

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ASSESSMENT OF EROSION PROCESSES IN THE ABSHERON PENINSULA OF THE CASPIAN SEA USING REMOTE SENSING TECHNIQUES

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Remote sensing methods are widely used (1990s) to study erosion processes. Remote sensing makes an important contribution to the assessment of erosion at various spatial levels. The use of remote sensing techniques has the potential to identify eroded areas and monitor erosion processes at the regional level. lines, zones of influence of geomorphological processes and quantitative indicators. The coastline and its dynamics of the coastal areas of the Absheron peninsula (according to geomorphological zoning: from Sumgayitchay to the Jeyrankechmez river) were studied using ArcGIS software using Landsat MSS, TM, OLI images of the coastal zone of the Caspian Sea for 1986, 2002 and 2019. The calculation was carried out using the WLR statistics of the DSAS method. The calculation was carried out using the WLR statistics of the DSAS method. Negative values obtained during the calculation indicate erosion, while positive values indicate accretion. Remote sensing based methods provide a cost effective way to investigate erosion or build-up where there are no available areas or direct field methods are expensive. An analysis of the compatibility of remote sensing data for identifying areas of erosion and accretion processes (accumulation), monitoring, assessing the impact on soil and other objects, shows the use of a number of images to solve these problems.

Keywords: *geomorphology, remote sensing, erosion and accretion processes*

INTRODUCTION

"Continental" and "marine" processes played an important role in the formation of the substrate of the coastal zone of the Absheron Peninsula. In conditions of low-contrast relief and the presence of a very poorly developed hydrographic network with a constant runoff, the nature and type of relief play the main role in the formation of the coastal zone. On the coasts of the Absheron (related to the areas of alpine folding), in areas of uplift, the main "peak" is given by abrasion and a smaller "peak" - coasts with dead cliffs and adjoining accumulative terraces. In areas of tectonic subsidence, accumulative leveled shores and abrasion-accumulative bay shores are most common; in stable areas - abrasion-accumulative bay, abrasion leveled and mainly coasts with dead cliffs and adjoining accumulative terraces. (L.G. Nikiforov, G.D. Solovieva, 1975).

In the absence of constantly functioning river systems in the formation of the coastal zone (all components of the physical and geographical environment), the main role belongs to the marine factor and, to some extent, the structure of the substrate. Under conditions of a stable sea level regime, the coastal land system expands into the aquatic system. In this process, an important role belongs to the arid-denudation process, the structure of the substrate and, very weakly, but still, the degree of loading of the rivers with sediments. Due to the increase in the relative load of the sediment flow, the front of the coastal zone advances towards the sea. This process was typical for the entire Pleistocene history of the coastal zone of the study region.

From the point of view of the complex of rocks, the forming Absheron Peninsula is distinguished by a variegated lithological structure. According to the research of Israfilbekov, I.A. Listengarten V.A. et al. (1980) identified the boundaries of lithological differences of 3 layers with different rock thicknesses (with the exception of the overlying rocks first from the day surface). The thicknesses of the identified gradations of the first layer are <2, <5, 5-10, >10, >20 m. According to the totality of factors that determine the degree of homogeneity of the territory, the above authors have identified: regions - on a tectonic basis; regions - by geo-morphology and districts - by lithology. The region of the first order is composed of clayey rocks, the region of the second order is composed of sandy loams lying on clayey rocks, and the third region is composed of sands lying on clays of different geological tiers.

The climate of the peninsula is characterized as a climate of moderately warm semi-deserts and dry steppes. It is formed under the influence of complex circulation processes in the atmosphere. The processes of atmospheric circulation are influenced by solar radiation and the Main Caucasian Range, this is a natural obstacle for air masses invading from the north. Air masses invade the Absheron peninsula with significant speed winds, causing a strong “north” wind. Significantly affects the dynamics of atmospheric circulation and the Caspian Sea. It softens the intense heat in summer, and in winter it reduces the temperature of the cold air masses of the northern direction. Climatic factors largely determine the quantitative and qualitative characteristics of the process of groundwater formation. According to Isra-filbekov I.A. and Listengarten V.A. (1980) in the region of study, on average, 227 mm of precipitation falls per year with an evaporation rate of 947 - 1344 mm. The total mineralization of atmospheric precipitation ranges from 56 to 208 mg/l, and its annual weighted average value is 102 mg/l. and 185 kg / ha / year of salts comes to the surface of the earth with solid precipitation. Of these, 13% is accounted for by NaCl. An important role in the formation of groundwater is played by the condensation of water vapour from the air. Hydrological factors determine the conditions for groundwater discharge, and these processes are most significantly influenced by long-term fluctuations in the level of the Caspian Sea. The drop in the level of the Caspian Sea leads to a certain decrease in the level of groundwater in coastal areas and the associated decrease in water inflows.

The balance of ground and underground waters in the region is composed of infiltration of atmospheric precipitation and condensation moisture, recharge of lakes and formation waters of the productive stratum, infiltration of leaks from irrigation canals and wells, recharge of waste oil waters from water receivers and infiltration of leaks from water supply systems. According to the table, the incoming part of the groundwater supply balance is 174.5 million m3/year, and the discharge is 166.7 million m^3/year. The share of underground runoff to the Caspian Sea is 98.0 million m^3/year, and this is 59.0% of the total flow. So, for example, 1978-1995. There was a sharp rise in sea level by an average of 14 cm per year. The coast of the territory of Azerbaijan receded by about 10-20 m/year, and on the shallows within 50-100 m/year. And before that, i.e. prior to 1978 was preceded by a drop in sea level. The rise and fall of the sea level causes the activation of all geomorphological processes of the coast. According to the map of the horizontal dissection of the relief surface of the region, the dissection coefficient of significant indicators (2–4 km/km2) is typical for the western part of the Absheron Peninsula. This is due to the low-mountain relief and the corresponding substrate. According to the hydrogeological conditions in the region of study, two parts are clearly distinguished: the western and eastern Absheron (the settlement of Nardaran-Cape Gousany). Clay rocks of pre-Quaternary age are predominantly developed in Western Absheron. Groundwater is associated with individual areas of development of the Upper Pliocene and Quaternary sandy deposits, often has a sporadic distribution, increased and high mineralization. As a rule, these are brackish or salty waters. Only in rare cases are fresh and slightly brackish waters found. Eastern Absheron is characterized by almost ubiquitous distribution of groundwater; their occurrence varies from fractions of a meter to 20 m or more. The hypsometric position of the groundwater table is determined by absolute marks from 30 to minus 31 m. The direction of the groundwater flow is radial - from the central parts of the peninsula to the shores of the Caspian Sea. The mineralization and chemical composition of the waters is varied; there are waters from fresh hydro carbonate calcium to chloride sodium-magnesium brines (Fig 1).

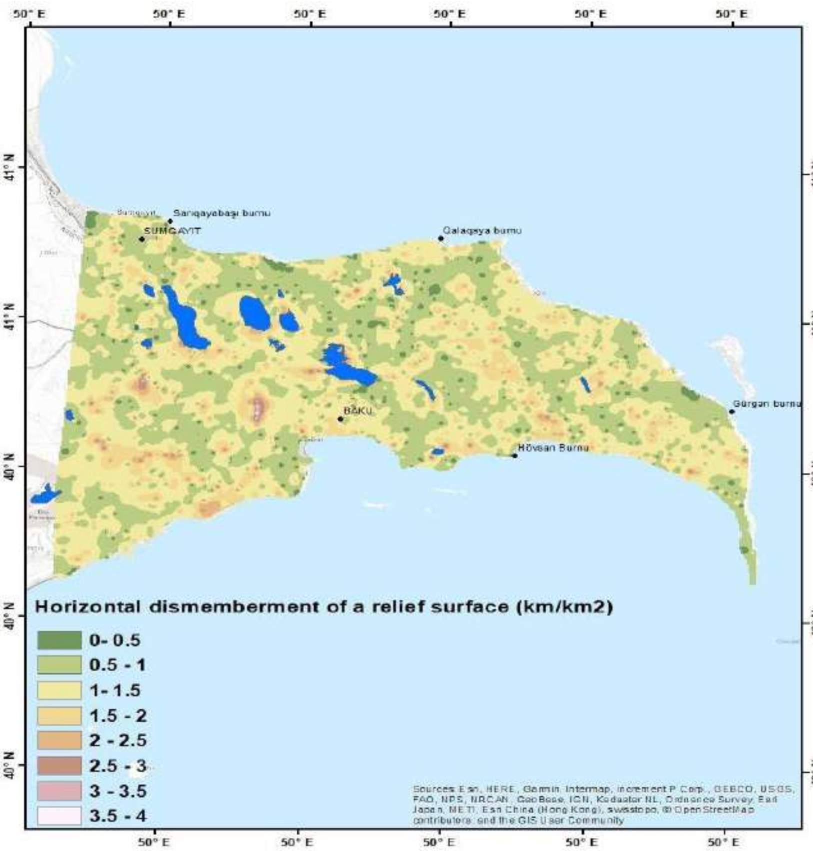

Fig 1. Map of the horizontal distribution of the relief surface

Sodium-magnesium chloride waters are found in areas where groundwater is recharged by waste oil waters. The rest of the territory has brackish or salty waters.

Geological and geomorphological factors are involved in the formation and circulation of groundwater. Ancient pre-Quaternary clayey rocks, exposed in the north western and western parts of the peninsula, are increasingly submerged to the east to a greater depth, where they are covered by a cover of Quaternary formations. The large thickness of the cover of Quaternary deposits in the eastern part of Absheron favours the accumulation of groundwater.

The relief is also involved in the formation of groundwater. For the accumulation of precipitation are hollows, ravines and other relief depressions.

The rivers of the study region are shallow and they directly carry their runoff (solid and liquid) towards the sea, sometimes without bringing their waters to the sea. These are: Sumgayitchay river - length 198 km, catchment basin 1751 km^2. It starts from an absolute height of 2000 m. In the nutrition of the river, 90% falls on the share of rainwater. Jeyrankechmezchay the length of the river is 100 km, the catchment area is 896 km^2. It originates from the south eastern slope of the Greater Caucasus, flows into the Caspian Sea. Has no tributaries. The flow of the river is formed mainly due to rainwater, therefore it does not have a permanent flow.

The study of modern erosion processes is directly related to changes in the turbidity of river water, the nature and dynamics of sediments in lakes and on the seabed (coastal areas).

MATERIALS AND METHODS

Remote sensing methods are widely used (1990s) to study erosion processes. Due to the presence on spacecraft of many sensors orbiting the Earth, remote sensing makes an important contribution to the assessment of erosion at various spatial levels. Studies have shown that the use of remote sensing methods has the potential to identify eroded areas and monitor erosion processes at the regional level. Several methodologies that are used to monitor erosion include spectral data, vegetation indices, and combinations of remote sensing data and morphological data.) Various semi-automated methods such as Tasseled Cap (Brightness, Greenness, Wetness) and DSAS (Digital

Shoreline Analysis System) were used to determine shoreline and shoreline dynamics, geomorphological impact zone and quantitative indicators. The coastline and its dynamics of the coastal areas of the Absheron peninsula (according to geomorphological zoning: from Sumgaytchay to the Jeyrankechmez River) were studied using ArcGIS software using Landsat MSS, TM, OLI images of the coastal zone of the Caspian Sea for 1986, 2002 and 2019.

The baseline was taken from a height of 200 m, and the processes of erosion and growth from this height to the coast were studied (Fig. 2). The calculation was carried out using the WLR statistics of the DSAS method.

WLR is a weighted linear regression, more robust data is given more emphasis or weight. The weight ("w") is defined as a function of the variance of the measurement uncertainty ("e") and is usually defined as: w = 1 / (e2)

The Accuracy field for the shoreline feature class in the DSAS data is used to calculate the weight, where: w = [1 /(precision2)] This is a typical weighting method, but it is important to note that there is no standard. an equation for determining a weighted linear regression (that is, other, more complex weighting schemes can be used). Our weighting method results in a best fit line that pays more attention to data points where coastline position accuracy is lower (years with lower +/- in accuracy field with more impact on best fit line). When all coastlines are of the same accuracy, the emphasis will not be on any particular year, so the best fitting line should be the same as the line calculated for normal/standard linear regression. All other related statistics must also match (LRR = WLR, LR2 = WR2, LSE = WSE and LCI = WCI). However, one exception is that the equation used to calculate the WSE has a weight component that is reversed (when all coastline weights are equivalent) when the weight is one. This results in different reported standard errors between weighted and normal linear regression. In these cases, there is no need for weighted regression (because all accuracies are the same), so weighted linear regression values should be ignored (Fig 2).

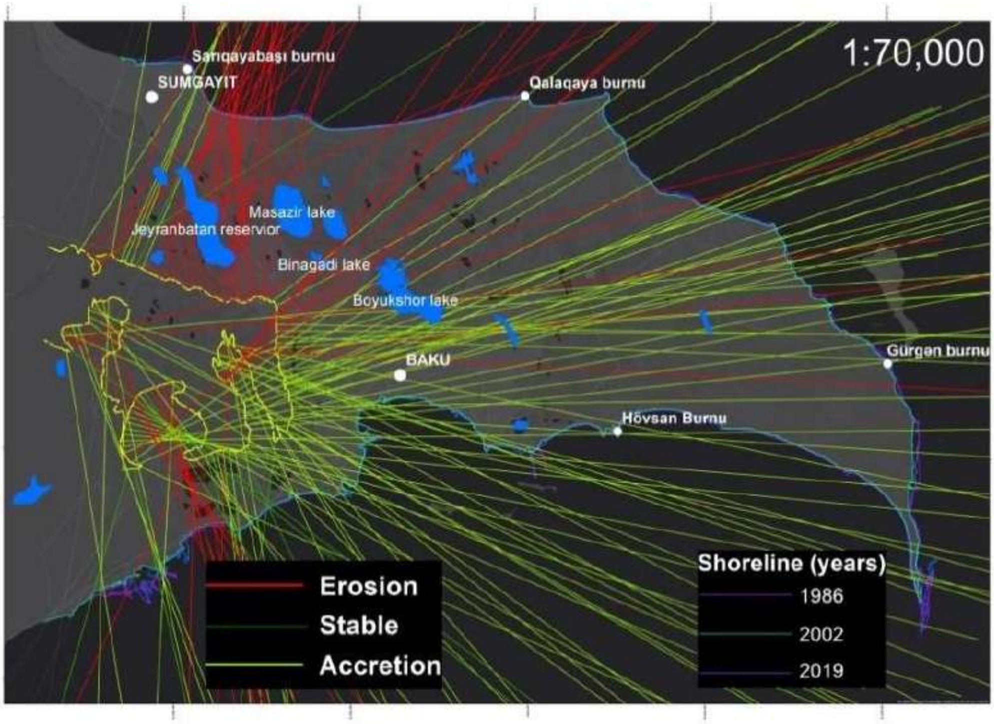

Figure 2. Erosion direction

RESULTS AND DISCUSSION

Negative values obtained during the calculation indicate erosion, and positive values indicate accretion (Fig. 3).

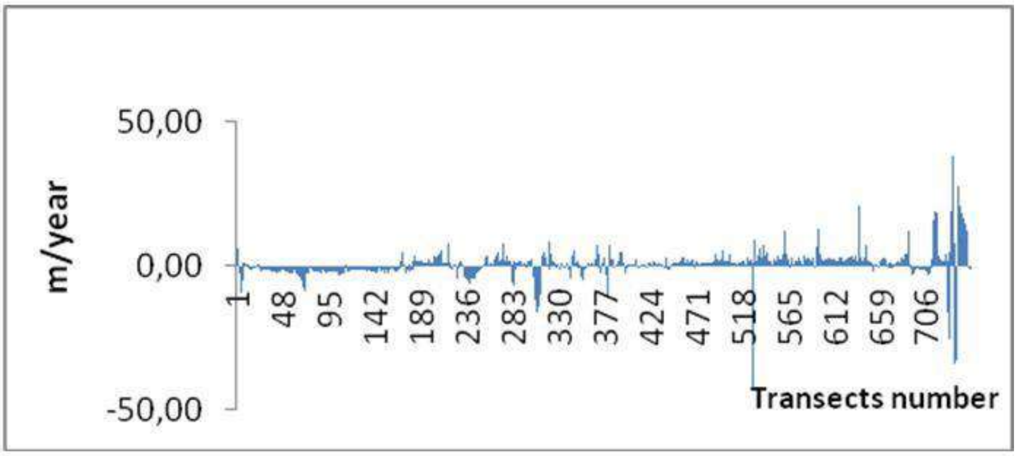

Figure 3. Erosion and acrcetion evaluation

Remote sensing data is an important source of information for mapping, monitoring and predicting growth and erosion. With the help of remote sensing of the Earth, one can quickly obtain information on the development of erosion processes, observe them both at a particular moment and over time. Although satellite imagery is expensive, research materials are sometimes provided free of charge. Thus, the main advantages of remote sensing are speed, accuracy and price. Remote sensing based methods provide a cost-effective way to investigate erosion or build up where there are no accessible areas or direct field methods are expensive (Fig 4).

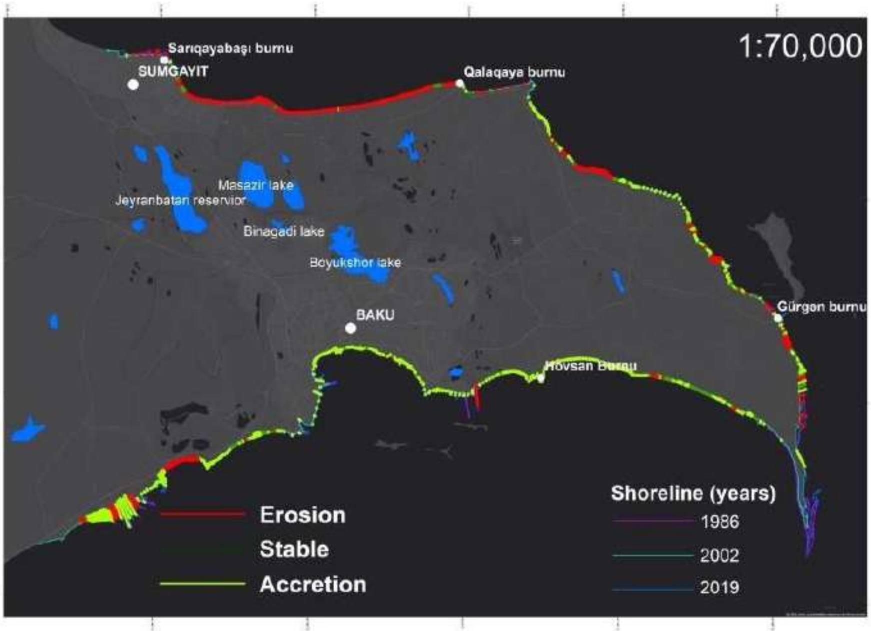

Figure 4. Coastal zone assessment

CONCLUSION

An analysis of the compatibility of remote sensing data for identifying areas of erosion and accretion processes (accumulation), monitoring, assessing the impact on soil and other objects, shows the use of a number of images to solve these problems. Satellite images make it possible to quickly and timely fix the presence and intensity of erosion processes, predict their impact on the relief, soils, arable land and landscape systems, as well as approve a number of measures to minimize environmental impact.

Acknowledgements

We would like to emphasize the cost-effectiveness of remote sensing-based methods in investigating erosion processes and coastal dynamics. These methods offer valuable insights, especially in areas where direct field measurements are expensive or inaccessible. The compatibility analysis of remote sensing data for identifying erosion and accretion areas, monitoring processes, and assessing their impacts on soil and other objects has highlighted the importance of utilizing multiple images to solve these complex problems.

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CHOICE OF CRITERIA FOR ECO-GEOBOTANICAL ASSESSMENT OF SOIL-VEGETATION COVER

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For the first time a new methodology for eco-geobotanical assessment of the soil and vegetation cover of the territory of Shirvan was developed based on the data on bonitation and ecological assessment of soils, as well as data on the assessment of natural plant communities. This method can be applied to areas similar in terms of soil and vegetation cover throughout the Republic.

Keywords: *soil, plant, bonitation, eco-geobotanical assessment*

INTRODUCTION

Protection of nature and rational use of natural resources are one of the leading and most important problems of mankind. At present, the deterioration of the ecological state of soils in the world has led, in particular, to desertification. 3.3 billion hectares (80%) of agricultural land are arid territories. As is known, 21% of irrigated areas of the earth, 77% of rainfed lands, and 8.2% of pastures are moderately prone to desertification. It should be noted that on a global scale, the main factors leading to desertification are water erosion, deflation, and destruction of vegetation cover. The solution to this problem requires an integrated approach, including environmental protection, proper and rational use of natural resources, etc. After 2001, a number of decrees of the President of the Republic of Azerbaijan for the conservation of biodiversity and a National Report and a Strategic Action Plan were prepared (1). The environmental assessment of such territories in their relevance is at the centre of scientists' attention (2,3).

The Shirvan region is also subject to degradation of landscapes and a tendency to desertification, and in this research paper, these processes are the most highlighted ones. According to real biocenoses, a part of the territory of Shirvan, in terms of aridity and climatic indicators, as well as xerophilic and salt vegetation, belongs to desert and semi-desert. The indicators of these ecosystems are xerophytes and halophytes. The irrational use of winter pastures and the failure to take measures to improve their condition resulted in a decreased productivity and a deterioration in the quality of forage. The surface coverage of such arid territories is characterised as highly underdeveloped (10-15%) (4).

MATERIAL AND METHODS

Objests of research were soil and vegetation of Shirvan zone of Azerbaijan. Bioecological and geobotanical methods; methods for studying vegetation resources and their productivity; ecological methods; soil research methods and pasture assessment method; bonitation method have been used.

RESULTS AND DISCUSSION

Both soil and vegetation in Shirvan have independent spatial dynamics to some extents have shown observations. Thus, there may not be an overlay of plant formations on soil contours: several plant formations can be distributed along one soil contour or, conversely, several soil contours can be distributed within one plant formation, which was taken into account when conducting an eco-geobotanical assessment (EGA) of soil-vegetation cover of Shirvan.

However, in most cases, the regularity of the variability of plant formations depending on the composition of the soil cover was observed both in mountainous and in lowland areas:

- in soil and plant communities distributed within alpine and subalpine meadows and meadow-steppe landscapes;
- in soil and plant communities of mesophilic, xerophilic forests, shrubs and dry mountain steppes;
- in agrophytocenoses

An EGA of the soil and vegetation cover which has both theoretical and practical significance can be a valuable tool in the management of soil and plant resources, as well as in optimizing the use of summer and winter pastures was carried out after the stage of a comparative assessment of soils and an ecological assessment of soil and landscape complexes at our research site. With this in mind, using the indicators obtained as a result of the study of vegetation and soil cover, we conducted the EGA of the soil- vegetation cover of Shirvan for the first time (Table 1).

The choice of evaluation criteria and the establishment of an eco-geobotanical assessment scale is one of the most important issues of soil and vegetation EGA. As with all forms of assessment, the choice of assessment criteria for EGA is associated with certain difficulties. The following formula has been used to determine the eco-geobotanical ball of soil-vegetation cover:

$$E_{gb}= [(B_t + B_p +B_o) + B_e]:n$$

Here, E_{gb} is the eco-geobotanical assessment of soil-vegetation cover; B_t is the yield of grain crops, expressed in ball; B_p is the yield of legumes, expressed in ball; B_o - productivity of motley grass, expressed in ball; B_e- ecological assessment of soils; n is the number of units (ball) participating in the assessment. The results of the EGA of the soil and vegetation cover of Shirvan in landscape complexes varied between the following parameters (Table 1):

Alpine and subalpine meadows and meadow steppes: 74 balls [cereals, motley grass (composition: juniper-feather grass-fescue), (mountain-meadow chernozem-like)] - 91 balls [motley grass-bean-cereals (mountain-meadow sod; mountain-meadow soddy-peaty)];

Mesophilic, xerophilic forests, shrubs and dry mountain steppes: 61 ball [legumes-cereals (composition: clover- wheatgrass-feather grass), (mountain brown steppe; mountain brown underdeveloped)] - 96 balls [cereals, legumes (composition: polyurus-bromegrass-couch grass), (mountain-forest brown typical)];

Dry subtropical steppes: 39 balls [motley grass (composition: wormwood-ephemeral), (mountain gray-brown (chestnut) meadow solonchak; mountain gray-brown (chestnut) underdeveloped; mountain gray-brown (chestnut) light solonetzic thin; mountain gray-brown (chestnut) light saline thin; mountain gray-brown (chestnut) ordinary deep-saline thin)]- 71 balls [cereals (composition: ephemer) (mountain gray-brown (chestnut) ordinary thin; mountain gray-brown (chestnut) ordinary gypsum; mountain gray-brown (chestnut) ordinary deep-salted; mountain gray-brown (chestnut) ordinary carbonate)];

Semi-deserts: 20 ball [motley grass (composition: wormwood ephemerality), (gray-brown solonetzic-saline;)] - 86 balls [salt-grass, (composition: petrosimonia, comb-salt-grass-grass petro-simonium), (meadow-gray dark irrigated; meadow - sierozem dark long-term irrigated; meadow-sierozem dark solonetzic long-term irrigated; sierozem-meadow ordinary irrigated)].

Table1.

Eco-geobotanical assessment of the soil and vegetation cover of Shirvan (fragment)

Landscapes	Soil and plant complexes	Productivity of plant formations, centner/ha/bal			Ecological ball of soils in plant formations	Eco-geobotanical ball of soil and plant association
		Cereal	Legum	Motl-gr.		
alpine and subalp.meadows and meadow steppes	Motley-grass-legume-cereals (mountain-meadow soddy; mountain-meadow soddy-peaty)	1200/100	210/100	1600/100	75,79	91
	Cereals, motley-grass (mountain-meadow chernozems-prominent)	1100/92	-	760/48	83	74
mesophilic, xerophilic forests, shrubs and dry mountain steppes	Cereals, legumes (mountain-forest brown typical,)	850/100	700/100	-	88	96
	Legumes, cereals (mountain brown steppe; mountain brown immature)	500/59	380/54	-	88, 42	61
dry subtropical steppes	Motley grass (mountain gray-brown (chestnut) light deep gypsum-bearing thin; mountain gray-brown (chestnut) light deep-saline; mountain gray-brown (chestnut) ordinary solonetzic;)	-	-	480/87	37, 48, 43	54
	Cereals (composition: ephemers) (mountain gray-brown (chestnut) ordinary thin; mountain gray-brown (chestnut) ordinary gypsum bath; mountain gray-brown (chestnut) ordinary deep-salted; mountain gray-brown (chestnut) ordinary carbonate)	-	-	550/100	53, 61, 58, 83	71
	Motley grass (mountain gray-brown (chestnut) meadow solonchak; mountain gray-brown (chestnut) underdeveloped; mountain gray-brown (chestnut) light solonetzic thin; mountain gray-brown (chestnut) light solonchak thin; mountain gray-brown (chestnut) ordinary deep-ashed, thin)	-	-	350/64	45, 38, 26, 27, 34	39

CONCLUSION

For the first time a new methodology for eco-geobotanical assessment of the soil and vegetation cover of the territory of Shirvan was developed based on the data on bonitation and ecological assessment of soils, as well as data on the assessment of natural plant communities. The eco-geobotanical assessment of the soil-vegetation cover of Shirvan, expressed in balls, made it possible to identify at the first time eco-geobotanical groups on the territory: high productivity (100-81 balls), average productivity (80-61 balls), low productivity (60-41 ballst), very low yield (40-20 balls) in the course of our research.

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STUDYİNG THE ECOLOGİCAL CONDİTİON AND PH VALUES OF THE KORCHAY STATE NATURE RESERVE BY THE "INTERPOLATİON METHOD"

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The Korchay State Nature Reserve, established in the western zone of the Republic of Azerbaijan, covers an area of 4833.6 hectares. It was established through a decree issued by President Ilham Aliyev on April 1, 2008, with the primary objective of preserving the natural landscape of Bozdag and protecting rare and endangered animal species. The reserve operates under a special mode to safeguard various types of animals, plants, and the natural landscape, which include plain, hilly, and low mountainous areas. In recent times, the application of modern technologies for environmental assessment has gained prominence. Consequently, one of the main tasks is to employ these technologies to study the ecological assessment of biological diversity within the protected area, while providing accurate electronic coordinates for enhanced precision. In this article, we will talk about determining the ph indicators of the area by the interpolation methods. The discusses the use of pH values in interpolation methods, particularly in environmental and geospatial analysis. Interpolation is a technique that estimates values between known data points based on their spatial relationships. pH interpolation methods, such as inverse distance weighting (IDW), kriging, and splines, can be employed to predict pH levels at unmeasured locations based on nearby pH measurements. This process aids in identifying areas with potential acidity or alkalinity issues in environmental monitoring, delineating soil acidity variations in agriculture, and assessing water quality in hydrology. However, it is important to acknowledge that interpolation introduces uncertainty, and the accuracy of interpolated pH values relies on the density and distribution of measured pH values and the spatial patterns of pH variation. Careful consideration of the interpolation method and validation against additional pH measurements are crucial for reliable results.

Keywords: *state nature reserve, pH value, interpolation, mapping, soil*

INTRODUCTİON

The Republic of Azerbaijan boasts an impressive 7 percent of its territory dedicated to various types of reserves, encompassing state-nature, historical, and other categories. These reserves are meticulously managed under a specialized nature protection regime. The primary objective behind their establishment is to safeguard natural areas and preserve their inherent qualities, including genetic diversity, biological richness, ecological systems, as well as natural complexes and objects. A crucial aspect of managing these reserves involves conducting state cadastral regions, which assesses and forecasts the condition of the reserve's natural resources. This process aids in determining the prospective development network for the area and strengthening state control to ensure the protection regime is adhered to. The initial reserves in Azerbaijan were established between 1925 and 1930, including Goygol, Zagatala, Kyzylagac, Hirkan in 1936, and Turyanchay in 1958. Subsequently, from 1930 to 1990, the number of state reserves grew from 3 to 15. By 2004, the country had 13 reserves, 4 national parks, and 17 sanctuaries, collectively spanning 194,898 thousand hectares, which accounted for approximately 2.28 percent of the nation's territory. The total area of specially protected natural areas in the republic reached an impressive 594,939.1 hectares.

These reserves play a critical role in conserving Azerbaijan's natural heritage and promoting ecological balance. By safeguarding these unique landscapes, the reserves ensure the preservation of the country's genetic resources and facilitate the survival of diverse flora and fauna. Moreover, the protection of ecological systems within these reserves contributes to the overall health of the environment, benefiting both local communities and the nation as a whole.

The establishment of nature reserves in Azerbaijan demonstrates the government's commitment to environmental sustainability and responsible stewardship. These reserves serve as havens for rare and endangered species, allowing for their protection and potential reintroduction to areas where they have become scarce. Additionally, the reserves offer opportunities for scientific research, educational initiatives, and ecotourism, which further promotes public awareness and appreciation for the natural wonders of Azerbaijan.

Efforts to expand the reserve network and protect additional natural areas are ongoing, reflecting the country's dedication to environmental conservation. By continually assessing the condition of existing reserves and identifying new areas of ecological significance, Azerbaijan aims to enhance its nature protection regime and ensure the long-term preservation of its remarkable biodiversity. Through collaborative efforts among government agencies, local communities, and environmental organizations, Azerbaijan strives to strike a balance between economic development and environmental sustainability, ensuring a prosperous future for both its people and its natural heritage.

The Korchay State Nature Reserve plays a vital role in maintaining the genetic diversity and ecological balance of the region. It serves as a habitat for numerous plant and animal species, including those that are rare and endangered. By protecting these species and their habitats, the reserve contributes to the overall conservation efforts in Azerbaijan.

In recent times, the application of modern technologies for environmental assessment has gained importance. This includes studying the ecological assessment of biological diversity within the protected area using advanced techniques and providing accurate electronic coordinates. By utilizing these technologies, the reserve management can gain valuable insights into the biodiversity and ecological health of the Korchay State Nature Reserve.

Overall, the Korchay State Nature Reserve stands as a significant conservation area in Azerbaijan, aiming to safeguard the natural heritage and promote sustainable management practices for the benefit of present and future generations.

MATERIAL AND METHODS

To create an interpolation of pH values, you would need a dataset of pH measurements at specific locations within your study area. The dataset should include the coordinates (latitude and longitude or any other spatial reference system) of the measurement points and the corresponding pH values.

Once you have the dataset, you can employ interpolation methods to estimate pH values at unmeasured locations within the study area. Several interpolation techniques can be used, including:

1. Inverse Distance Weighting (IDW): This method assigns weights to nearby measured pH values based on their distances to the target location. The weights decrease as the distance increases, and the estimated pH value is calculated as a weighted average of the nearby measurements.

2. Kriging: Kriging is a geostatistical interpolation method that models spatial autocorrelation in the dataset. It utilizes the spatial relationships between measured pH values to estimate pH values at unmeasured locations. Kriging considers the spatial variation, the direction, and the magnitude of pH values to generate interpolated estimates.

3. Splines: Splines are mathematical functions used to approximate the pH values between measured locations. They create smooth curves or surfaces that pass through the measured pH points while minimizing abrupt changes.

The choice of interpolation method depends on the characteristics of your dataset, the spatial distribution of pH values, and the desired level of accuracy. It is important to note that interpolation is an estimation technique and may introduce some level of uncertainty. The reliability of the interpolated pH values should be evaluated by comparing them with additional measured pH values and considering the overall spatial patterns of pH variation in the study area.

By utilizing interpolation techniques, you can create a continuous surface or map of pH values, which can provide valuable insights for environmental monitoring, spatial analysis, and decision-making related to pH-dependent processes or phenomena.

Kriging is a popular geostatistical interpolation method that can be effectively used to interpolate pH values. It takes into account the spatial autocorrelation or the relationship between measured pH values at different locations. Kriging provides a robust estimation of pH values at unmeasured locations by incorporating information from nearby measured points.

The process of using Kriging for pH value interpolation typically involves the following steps:

1. Data Collection: Collect a dataset of pH measurements, including their spatial coordinates (latitude, longitude, or other spatial reference system). Ensure that the data is representative of the study area and covers a sufficient spatial extent.

2. Variogram Calculation: Calculate the variogram or semivariogram of the pH values. The variogram quantifies the spatial variability or the dissimilarity between pH measurements at different distances. It helps to model the spatial autocorrelation of pH values, which is essential for Kriging.

3. Variogram Modeling: Fit a mathematical model to the experimental variogram to describe the spatial dependence of pH values. Common models include spherical, exponential, and Gaussian models. The choice of model depends on the shape of the variogram and the characteristics of the pH dataset.

4. Interpolation: Use the fitted variogram model to interpolate pH values at unmeasured locations. Kriging considers the spatial relationship between measured points and assigns weights based on the variogram model. The weights are then used to estimate pH values at the target locations.

5. Validation and Error Assessment: Assess the accuracy and reliability of the interpolated pH values. Validate the results by comparing them with additional measured pH values or through cross-validation techniques. Calculate error metrics such as root mean square error (RMSE) or mean absolute error (MAE) to quantify the interpolation error.

Kriging provides not only interpolated pH values but also estimates of the uncertainty associated with the predictions. The resulting interpolated surface or map of pH values can be used for further analysis, visualization, and decision-making related to pH-dependent processes or environmental assessments.

It is important to note that Kriging assumes stationarity, which means that the spatial patterns of pH values remain relatively consistent across the study area. If there are strong spatial trends or non-stationarity in the pH data, additional preprocessing steps or advanced variations of Kriging (such as universal kriging) may be necessary to account for these factors.

RESULTS AND DİSCUSSİON

As a result of the research conducted in the area, the following table was drawn up based on the samples taken from the reserve. (Table 1)

Table 1.

The pH indicators of the soils of the area

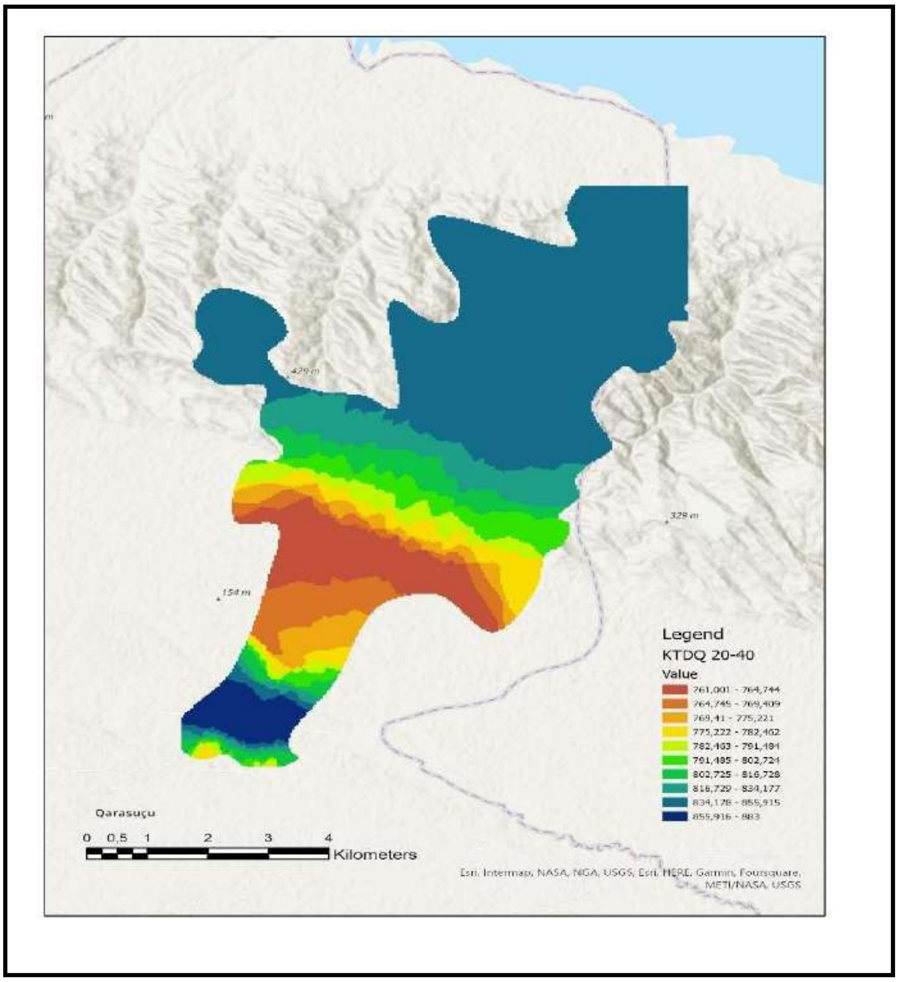
Name of the sample	pH value	pH normative
sample 1		
K-1 0-19	8.06	Medium alkaline
K-1 72-120	7.92	Medium alkaline
sample 2		
K-2 0-27	8.24	Medium alkaline
K-2 106-130	7.83	Weakly alkaline
sample 3		
K-3 0-25	8.21	Medium alkaline
K-3 65-91	7.93	Medium alkaline
sample 4		
K-4 0-17	8.05	Medium alkaline
K-4 92-124	7.72	Weakly alkaline
sample 5		
K-5 0-18	7.64	Weakly alkaline
K-5 116-140	7.86	Weakly alkaline

In this table, the pH values of soils taken from different soil types are given. As we can see, the pH indicator is slightly higher than the standard since the area is mostly alkaline soil. In alkaline soil, pH values typically range above 7 on the pH scale. However, the specific pH range considered "alkaline" can vary depending on different guidelines and references. Generally, alkaline soil is characterized by pH values ranging from 7.5 to 8.5 or higher.

Alkaline soils are often associated with regions where the parent material or geological factors contribute to high levels of carbonate, bicarbonate, or other alkaline substances. These soils tend to have elevated levels of calcium, magnesium, and other alkaline minerals.

It's important to note that not all plants are well-suited to alkaline soil conditions. Many plants prefer slightly acidic to neutral soil, and alkaline soil can affect nutrient availability and plant growth. However, there are plant species that have adapted to or tolerate alkaline conditions.

Based on the results we received, the pH indicators of the area were transferred to the map with Arcgis software, and the Ph map of the area was drawn up using the interpolation method. (Map 1)



Map 1. pH interpolation map of the area

CONCLUSİON

In conclusion, the study focused on the ecological condition and pH values of the Korchay State Nature Reserve in Azerbaijan using the interpolation method. The reserve, established in 2008, aims to preserve the natural landscape and protect rare and endangered animal species. The article emphasized the importance of employing modern technologies, such as interpolation methods, to assess the ecological diversity of the protected area accurately. Interpolation techniques, including inverse distance weighting, kriging, and splines, were discussed as means to predict pH values at unmeasured locations based on nearby measurements. These methods can assist in identifying areas with potential acidity or alkalinity issues, delineating soil acidity variations in agriculture, and assessing water quality in hydrology.

However, it is crucial to acknowledge that interpolation introduces uncertainty, and the accuracy of interpolated pH values depends on the density and distribution of measured pH values and spatial patterns of pH variation. Therefore, careful consideration of the interpolation method and validation against additional pH measurements is necessary to obtain reliable results.

The also highlighted the significance of the Korchay State Nature Reserve as a conservation area, contributing to genetic diversity and ecological balance. The use of modern technologies and the study of pH values provide valuable insights into the reserve's biodiversity and ecological health. By integrating modern technologies and understanding the pH characteristics of the area, the reserve management can make informed decisions regarding environmental monitoring, land management, and conservation strategies. The mapping of pH values using the interpolation method aids in visualizing and analyzing the pH distribution within the reserve, facilitating effective resource management and protection measures.

Overall, this research contributes to the ongoing efforts of Azerbaijan in preserving its natural heritage and promoting sustainable environmental practices. By studying and understanding the ecological condition and pH values of protected areas like the Korchay State Nature Reserve, the country can ensure the long-term conservation of its biodiversity for future generations.

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DIRECTIONS OF SOIL FORMATION IN ARID SUBTROPICAL FIELDS IN THE CONDITIONS OF MODERN CLIMATE CHANGES

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It was determined that strong changes happened in the arid subtropics in the last years. The information of the separate metrological points indicates that the temperature has risen and an amount of the precipitations has decreased everywhere in the Kur depression. The temperature has risen +1.0-1.5^{0}C and a quantity of the precipitations has decreased 10-60 mm.

These indicators are mostly felt in the summer and autumn season. Increase of temperature and decrease of rainfall had a negative effect on organic residue entering the soil, the biological activity was weakened and mineralization was intensified. Soil formation, including humus formation weakened. Therefore the change is mostly felt in the grey-brown and in the upper 20 cm layer of the grey soils which are used as a pasture, but this change isn't felt towards depth. Mixing of the soil mass at 0-25 cm due to cultivation in the upper horizon in the sowing soils, strong changes doesn't happen in soil formation due to application of organic and mineral fertilizers.

Key words: *Climate change, arid subtropical fields, soil formation, temperature, moisture, humus, organic residue.*

INTRODUCTION

At present the main characters of the changes happened in climate are actually accompanied by increase of temperature and decrease of rainfalls. Firstly, this affects the landscape transformation, soil processes and evaluation . Increase of the temperature in a small quantity index of the arid climate condition, enervations in water regime cause transformation in the landscape, change of soil processes and evaluation. Density of plant cover reduces and the botanical composition undergoes noticeable change. A quantity and composition of organic residue weaken as a result of aridity occurring in the plants . This process is mainly noticeable in the pasture soils of the research zone.

An investigation of the effect of the climate changes on soils is one of the actual problems in soil science. Many scientific centers of the world are engaged with the study of this problem . A main aim of our researches was to investigate directions of evaluation and process of soil formation spreading in the arid subtropical fields due to climate changes. Because the changes occurring in climate under the arid bio-climate condition affect soil cover, their composition indicators, morphogenetic and morphometric characters. These processes also intensify salinization, solonetzification, erosion and dehumification [1].

RESEARCH OBJECTS AND METHODS

The researches were performed in the soils spreading in the arid subtropical fields under physical-geographical condition of the Kur depression in the Republic of Azerbaijan. Here, arid field and semi-desert subtropical climate with mild winters and dry hot summers prevails. The annual average temperature is 14-15^0 in the separate points . Generally, an area of the pastures in the arid subtropical fields reaches 740 thousand hectares. These pastures are situated in the plans of Jeyranchol, Ajinohur, Bozdagh-Gazanbulaq, Shirvan, South- eastern Shirvan and Mughan [1].

The Cenozoic green sedimentary rocks prevail in the research zone. An age of the rocks rejuvenates towards the east. The surroundings of the Kur river, including the surroundings of the rivers that join it in both directions, are covered sediments, delluvial and prolluvial rocks in relatively high areas, while the areas near the Caspean Sea are covered with rocks of marine origin [2,3,4,5].

Though the plains prevail in the relief, they are distinguished with complexity, an absolute height changes by 28-1000 m. The inclination is from west to east. The west and north-west of the province are divided by the ravines network. The ancient river valleys in the Kur lowland and location of stagnant lakes near them are characteristic. Ajinohur massive around the Jeyranchol and Mingachevir water storage is concerned the low is belonged to the low front upland[3].

A climate of the research zone short mild semi-desert arid . They are totally characterized as arid subtropics. The average annual temperature is 13.1-14.5^0 C. But a quantity of the precipitations vibrates by 250-400 mm [1, 6, 13]. The vegetation of the zone is: ephemers, saline grass, -wormwood and they are considered a main fodder base of the animals in the winter months.

Grey-brown, grey, grey-cinnamonic and salinities of various origin are characteristic for arid landscapes. Zoning plays a main role in soil distribution. Resistance of these soils to erosion is weak and sensible for salinity [3].

The modern methods were used for research conduction. During the fulfillment of the field work, the methods of geographical comparison and semi-stationary research methods were applied. The mathematic-statistics and CIS were used in collection and analyses of the facts. H.A,Kachinsky [17] and M.S.Shalitin's methods were used in study of the plant root systems-subsoil part. According to these methods, 0.25m^2 (50×50 cm) monoliths were taken (in four – secondary), it was washed through a 0.25 mm sieve. The chemical composition, physical and water-physical features of the soils were totally defined by the adopted methods [15, 18].

Analysis of the research consequences

The climate changes are reflected in quantity indicators of the temperature and amount of rainfall. We determined the differences of these indicators of the climate in the research zone on seasons of 1961-1990 compared to 1991-2021 years. An analysis of the temperature was performed on the basis of data of the meteorological stations in this physical-geographical province. It is known from the analysis that increase of the temperature in winter is observed in all the points except Imishli station (Table 1).

Table 1.

Differences of the seasonal temperatures between 1961-1990 and 1991-2021

№	Meteorological station	Height, m	Winter	Spring	Summer	Autumn	Annual
1.	Kurdamir	2	+1,1	-0,5	+1,6-	+1,8	+1,1
2.	Mingachevir	93	+4.4	-0.5	-0.1	+1.1	+1.2
3.	Imishli	-3	-0.1	-0.1	+1.8	+1.9	+0.9
4.	Beylagan	55	+1.0	-0.2	+0.8	+1.8	+0.9
5.	Goychay	94	+0.5	-0.1	+1.1	+1.7	+0.8
6.	Zardab	-5	+1.1	-0.4	+1.7	+1.9	+1.1
7.	Bilasuvar	4	+0.6	-0.2	+1.2	+1.6	+0.8
8.	Salyan	-22	+0.8	+0.2	+1.3	+1.8	+1.0
9.	Shamkir	165	+0.9	-0.1	+0.9	-1.0	+0.2
10.	Ganja	309	+0.8	-1.2	+1.2	+1.3	+0.6
11.	Aghstafa		+0.9	-0.2	+1.1	+1.2	+1.0

The most temperature increase was 4.4 ^{0}C in Mingachevir, the least temperature was 0.5^0 in Goychay. The temperature decreased to 0.1-1.2^{0}C in all the stations except in Salyan point in spring months. The temperature decreased to 0.1-1.2 ^{0}C in the stations except Mingachevir in the summer season. The temperature increased in all the stations except Mingachevir in the summer season. The temperature rose in all the stations except Shamkir in the autumn season. Almost, the most temperature was observed in the autumn season. An average annual increase of the temperature was noted in all the stations. The highest index was 1.2^0 C, the least one was 0.2^{0}C in Shamkir. It is possible to conclude from the analysis that a temperature -a main element of the climate rose in the zone. It is seen from the second table that reduction of the precipitations happened in all the stations except two points (Imishli and Ganja). Decrease of precipitations occurred in the summer and autumn months. A quantity of annual decrease of the rainfall was 4.0-65.7 mm (Table 2).

Table 2

Differences of the seasonal temperatures between 1961-1990 and 1991-2021

№	Meteorological station	Height,m	Winter	Spring	Summer	Autumn	Annual
1.	Kurdamir	2	-7.0	+30.9	-18.5	-20.1	-14.7
2.	Mingachevir	93	-12.6	+25.6	-3.3	-65.8	-65.7
3.	Imishli	-3	+5.3	+43.0	-18.2	-19.9	+10.2
4.	Beylagan	55	+12.3	+36.5	-19.4	+29.3	-0.1
5.	Goychay	94	+5.1	17.6	-22.7	36.6	-30.5
6.	Zardab	-5	+5.8	+6.2	-23.5	-20.1	-31.7
7.	Bilasuvar	4	+10.5	+34.6	-12.1	-39.6	-6.6
8.	Salyan	-22	+1.5	+25.7	-19.3	-24.6	-16.7
9.	Shamkir	165	-12.1	+0.1	+7.6	-44.7	-49.1
10.	Ganja	309	-1.6	+27.3	-1.9	-19.8	+4.0
11.	Aghstafa	340	-13.4	+21.2	-18.9	-23.5	-34.6

The change indicators of the temperature and precipitation is one of the reasons of the degradation development for semi-desert and arid field landscape.

At present the bio-climate parameters of the semi-desert and arid field landscape zones in the research province of the Kur depression were shown on Table 3. Here, an annual quantity of precipitations is 285-466. The average annual temperature is 13.1-14.5^{0}C. The temperature is observed is observed in the Kurdamir and Imishli stations (14.5^{0}C), the least one is in Aghstafa (13,15^{0}C).

It is known that the soil processes is related to humidity regime as well as temperature. According to R.H.Mammadov's research an annual average index of the field moisture was 20-25% in the grey-brown soils, but it was 15-18% in the grey soils before 1990 [12,13]. Therefore these soils are formed in the arid condition. But the field humidity isn't higher than 10-15% in July. A constant height of temperature doesn't allo the moisture to rise. The experiment shows that it covers 20-25 cm-layer in the pastures and negatively affects the soil processes in this part. It forms difference in the cultivated soils depending on agro-technical measures. The heat entering the soil makes its intensive transformation though there is enough moisture in the soil. This process occurs very intensively during the plowing period. But it is necessary to note that the same transformation is noticeably different in development phase of the plants grown depending on the seasons of the year. The observation shows that in the last 30 years the field humidity decreased 15-20%, and its quantity was 15-20 % in the grey-brown soils, but it was 12-18 % in the grey soils. Therefore a water regime was formed without a nest in these soils. That's why all the processes in these soils are related to the atmospheric precipitations. These changes in climate strongly reduce productive moisture reserve in the soil. As a result, the activity of ferments which forms soil-formation, humus-formation weakens or stops completely. According to R.H.Mammadov's information the moisture reserve was higher in the grey-brown and grey soils before 1990 to the current period. But this difference changes on seasons. (Table 3). Though the most difference appears in the winter, not using the moisture reserve during that period weakens its effect. But minority of the moisture reserve weakens soil processes or stops completely in the summer months. From Table 3 it is known that similarity occurs in both soils. Majority of the precipitations intensifies soil processes in the summer months depending on climate condition. That is, microbiological activity grows, humus-formation occurs optimally at the expense of decomposition of the organic residues.

Table 3

Difference of the productive moisture reserve in the soils of the arid subtropical field from 1990 to 2020 (0-30 cm) mm

Time	Winter	Spring	Summer	Autumn	In V-IX months	Annual
the grey-brown soils						
Before 1990,according to R.H.Mammadov	45.0	45.1	7.2	21.1	22.1	118.4
At present according to the research of 2020	43.0	43.2	6.1	19.0	20.5	111.3
the grey soils						
Before 1990,according to R.H.Mammadov	38.5	39.2	6.8	18.3	20.2	102.8
At present according to the research of 2020	35.3	38.1	5.7	17.1	18.4	96.2

There is no need for argument that a large number of microorganisms main and decisive role in conversion processes of the organic substances gathering under the plants dependent on hydrothermal conditions. The new plant residues decompose quite intensively under conditions of temperature (35-37^{0}C) and sufficient humidity (40-50 % from soil weight). The whole main mass of the new plant residues can be decomposed in a short time, because such condition is very good for activation of life action of microorganisms.

The plant residues decomposed in a hot-dry climate are slowly mineralized. Their mineralization is very fast under conditions of high temperature (50-60^{0}C) and humidity (50-60 % from soil weight). In these perished plant residues it is seen that the thermophilic microorganisms actively participate .

While the temperature is sufficient, the plant residues can decompose under conditions of the low temperature (0-10^0 C), their decomposition velocity grows as the temperature increases. Very dried plant substances decompose very sufficiently, so their mineralization temp grows consistently as the temperature increases, but it reaches a much higher degree at very high temperature. The observation indicates that in conditions of very low humidity and high temperature it continues until the last products of the plant residues are obtained. But decomposition of the soil rot goes at a relatively low temp. In order to reveal a decomposition velocity of the rot under different humidity and temperature, the results of the laboratorial experiments prove it. It is known that decomposition intensity of humus changes depending on hydrothermal condition [10, 11, 14, 19].

From Table 4 as can be seen that the decomposition temp of soil rot grows very much and its quantity sharply decreases in the air compared to arid soils while irrigating the ordinary grey-brown and grey soils under arid climate condition in the dry subtropical fields. This is explained with the activity of life action of the microorganisms which use soil humus as a carbon nutrition source.

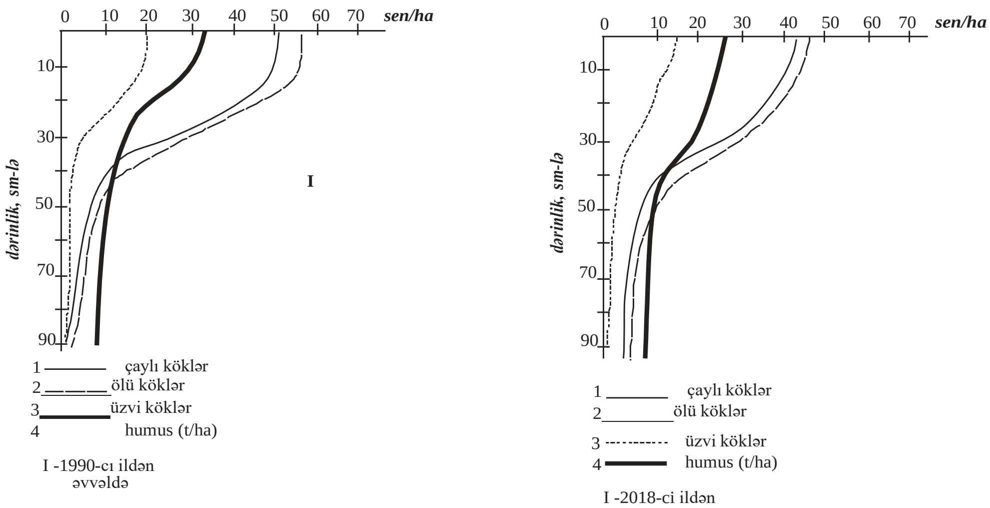
The experiment shows that a decomposition velocity of organic substance especially grows as the soil temperature increases. While the temperature grows from 3^{0}C to 37^{0}C, the decomposition velocity of humus rises steadily and it reaches [8,12] the highest level at 65 ^{0}C (especially in the air -dry soil). At this time the soil rot can decompose not only under an effect of biological factors, but also it undergoes chemical oxidation as a result of the high temperature effect

Table 4

Impact of change of the temperature and humidity of soil on humus quantity

Name of soil	Temperature degree, on C	Soil fertility In dry state in the air	In a state of capillary moisture
Ordinary grey-brown	3-10 25 38 65	3.34 3.29 3.16 2.97	3.10 2.83 2.57 2.07
Grey soil	3-10 25 38 65	2.10 1.99 1.89 1.48	2.01 1.67 1.52 1.03

Molecules of humus acids change under an influence of high temperature and can be well assimilated by microorganisms for nutrition. S.A.Aliyev shows that 10-39 % of the first quantity of humus can be mineralized at 65^{0}C in the air and dry soil during a year. Loss of organic substances is more in the grey-brown soil, but it is somewhat weak in the grey soil [20].



Picture. Change of composition fraction of wormwood-ephemeral biomass in biogeocenoses.

We determined a change of fraction of the biomass composition in sein dry subtropics during the research period. It was known that it reduced in 2020 compared to the 90th years (pic). It is seen that the living roots, dead roots, organic dust and humus reserve decreases till 40 -60 cm along profile and then it stabilizes towards depth. S.A.Ganiyev and E.A.Gurbanov's researches prove that a quantity of subsoil and surface reserves sufficiently reduce in wormwood-ephemeral biogeocenoses [7].

As a result of long researches S.A.Aliyev determined that active enzymes that play a main role in soil processes- 12-18^{0}C temperature and 18-25% humidity in a optimal development of invertase, 14-20^{0}C and 20-30 % in phosphatase, 20-25^{0}C and 20-25% in protease, 12-18^{0}C and 18-25% in catalase, 18-25^{0}C and 18-25 % in polifenoloxidasa. They are good environment for soil processes [7]. As it is shown that the temperature increased and humidity reduced as a result of climate change in the arid subtropical fields. Consequently, the soil-formation process sufficiently decreased.

CONCLUSION

Increase of temperature and decrease of moisture occurred as a result of the climate changes, and this changed a direction of the soil-formation in the arid subtropics. Weakening of microbiological activity stops humus-formation direction and accelerates mineralization in dry-hot period of the year.An amount of organic reserve sharply weakens in wormwood-ephemeral biocenoses. Occurrence of weakening in soil-formation has a negative influence on its fertility indicators.

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ENVIRONMENTAL PROBLEMS ARISING IN THE SOIL AS A RESULT OF OIL DERIVATIVES

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The Republic of Azerbaijan is a country rich in natural resources - oil, gas, ore deposits, construction materials. Improper implementation of a number of technological processes during the production and use of natural resources eventually leads to the disturbance of the ecological balance of the landscape. It also includes production and transportation of oil and oil products. In this regard, the negative impact of oil pollution on the biosphere is particularly relevant, one of the most characteristic features of the 20th and 21st centuries is the strengthening of anthropogenic influence on the normal course of the environment. As a result of anthropogenic influence, significant changes have occurred in the soil-ecological parameters of the Absheron peninsula.

Today one of the biggest problem in the world is the increasing of the pressure on the environment as a result of technogenetic development's reaching a larger scale. In other words, the role of anthropogenic influences in the ecological crisis has reached its peak that it manifests itself shows in abnormal climatic conditions, increasing natural disasters, and so on. Most countries have already been forced spending more power for overcoming these consefuences. Of course, it has also been materializing various measures to solve environmental problems in our country that have existed for many years.

Key words: *oil pollution, soil, physical-chemical degrees, recultivation, health.*

INTRODUCTION

Land and oil are indispensable for the development of the national economy. Land is used for cultivation of agricultural products, and crude oil is used for raising valuable products. Therefore, both blessings should be used properly. Due to the high development of industry in several countries of the world in the age of technical progress, land cover degradation has become widespread. Instead of the fertile lands under which agricultural crops were grown, meadows, and pastures, quarries have been dug, covered with unusable strata, roads have been built, and the land has been destroyed. Absheron Peninsula is an oil extraction region with a history of nearly 200 years. Lack of modern oil extraction technology, non-observance of environmental protection has led to the creation of land areas contaminated with oil and oil products on the peninsula. As a result of the exploitation of oil fields, a large amount of oil has accumulated on the surface and inside the soil. As a result, the fertile layer of the soil has been severely degraded. Mechanical disturbance of the soil surface, the vegetation cover of the fertile soil layer has completely decreased. In other words, soil pollution with oil has led to the complete destruction of biological productivity.

Based on many years of research, the following factors affect land degradation in our republic: loss of organic matter, weakening of biological activity, agrophysical degradation, soil erosion, salinization, technogenic and chemical pollution [1].

The main goal of eliminating this tension in the soil-plant system of the peninsula is to determine the physical, physical-chemical, agrochemical, biological and sanitary-hygienic indicators of man-made disturbance processes as well as the genetic characteristics of polluted soils.

Contaminant composition and degradation stages, together with soil self-healing potential, determine the ecological basis for remedial measures. The self-recovery potential of degraded soils should be taken into account for the amount of pollutants that can be released into the soil for individual soil types [2].

MATERIALS AND METHODS

Oil-contaminated, tarry bituminous soils from the surface are spread in the territory of all oil and gas extraction departments of the Absheron peninsula. For the purpose of studying the morphological-genetic and agrochemical properties of this type of pollution, oil-contaminated areas were selected on the Absheron peninsula, soil sections were placed, and samples were taken along the soil profile. Granulometric content, humus, carbonation, etc were analyzed in these samples. analyzes were conducted according to generally accepted methodology.

ANALYSIS AND RESULTS

As a result of the conducted scientific-research works, the level of oil pollution of land areas in some oil extraction areas of the peninsula was determined as high, medium, weak. Thus, in these areas, the oil content of moderately contaminated soils is in the range of 12.0-16.4%. These soils are light gilly sandy soils. Soil composition of soils moderately polluted with oil was determined. This composition consists of organic and chemical, physical-chemical indicators, the amount of humus in the 0-20 cm layer is 1.14%, and 1.00% in the 0-50 cm layer. The ratio of carbon to nitrogen is equal to 7.7 and 8.8, respectively. The amount of oil here is 16.4% in the 0-20 cm layer, 18.0% in the 0-50 cm layer, and 12% in the 0-100 cm layer. Chemical indicators refer to the general form of biogenic elements (N2O5, P2O5 and K2O). Thus, in these soils moderately polluted with oil, in the 0-20 cm soil layer the total N is 0.08%, P is 0.13%, and K is 1.6%. The reaction of the environment (pH) is neutral or weakly alkaline. In addition to soil composition, soil properties were determined for moderately oil-contaminated soils. These include agrophysical properties, i.e., soil density, specific gravity, porosity, humidity, and agrochemical properties include nitrogen, phosphorus, and potassium, easily absorbed forms of nutrients by the soil. The sanitary-hygienic condition of the oil-polluted gray-brown soils of the Absheron Peninsula is determined by the amount of oil that causes soil pollution and the degree of infection of the population living in these areas with various diseases. The excessive amount of heavy metals and radioactive elements in oil-contaminated soils causes a decrease in the amount of microelements necessary for the human body. It causes many negative consequences for the human body. Thus, the number of people infected with various diseases in the moderately oil-contaminated areas of the peninsula has been determined: infectious diseases - 2.3%, respiratory tract diseases - 4.7%, digestive organs diseases - 2.8%, circulatory diseases - 3.4%.In order to improve the soil-ecological indicators of the Absheron peninsula, to restore the biological productivity of oil-contaminated soils, these soils must first be cleaned. The development of new effective recultivation measures for cleaning these lands is one of the most urgent problems.

In most of the industrially developed countries of the world, reclamation works are carried out in disturbed areas due to the production of coal, building materials, mining and chemical raw materials, oil and gas. The reclamation of moderately polluted lands with oil is in the center of attention of the whole world [3].

In areas moderately polluted with oil, the depth of pollution is 60 cm deep in some places. During the recultivation of such lands, first of all, the upper layer of the soil should be partially cleaned of fuel oil and repeated plowing should be carried out for 2-3 years. In general, chemical and biological reclamation measures should be implemented for the reclamation of moderately oil-contaminated lands. Chemical reclamation measures include washing these soils with high-quality adsorbents, mineral and organic fertilizers. Biological reclamation is carried out by planting perennial herbs.

Recultivation of soils moderately polluted with oil, good results can be obtained if biogenic additives "Biotrin", "Gumi", "manure" are added to "Devoroyl" biopreparation.

The best result is obtained when using "Devoroyl" and "Biotrin", as at this time the oil products undergo an average of 96% decomposition [6].

In the recultivated areas, especially those used under perennial plants, the activity of microflora is significantly activated, its quantitative and qualitative indicators change, fermentation activity increases. When a mixture of grain-leguminous plants is cultivated on the layers, it accelerates the development of the soil tillage process. Intensive humus accumulates in a short period of time, differentiation of primary soils takes place [5].

The development of reclamation works on the Absheron peninsula depends on natural conditions, the type of degraded land, economic purposefulness, and social effects expected from reclamation. Recently, certain works have been done in the field of assessment of oil-contaminated lands of the Absheron peninsula depending on the degree of pollution. Land scoring or bonitirovka is a scoring evaluation of soil fertility. Soil diagnostic signs and indicators may be different for different soil types during soil inspection. This is due to the fact that soil thickness, humus supply, granulometric composition and other natural properties have different effects on the productivity of agricultural plants in different soil zones. Evaluation of the soils of the Absheron peninsula moderately polluted with oil is the main condition for the effective use of these soils in agriculture. The predicted solvency score for these lands is equal to 34 according to the soil properties. Thick gray-brown soils with bonitet of 100 were taken as benchmark.

Increasing control over the use of land resources in the Republic of Azerbaijan, restoration, increase, protection of natural fertility of lands that lost their fertility and degraded lands during the period of social economy, etc. Many such issues have been studied in depth and comprehensively for the first time [4].

The experience in the field of pollution of the environment with petroleum products and the elimination of this pollution shows that objective assessment of the polluted ecosystem, forecasting the change of this quantity, as well as effective measures aimed at cleaning and restoring the fertility of the polluted land, taking into account the degree of variability of the landscape, the stages of transformation of pollutants, should be carried out, it is possible to spend.

CONCLUSION

The degree of contamination of contaminated land on the Absheron peninsula has been determined. Physical-chemical, sanitary-hygienic indicators of soils were determined depending on the degree of pollution.

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DEVELOPMENT OF MATHEMATICAL MODELS AND INTELLIGENT EXPERT SYSTEMS FOR INTEGRATED USE OF FRESHWATER RESOURCES

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Considering management problems and new realities in water management, distribution of freshwater resources is one of the important issues to be solved in the region. Here, it is important to consider the interests of each of the parties, conduct negotiations and find compromise solutions. To analyze the above-mentioned problems, to understand their essence and to find compromise solutions, it is important to create four-system mathematical tools and mathematical models developed on this basis. Mathematical models and tools using computer technologies to make coordinated decisions on the problem and efficient use of resources in water basins are already being created in many countries. Creating dynamic monitoring and prediction models with probabilistic-statistical characteristics that consider all possible properties of underground and surface, natural and artificial water sources. Creation of method and program complexes for selection and management of operation mode of closed and open water basins based on dynamic mathematical models. Prevention of salinization and swamping in irrigated areas suitable for cultivation, selection of irrigation method and regime to ensure moisture-salt exchange in accordance with the requirements of the "Soil" management system, management of groundwater levels and development of soil fertility recovery models.

Keywords: *water-soil problem, complex use, mathematical models, predictions, expert systems.*

İNTRODUCTION

To improve water supply in the future, it is not enough to reduce water use and use it economically; it is necessary to accelerate scientific and practical work to increase and comprehensively use water resources. The problem of managing the efficient use of water is especially relevant due to the acute shortage of water in many world regions. According to a number of international organizations (for example, FAO, the Food and Agriculture Organization of the United Nations), by 2030 the demand for fresh water worldwide will increase by 60% [1].

At present, in hydrology, as in other geosciences, fundamental changes are taking place due to the introduction of information technologies, available data, the emergence of new algorithms for their processing and analysis. In modern conditions, the water problem is one of the main factors affecting the sustainable development of countries. The aggravation of the water problem has a direct impact on the food supply of the population and the environmental safety of the regions [3].

To select the optimal source of precipitation data in the snow cover model, we compared the reliability of calculating the total precipitation of the cold period according to weather stations, as well as according to the WRF, GEM, GFS, and ICON weather forecast models. 70% of the world's resources are river and groundwater - for irrigation, 20% - for industrial and other needs, 10% - for domestic needs. Due to growth in the next 25-30 years, the use of fresh water by the population in the world will be 70%. Due to the current climate change, the situation will worsen, more intense natural changes (droughts and floods) will occur [2.4].

Within the framework of each of the above-mentioned separately, problems related to the use of water lead to tense relations between countries and states. At the same time, the occurrence of conflict situations is not excluded. Therefore, taking into account management problems and new realities, the distribution of fresh water resources is one of the important issues that need to be addressed in the region. Here it is important to take into account the interests of each of the parties, negotiate and find compromise solutions. To analyze the above problems, understand their essence and search for compromise solutions, it is important to create a four-system mathematical apparatus and mathematical models developed on its basis [5.7].

Mathematical apparatus and means using computer technologies for making coordinated decisions on the problem and efficient use of water basin resources are already being created in many countries [6]. A National Action Plan on Integrated Water Resources Management has been prepared for Azerbaijan. The National Action Plan identifies 4 main problems. More efficient use of water resources; Adaptation to climate change to protect water resources; Protection of aquatic ecosystems; Water quality improvement.

RESULTS AND DISCUSSION

Reducing the volume of fresh water under the influence of natural and anthropogenic factors, their rational use and integrated management is one of the urgent problems of our time. Therefore, it is very important to address the questions below. For this, it is very important to create operational monitoring, reporting and forecasting models and address the following issues.

1. Creation of dynamic monitoring and forecast models with probabilistic and statistical characteristics, taking into account all possible properties of underground and surface, natural and artificial water sources.
2. Creation of methodological and software complexes for selection and control of operation modes of closed and open reservoirs based on dynamic mathematical models.
3. Prevention of salinization and waterlogging of irrigated lands suitable for cultivation, selection of irrigation method and regime to ensure moisture-salt exchange in accordance with the requirements of the “SOIL” management system, groundwater level management and development of soil fertility restoration models.
4. Development and application of reporting models and algorithms for minimizing the harmful effects of soil erosion and deformation processes during natural disasters such as floods and landslides.
5. Computer modeling of water consumption and yield management in crop production.

What needs to be done to achieve this goal:

- Creation of a knowledge base
- Simulation
- Creation of expert systems
- Creation and implementation of an applied software package
- Key factors to consider
- Melting of snow cover and glaciers on mountain slopes
- Rainwater entering the source and the river basin
- Evaporation of water from the surface of rivers, canals and reservoirs
- Seepage of water into the soil
- Water used for irrigation and other purposes
- Groundwater infiltration

Development of a methodology for calculating the maximum amount of water that may result from snowmelt in mountain rivers (taking into account all real effects), calculating the maximum amount of water resulting from melting and rain mixed with rivers (taking into account geographical factors, results of long-term hydrometeorological observations etc.), flow velocity and turbulence. A functional relationship between the coefficient is found.

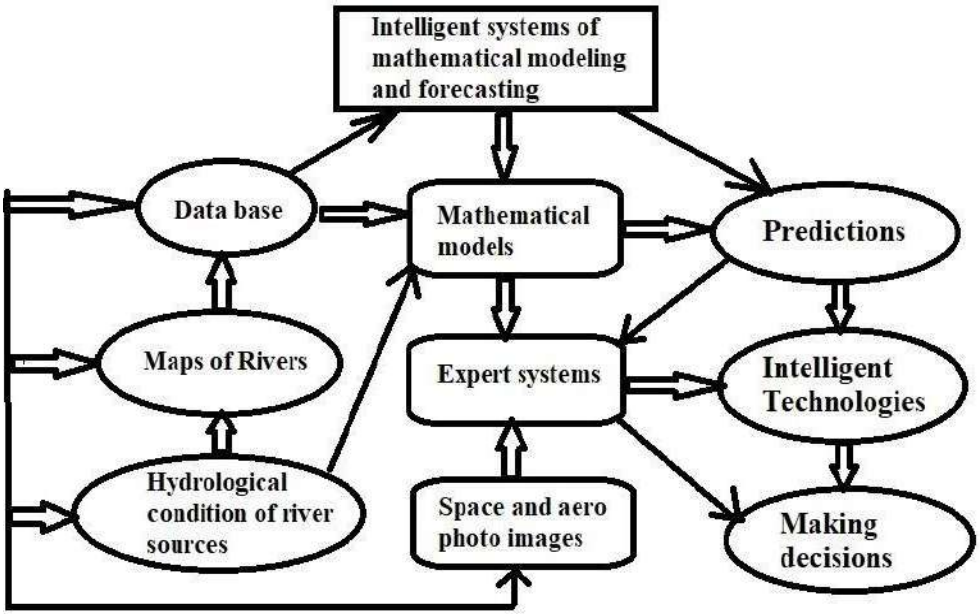

Fig. 1. The structure of the proposed complex

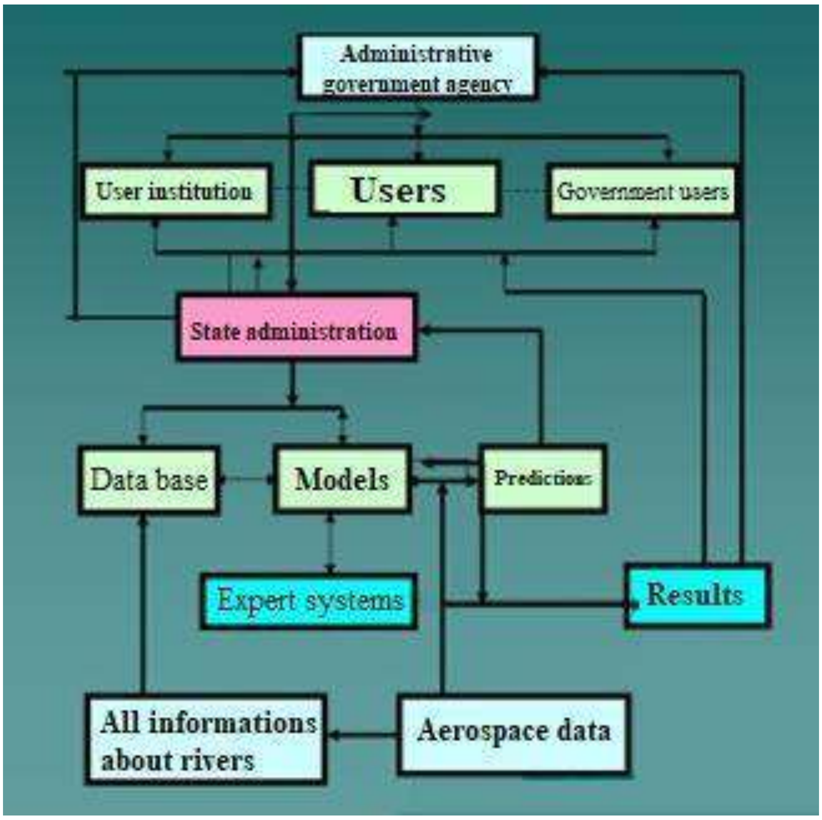

Fig. 2. The structure of users complex

Number of tanks: N_{si}, *(i=1,2,........ n)*

Capacity of reservoirs: $Q_i(t)$, $Q_{i\min} \le Q_i(t) \le Q_{i\max}$

Number of channels: N_{ki}, *(i=1,2,. ....n)*

Main controllable parameters: The amount of water consumption in a certain section of the river. In the simplest version, the working scheme can be proposed as follows.

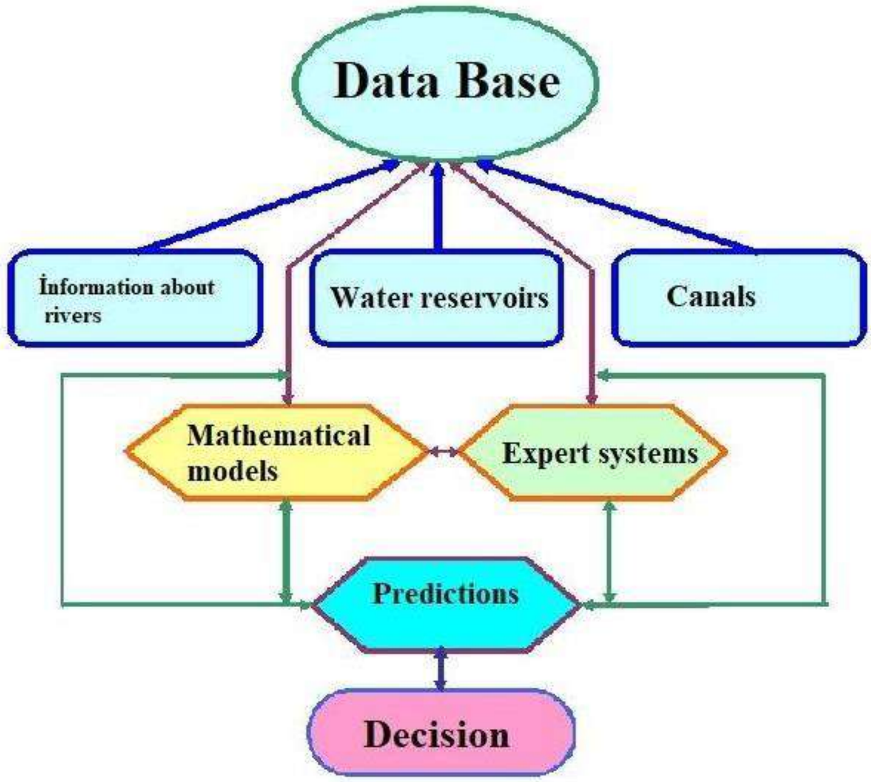

Fig. 3. Main controllable parameters

CONCLUSION

In addition to the above-mentioned, a number of other hydrological problems await their solution. Many hydrological directions necessary to meet the needs of water management and environmental protection are currently not developed or poorly developed in Azerbaijan. Examples of such areas are channel processes, water flow, mathematical and physical modeling of hydrological processes, flood events, hydrological forecasts, the impact of climate change on water resources, experimental hydrology, river estuaries and the hydrological processes occurring in them can be shown. Mathematical modeling of hydrological processes is one of the most promising areas of modern hydrology. It is believed that in the future all hydrological problems can be solved using various mathematical models. In Azerbaijan, where water resources are limited and unevenly distributed both over time and territory, these resources are gradually declining and their quality is deteriorating under the influence of economic activity and climate change. All this necessitates increased attention to the development of these and other related areas of hydrological science, one of the main tasks of which is the study of water resources, as well as the training of personnel at all levels in the field of hydrology.

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COMPARATIVE CHARACTERISTICS OF DIAGNOSTIC PARAMETERS OF ALLUVIAL-MEADOW SOILS OF WET AND DRY SUBTROPICAL ZONES OF RIVER FLOODPLAINS OF AZERBAIJAN

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This study presents the results of the investigations of soil forming processes in the alluvial-hydromorphic soils of the humid and arid subtropical flood plains in Azerbaijan. The priciple diagnostic indexes of primary, bedded and dark suborders as well as its washed out and carbonated suborders were determined. The mineralization rates and salt composition of the underground water and soils were studied. The group and fractional composition of humus was studied representing high activity of humic acids. The analysis of the total chemical composition showed that washed out soils in the humid subtropical zone rich in R_2O_3 (26,8-29,2%), however, CaO content increases (8,0-15,4%) in the soils of the arid subtropical zone . The leached alluvial-meadow soils are rich in active forms of iron (Fe^{3+}- Fe^{2+}) while carbonated soils contains considerable less iron.
Keywords: *soil diagnostics, carbonates, soil profile, soddy-alluvial soils, ground water,*

INTRODUCTION

The importance of river valleys for the development of agriculture of the ancient East has long been known. The first information on early farming is con- fined to places with a favorable moistening regime and high natural potential fertility of soils, which include floodplain-alluvial lands [1]. The soil cover of river floodplains is characterized by the exceptional dynamism of the soil formation process and the variegated structure of the soil cover. Because of this, genetic features, classification position, and diagnostic indices of floodplain-alluvial soils have been poorly studied compared to zonal soils [2–4]. Alluvial-meadow soils are widely distributed in the humid and arid subtropics of the river valleys of Azerbaijan and have a high fertility potential. In a half-meter thickness, they are fairly well provided with humus, gross nitrogen, and nutrients. Soils are under periodic surface and ground moistening conditions and are characterized by favorable water-physical properties. Due to the lack of systematic research, the floodplain soils of the river valleys of Azerbaijan, including alluvial-meadow soils, have not been sufficiently studied. Only some primary information on the soils of the Kur-Araz and Lankaran lowlands is found in the works of V.R. Volobuev [5] and R.V. Kovalev [6]. A significant part of these soils are used for pastures, hayfields, and shrubs. In recent years in the republic, much attention has been paid to the development of floodplain lands as a reserve fund for agricultural production, especially vegetable growing.

OBJECT AND METHODS OF RESEARCH

The object of the study consisted in the floodplains of the Kura River and the Lankaran Lowland of Azerbaijan. The Kura River is a large artery of eastern Transcaucasia, the width of its floodplain along with the first terrace above the floodplain is 3–5 km. The investigated area of the floodplain of the Kura River with an area of more than 200000 ha is located in the Kur-Araz Lowland and refers to a semiarid subtropical bioclimatic area characterized by an arid climate. The average annual amount of precipitation is 270– 310 mm, the evaporation is 950–1100 mm, the humidification coefficient is <0.4, the average annual air temperature is 14.1–14.5^{0}C, and the sum of active air temperatures is 3800–4000^{0}C. The vegetation cover is represented by herbage-meadow phytocenosis, leaving in the soil 135–200 c/ha phytomass annually. The Lankaran Lowland is characterized by a moist subtropical climate with the annual precipitation of 1100– 1300 mm, evaporating capacity of 800–900 mm, humidity factor of 1.3–1.5, average annual temperature of 14.0–14.3^{0}C, and the sum of active temperatures of 3600^{0}C.

In 2017–2019, during field soil works using the methods of key sites, three characteristic areas of 10– 15 ha have been identified, in each of which more than ten soil sections were established at a depth of 1.5–1.8 m, and their soil maps were compiled on a scale of 1 : 2000. In soil samples, the granulometric composition was determined by the pipetting method of trituration with a solution of sodium pyrophosphate, the volume weight was determined according to N.V. Kachinskii, the content of humus and gross nitrogen according to the method of I.V. Tyurin, the amount of absorbed Ca^{2+} and Mg^{2+} cations according to D.V. Ivanov, Na according to K.K. Gedroits, pH of aqueous suspension was found using the potentiometer, CO content of carbonates using the calcimeter, water-soluble salts and gross soil composition were estimated by the classical method by E.A. Arinushkina, and the fractional and group composition of humus according to I.V. Tyurin in the modification of V.V. Ponomareva and T.A. Plotnikova. The moisture content of soils and the content of ferrous oxide and iron oxide soluble in 1N sulfuric acid (according to K.V. Verigina) were studied. A sample of soil to determine the content of ferrous oxide and iron oxide was taken from the genetic horizons in a state of natural moisture. Ferrous oxide (Fe^{2+}) was determined colorimetrically by red blood salt with α–α dipyridyl, iron oxide (Fe^{3+}) was also determined colorimetrically by sulfosalicylic acid, and water-soluble humus was found according to I.V. Tyurin. In the study at the end of May 2018, the soil temperature was recorded.

RESEARCH RESULTS AND DISCUSSION

Comparative-geographical studies and detailed mapping made it possible to significantly detail the structure, classification position, and nomenclature of alluvial-meadow soils of humid and arid subtropics of the floodplains of Azerbaijan as well as to specify the morphogenetic diagnostics of the soil profile. According to the conditions of occurrence, the nature of the soil-forming process, and the degree of development of the genetic profile, these soils are subdivided into three suborders: alluvial-meadow primary, alluvial- meadow bedded, and alluvial-meadow dark suborders. The alluvial-meadow soils are also divided into leached and carbonate differences [7–11]. That being said, we were guided by the main sources [12–14].

Alluvial-meadow leached soils are common on the cones of mountain river outflows in the humid sub- tropics of the Lankaran Lowland on noncarbonate alluvial sediments. The mineralization of groundwater (0.46–0.75g/l) differs little from river water. In soils, the humus content is relatively high and is characterized by a neutral medium (pH 6.4–7.0).

Table 1.

Composition (g/L) of groundwater salts of alluvial-meadow soils of the floodplains of Azerbaijan

Section no.	Depth, cm	Dense residue, g/l	CO^{2-}_{2}	NCO_3^-	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	$Na^+ + K^+$	pH
Humid subtropics of the Lankaran Lowland										
902	156	0.648	No	0.285	0.049	0.032	0.052	0.039	0.044	7.7
905	168	0.754	“	0.346	0.092	0.028	0.082	0.020	0.010	7.8
910	152	0.462	“	0.190	0.035	0.059	0.064	0.021	0.028	7.5
913	174	0.546	“	0.242	0.031	0.104	0.076	0.028	0.031	7.7
Arid subtropics of the Kura River floodplain										
445	182	1.826	No	0.504	0.226	0.384	0.062	0.056	0.348	8.0
444	174	1,804	“	0.549	0.112	0.566	0.068	0.049	0.365	8.1
352	187	2.252	“	0.578	0.356	0.517	0.091	0.060	0.486	8.2
355	178	2.348	“	0.519	0.336	0.856	0.126	0.082	0.534	8.4
453	165	2.186	“	0.435	0.252	0.768	0.130	0.154	0.412	8.4
450	152	3.802	“	1.234	0.285	0.980	0.086	0.139	0.770	8.6
172	164	6.124	“	0.788	0.719	1.947	0.232	0.112	1.429	8.7

Carbonate alluvial-meadow soils are formed in the arid subtropics of the Kura River floodplain. Soil- forming alluvial deposits are characterized by high carbonate content. The mineralization of groundwater varies widely (1.7–6.2g/l). According to the composition of the salts, they refer to the sulfate-hydrocarbonate and sodium type (table 1).

Tabl.2.

Basic physicochemical indices of alluvial-meadow soils of the floodplains of Azerbaijan

Section no.	Horizon depth, см	Humus, %	Nitrogen, %	$CaCO_3$, %	Dense reside, %	Water suspen-sion pH	Absorbed cations, mmol/ekv 100 g soil				Qranulometric composition, %, mm		Bulk weight, g/cm^3
							Ca^{2+}	Mg^{2+}	Na^{+}	∑	<0,001	<0,01	
Alluvial-meadow soils of humid subtropics (lankaran lowland)													
Alluvial-meadow primary leached soils													
912	AYv 0-6	2.07	0.13	No	0.10	6.5	12,3	4.0	0.2	16.5	9.6	19.1	1.12
	AYz 6-20	1.90	0.12	“	0.08	6.6	11,2	3.8	0.3	15.3	8.5	15.7	1.24
	A/C 20-35	0.95	0.08	“	0.12	6.8	9.2	4.2	0.3	13.7	7.6	27.3	1.31
	CIg 35-52	0.88	Not defined	“	0.10	6.9	8.0	3.1	0.2	11.3	5.9	32.2	1.35
	CIIg 52-85	0.69	“	“	0.11	7.1	6.9	2.7	0.2	9.8	4.1	15.6	Not defined
Alluvial-meadow bedded leached soils													
910	AUv 0-10	4.32	0.29	No	0.14	6.4	15.2	5.4	0.3	20.9	17.4	40.6	1.14
	AUz 10-28	3.24	0.17	“	0.12	6.5	14.7	4.9	0.2	19.8	12.6	32.1	1.25
	A/B 28-50	2.41	0.14	“	0.10	6.6	11.8	4.4	0.2	16.4	11.4	37.8	1.34
	B/Cg 50-95	1.10	Not defined	“	0.09	6.7	7.1	2.6	0.3	10.0	6.0	11.6	1.37
	$AU^{h}{}_{g}$ 95-120	2.27	“	“	0.08	6.5	14.0	3.8	0.4	18.2	17.9	40.4	No tdefined
	Cg 120-145	0.85	“	“	0.11	7.0	8.3	3.0	0.2	11.5	8.0	15.8	“
Alluvial-meadow dark leached soils													
913	AUv 0-12	6.46	0.38	No	0.08	6.6	19.4	6.7	0.3	26.4	25.0	56.3	1.10
	AUz 12-36	5.60	0.29	“	0.10	6.7	18.9	6.8	0.3	26.0	26.8	62.2	1.24
	A/B 36-58	3.45	0.15	“	0.12	6.8	16.0	5.3	0.2	21.5	29.4	65.8	1.49
	Bg 58-90	1.21	Not defined.	“	0.14	7.0	13.5	6.0	0.3	19.8	23.2	30.1	1.46
	Cg 90--150	0.77	“	“	0.13	7.1	9.0	3.7	0.2	12.9	11.4	28.5	Not defined
Alluvial-meadow soils of arid subtropics (the Kura river floodplain)													
Alluvial-meadow primary carbonate soils													
445	AYvca 0-6	1.52	0.13	12.3	0.16	7.8	12.8	5.0	1.0	18.8	11.8	30.4	1.12
	AYzca 6-23	1.06	0.12	11.0	0.24	7.9	12.0	4.7	1.1	17.8	8.4	26.5	1.30
	A/Cca 23-48	0.84	0.08	14.5	0.22	8.0	10.5	3.8	1.1	15.3	9.2	28.3	1.38
	CIgca 48-89	0.57	Not defined.	11.9	0.27	7.1	8.0	3.4	1.4	11.8	5.9	21.8	1.35
	CIIgca 89-125	0.34	“	9.0	0.23	8.2	8.8	3.0	1.2	13.1	7.3	24.7	Not defined
Alluvial-meadow bedded carbonate soils													
352	AUvca 0-10	2.82	0.20	11.2	0.23	8.0	19.1	4.0	1.2	24.4	9.0	38.3	1.13
	AUzca 10-28	1.66	0.12	11.0	0.25	8.0	17.6	5.6	1.0	23.1	12.2	46.8	1.28
	B/Cca 28-67	1.06	0.07	11.8	0.28	8.2	18.0	5.8	1.1	24.9	6.8	34.9	1.34
	CIgca 67-103	0.85	Not defined.	11.3	0.27	8.3	10.4	4.6	0.8	15.8	2.2	21.2	1.42
	$AU^{h}{}_{g}$ 103-128	2.12	“	10.8	0.23	8.0	15.0	8.2	1.2	24.5	18.6	44.8	Not defined
	CIIg 128-170	0.77	“	13.5	0.28	8.3	12.8	5.2	0.7	18.9	8.4	17.4	“
Alluvial-meadow dark carbonate soils													
450	AUvca 0-12	3.70	0.30	5.8	0.36	7.9	21.8	6.6	1.7	30.8	26.7	62.7	1.16
	AUzca 12-34	3.27	0.27	8.6	0.38	8.0	18.4	5.8	1.2	31.7	31.4	68.4	1.30
	A/Bca 34-56	1.97	0.11	15.0	0.34	8.2	13.5	6.7	1.2	21.4	23.0	62.2	1.35
	Bgca 56-89	0.96	Not defined.	14.3	0.46	8.2	17.5	6.0	1.5	25.0	20.8	39.7	1.42
	Cgca 89-130	0.53	“	12.0	0.52	8.5	12.5	6.7	0.9	17.4	10.7	26.5	Not defined

The weak mineralization of groundwater (1.8–2.3g/l) is significantly affected by the infiltration of river beds. Therefore, primary and bedded alluvial-meadow soils are hardly saline (dense residue 0.16–0.28%). Notable signs of salinity were observed in the alluvial-meadow dark soils, where the dense residue is 0.46–0.55%. Here the mineralization of groundwater rises to 3.8–6.1 g/l. HCO_3 (0.78–1.23 g/l) predominates in the salt composition, and there is significant SO_4^{2+} (0.98–1.95g/l) and Na^+ the mineralization and hydrocarbonate content of water is considerably influenced by side effluents.

Alluvial-meadow primary soils are mainly distributed in the riverbed area of river floodplains. They are in the initial stage of development, and their process of primary soil formation occurs in conditions of temporary surface (flood) and insignificant ground moistening with the participation of underdeveloped meadow and herb-gramineous vegetation. The level of ground- water is very dynamic and f luctuates sharply in the seasons of the year from 1.5–2.0 to 3.5 m. In the studied soils, the weakly humified horizon (AY) is loose, bedded, its thickness does not exceed 15–20 cm, and the humus content is 1.5–2.1%. This is confirmed by the low productivity of the aboveground (15–20 c/ha) and the root mass (8.9-10.3t/ha) of vegetation. These soils are characterized by a light loamy sandy-loam granulometric composition (<0.01mm=15.6–30.4%; <0.001mm= 4.1-11.8%). The soil profile is characterized by a reduced value of the absorption capacity (16.5–20.9 mmol/ekvl) (table 2). The following underdeveloped genetic horizons are distinguished there: **AYv-AY-CIg-CIIg; AYvca-AYca-CIgca-CIIgca**.

Table 3.

Group and fractional composition(% of total) of humus of alluvial-meadow soils

Section №	Horizon, depth, cm	C, %	Bitumen	Decalcinate	C, % humus carbon									$C_{h.a}:C_{f.a}$
					humic acids				fulvic acids				humin	
					fractions									
					1	2	3	sum	1	2	3	sum		
Alluvial-meadow leached soils of humid subtropics (Lankaran Lowland)														
910	AUV 0-8	2.51	3.07	2.62	17.80	4.24	3.26	25.30	20.42	3.50	2.86	26.28	35.20	0.96
	AUZ 8-26	1.88	3.20	2.28	15.20	4.76	2.47	22.43	17.20	3.02	2.67	23.89	27.10	0.98
	A/B 26-42	1.40	1.52	3.48	14.46	3.45	2.56	20.47	15.26	3.68	3.70	22.64	29.34	0.90
913	AUv 0-12	3.75	4.95	4.70	18.26	4.50	3.64	26.40	24.26	2.80	1.82	28.88	37.24	0.84
	AUz 12-36	3.25	3.30	4.86	17.75	4.84	4.07	26.66	23.41	3.15	3.68	30.31	40.21	0.88
	A/B 36-58	2.00	1.56	3.97	11.86	3.28	2.37	17.45	15.90	1.46	1.30	18.46	43.40	0.93
Alluvial-meadow carbonate soils of arid subtropics (the Kura River floodplain)														
352	AUvca 0-10	1.64	3.92	4.48	20.14	5.01	2.08	27.28	12.95	3.86	2.98	19.79	30.42	1.38
	AUzca 10-28	0.96	3.04	4.70	17.46	7.27	2.21	26.94	13.63	3.84	3.25	20.72	35.15	1.30
	B/Cgca28-47	0.65	2.45	2.55	11.54	3.10	1.12	14.86	8.51	1.06	2.02	12.19	40.18	1.22
	AU^h_gca103-128	1.25	3.48	3.24	22.46	6.18	5.42	34.06	18.91	4.18	3.03	26.12	35.19	1.18
450	AUvca 0-12	1.91	3.65	3.60	23.10	5.60	4.56	33.26	18.46	3.14	3.41	25.01	38.25	1.33
	AUzca 12-34	1.87	2.90	2.48	24.05	6.08	3.64	33.84	20.15	3.17	3.80	27.12	40.42	1.25
	A/Bca 34-56	1.14	3.65	1.90	26.06	5.08	3.46	34.06	20.08	4.12	3.34	27.54	38.14	1.24

Alluvial-meadow bedded soils are mainly distributed in the central part of the floodplain and develop under conditions of short-term periodic flood and soil humidification under relatively well-developed meadow-grassy vegetation. The productivity of the aboveground phytomass is 3.1-3.5 t/ha, while that of the root mass is 10.6-12.4 t/ha. The level of groundwater varies from 1.0 to 2.5 m in seasons of the year. These soils differ from the primary differences by a comparatively well-developed turf-covered humus-accumulative horizon (AU = 25–30 cm), somewhat stretched humus profile (40–50 cm), and well-marked gleyey signs in the middle and lower horizons. Noticeable stratification and frequent burial of humus horizons ($AU^h{}_g$=0.8–1.3m) are characteristic morphological features of these soils, which are formed as a result of the riverbed wander. The upper half-meter parts of alluvial-meadow bedded soils are characterized by heavy loamy granulometric composition (<0.01mm=40.6–46.8%;<0.001mm=12.2–17.2%) and lower horizons by a rather light granulometric composition (<0.01 mm=15.8–17.4%; <0.001 mm = 4.1–7.3%).

The humus content in the upper horizons is 4.1-8.4% and decreases with depth to 0.8% but increases to 2.1–2.3% in the buried humous horizons ($AU^h{}_g$ = 0.8–1.3 m), which serves as the main diagnostic sign of the investigated bedded alluvial-meadow soils. The amount of total nitrogen in the AU horizon is 0.20–0.29%. These soils of the Kura River floodplain are characterized by carbonate content ($CaCO_3$ = 10.4-19.1%) but without visible carbonate depositions (Table 2). The sum of the exchange bases is relatively high and amounts to 20.9– 24.4 mmol/ekv in the AU horizon, then gradually decreases with depth to 15–18 mmol/100 g soil, while it usually reaches 19–24 mmol/100 g soil in the lower buried humous horizons ($AU^h{}_g$). The reaction of the soil medium in leached soils is neutral (pH 6.4–7.0), while that in carbonate soils is weak-alkaline (pH 7.8– 8.3). For alluvial-meadow bedded soils, the following structure of the soil profile is typical: **AUv-AUz- B/Cg-CIg-$AU^h{}_g$-CIIg; AUvca-AUzca-B/Cgca-CIgca- $AU^h{}_g$ca-CIIgca.**

Alluvial-meadow dark soils are mainly distributed in a complex with alluvial-meadow-bog soils and lie on relief elements with micro-depressions. They develop under conditions of periodic soil excess humidification under lushly developed meadow-grassy vegetation. This vegetation forms a fairly powerful and dense sod horizon (AUv = 10–12 cm) as well as abundant overground (4.2-4.8t/ha) and underground (13.5-15.4t/ha) phytomass. In this connection, the humus-accumulative horizons (AUv+AU=40–50 cm) of the described soils have a dark (in wet state black) coloration, a considerable humus content (3.7–6.5%), and a lumpy granular structure. The thickness of the humified layer reaches 70–80 cm. The amount of total nitrogen in the AU horizon is 0.30–0.38%. These soils are characterized by a rather high value of the absorption capacity (26.4–30.8 mmol/ekv) as well as high carbonation ($CaCO_3$=5.8–14.5%). The forma- tion of carbonates is significantly affected by closely lying (1.4–1.5 m) hydrocarbonate groundwater (HCO_3 = 0.78–1.22 g/l). Carbonates in moist soil are not morphologically distinguished and are present in impregnated soil mass. It should be noted that surface water has significantly influenced the particle size distribution of soils. As a result of their long standing on the surface of the earth in the bog and the meadow-bog regime, clay particles from the upper horizon (AU = 30–35 cm) were leached and accumulated in the middle part of the profile (<0.01 mm= 56.3-62.7%; <0.001 mm=25.0–31.4%). Unlike primary and bedded varieties, dark alluvial-meadow soils have signs of poor salinity: at a depth of 90–150 cm, the dense residue content is 0.46–0.52%. Calcium sul- fates (0.19–0.25%) and sodium sulfates (0.08–0.12%) predominate in the composition of the salts in these soils, while the amount of chlorine is small. They are characterized by the following system of genetic horizons: **AUv-AUz-A/B-Bg-B/Cg-Cg; AUv-AUz-A/B- Bgca-B/Cgca-Cgca.**

Table 4.

Total chemical composition (% of the calcined substance) of alluvial-meadow soils

Section no.	Horizon and depth, cm	SAC	SiO_2	Al_2O_3	Fe_2O_3	P_2O_5	CaO	MgO	SO_3	Na_2O	K_2O	SiO_2/Al_2O_3	SiO_2/Fe_2O_3	SiO_2/R_2O_3
Alluvial-meadow leached soils of humid subtropics (Lankaran Lowland)														
913	AUv 0–12	10.30	61.16	21.52	10.81	0.10	2.65	2.10	2.10	1.18	3.24	5.15	15.28	3.84
	AUz 12–36	8.02	58.45	20.42	10.56	0.08	3.16	1.85	1.46	0.65	1.56	4.72	14.16	3.65
	Bg 58–90	5.41	56.75	21.05	11.48	0.08	3.67	4.34	1.40	0.82	1.40	4.51	12.41	3.42
	Cg 90–150	5.96	55.94	18.81	8.37	0.09	3.82	2.19	1.72	1.08	2.05	5.08	14.05	3.86
Alluvial-meadow carbonate soils of arid subtropics (the Kura River floodplain)														
352	AU’vca 0–10	7.34	55.68	16.40	8.21	0.08	5.42	3.21	1.58	1.16	0.90	5.56	15.09	4.09
	AUca 10–28	6.71	56.54	14.15	8.26	0.07	7.56	4.64	1.74	0.95	0.81	5.32	15.21	4.15
	CIca 67–103	4.58	53.07	13.06	7.47	0.06	6.68	2.56	1.32	1.04	0.76	6.44	18.66	4.82
	$AU^h{}_g$ca 103-125	7.36	57.03	15.12	9.52	0.09	9.44	3.72	1.56	1.31	0.58	5.28	16.05	4.26
450	AUvca 0–12	12.78	47.62	13.52	7.58	0.12	12.15	9.45	1.62	1.50	2.47	6.20	17.52	4.48
	AUca 12–34	11.52	49.04	14.45	7.60	0.11	14.41	7.27	1.45	1.42	1.74	5.45	16.98	4.35
	Bgca 56–89	10.18	50.30	14.84	8.74	0.08	15.67	6.38	1.18	1.37	1.80	6.14	16.12	4.68
	Cgca 89-130	13.44	51.28	14.60	8.82	0.07	14.28	8.07	1.27	1.58	1.52	5.92	17.94	4.47

The first fraction of humic (15.2–18.3%) and fulvic acids (20.4–24.3%) predominates in the fractional composition of the humus of alluvial meadow soils, the content of the third fraction of both humic (2.3– 4.1%) and fulvic acids (1.3–3.7%) is very low, and humic acids are characterized by high mobility (table 3). The humus of alluvial-meadow leached soils differs by a rather high content of humic acids (22.4–26.7%), however, fulvic acids (26.8–30.3%) predominate in its composition, which affects the $C_{h.a} : C_{f.a}$ ratio, which is lower than one (0.84–0.98); in carbonate variants of soils, it is greater than one (1.18–1.38). In contrast to the leached differences, the amount of humic acids in carbonate soils significantly increases (28.0–35.5%), especially due to the second fraction (5.6–7.3%). High mobility of humic acids of both the leached and carbonate differences of these soils is also confirmed by the low content of humin (27.1–43.4%) as well as weak development and youth of the accumulative humus horizon (AU=25–30 cm) and the entire genetic profile.

The leached and carbonate variants of alluvial-meadow soils differ in terms of the total chemical composition (Table 4). The leached differences contain more SiO_2 (58.7–60.2%) and sesquioxides (31.3– 32.4%); in the loamy sandy-loam alluvial deposits, the amount of R_2O_3 slightly decreases (25.1%).

The distribution of SiO_2 from the surface to the lower horizon has a similar character; its amount decreases from 60.2 to 55.9%. In the carbonate varieties of alluvial-meadow bedded soils (p.352), the distribution of silica and sesquioxides is mainly due to the lithological composition of alluvial deposits and their humus content. Thus, in the clay heavy-loamy humus-accumulative (AU=0–30 cm) and buried humous horizons (AU^{h}_{g} = 103–125 cm), the content of R_2O_3 is 24.5–25.2%; in loamy sandy-loamy horizons (Cg = 67–103 cm), it is reduced to 20.5%. Similar changes were also observed for SiO_2 (47.8-55.6%). In the upper horizons of carbonate alluvial-meadow soils, a relatively small amount of silica (47.6–49.0%) and sesquioxides (21.1–22.0%) was noted. The marked illuvial character of R_2O_3 and the SiO_2 in the AU horizon and the formation of the illuviated horizon B are simultaneously accompanied by a high degree of clayization (hor. B); the content of physical clay reaches 65.7-68.4%, sludge 30.8–34.7%. This indicates that the studied soils in the Kura River floodplain survived the marsh subaqual regime, which was noted by V.R. Volobuev [5]; these soils were previously called "deep-meadow." They are also characterized by a high content of carbonate form of CaO (12.2–15.7%).

Alluvial-meadow soils develop under conditions of seasonal surface and temporally excessive ground moistening, and the morphological signs of gleying are expressed by a bluish-gray color with ocherrusty spots in the middle and lower horizons (Bg, Cg).

Table 5.

Content of mobile forms of iron in alluvial-meadow soils of the f loodplains of Azerbaijan

Section no.	Horizon, depth, cm	Humus, %	Water-soluble humus, % to soil	Field humidity, %	mg/100 g absolutely dry soil		t^0 of soil
					Fe^{2+}	Fe^{3+}	
Alluvial-meadow leached soils of humid subtropics (Lankaran Lowland)							
910	AUv 0–10	4.12	0.045	37.6	108	542	24.2
	AUz 10–28	3.24	0.037	32.4	82	408	23.7
	A/B 28–50	2.41	0.025	28.2	74	364	20.4
	B/Cg 50–95	1.10	0.019	30.5	87	356	16.8
	AU^{n}_{g} 95–120	2.24	0.052	48.1	135	668	15.7
	Cg 120–145	0.85	0.018	27.6	87	393	16.9
Alluvial-meadow carbonate soils of arid subtropics (Kura River floodplain)							
352	AUvca 0–10	2.82	0.027	21.5	57	354	26.1
	AUzca 10–28	1.56	0.024	22.7	51	331	24.5
	B/Cgca 28–67	1.06	0.026	19.8	45	318	22.4
	CIgca 67–103	0.85	0.018	20.6	36	205	18.2
	AU^{n}_{g} 103-128	2.15	0.030	31.4	92	312	17.6
	CIIgca128–170	0.77	0.019	22.7	48	214	18.2

F.R. Zaidel'man [15] noted that gley formation, undoubtedly, is one of the most widespread processes of soil formation on the globe. Its study makes it possible to understand the genesis of many soils, the profiles of which are formed under the influence of temporary or sustained excess moisture. In the profile of alluvial-meadow leached soils, mobile iron oxides (Fe^{3+}) make up 356–542 mg, iron oxide (Fe^{2+}) 74-108 mg/100 g soil, and gradually decrease with depth. The exception is the buried humus horizon (AU^{h}_{g} = 0.8–1.1 m), in which their content (Fe^{3} is 668 mg, Fe^{2+} is 135 mg) sharply increases. The ratio of mobile forms of iron is in good agreement with the content of total and water-soluble humus, since migration and accumulation of iron occur in the form of organomineral compounds. It should be noted that the oxide form of iron (Fe^{3+} = 305–353 mg) predominates in the lower constantly excessively moistened loamy sandy-loamy alluvial deposits, which is explained by their weak humus content and also by the small amount of silty clay particles (Table 5). As noted by Yu.N. Vodyanitskii and S.A. Shchoba [15], in the carbonate soil, hardly soluble iron-organomineral compounds are usually formed; as a result, the amount of mobile forms of iron is significantly reduced. This is confirmed by our comparative studies; thus, in the carbonate variants of alluvial-meadow soils, a relative decrease in the mobile forms of iron is observed (Fe^{3+}=214-354 mq/100 g soil, Fe^{2+} = 36-57 mq/100 g soil).

CONCLUSIONS

This study presents the results of the investigations of soil forming processes in the alluvial-hydromorphic soils of the humid and arid subtropical flood plains in Azerbaijan. The priciple diagnostic indexes of primary, bedded and dark suborders as well as its washed out and carbonated suborders were determined. The mineralization rates and salt composition of the underground water and soils were studied. The group and fractional composition of humus was studied representing high activity of humic (15,2-18,3%) and fulvic (20,4-24.3%) acids. The analysis of the total chemical composition showed that washed out soils in the humid subtropical zone rich in R_2O_3 (27,2-30,4%), however, CaO content increases (12,2-15,7%) in the soils of the arid subtropical zone . The leached alluvial-meadow soils are rich in active forms of iron (Fe^{3+}=542-668; Fe^{2+}=108-135 mq/100 g soil) while carbonated soils contains considerable less iron (Fe^{3+}=312-354; Fe^{2+}=51-92 mq/100 g soil).

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ECOLOGICAL SOIL EDIFICATORS ON THE KARAMARYAM PLATEAU IN RECENT YEARS

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For the rational conduct of agriculture, the specialization its branches, the improvement culture of agriculture and the receipt the maximum amount of production, it is necessary to study the properties of the qualitative soil composition and the patterns of their distribution. Karamaryam plateau is located in the foothills of the Greater Caucasus between the Akhsuchay and Gokchay rivers. The studied territory, the total area of which is about 50 thousand hectares, has a heterogeneous soil cover. The amount of humus in the upper horizons reaches 2.9-3.8%, and below it gradually decreases and reaches 1% in the 80-100 cm layer.In the upper horizon, the humus composition is dominated by humic acids (14.97–16.50%). The ratio between humic acids and fulvic acids varies within 1.0-1.5, in the lower 30-60 cm horizon 0.4-0.8.The mechanical composition of the soils is heavy loamy and clayey. In layer B of the profile <0.001 mm 35-46%, <0.01 mm 67-75%.The silt content in physical clay is 55%. In merged horizons, the degree of silt reaches 60-63%. These soils are saturated with bases. The composition of exchangeable bases is dominated by calcium 11.50-33.54 mg-eq. The study of the current ecological state of the unique soils of the Karamaryam Plateau is very important for the development of agriculture in Azerbaijan and the satisfaction growing food supply of the population. The study of the main ecological edificators helps to determine the current state of soil types and subtypes here. As a result of a comparative study of the main indicator indicators of uncultivated soils of natural cenoses and cultivated soils of agrocenoses, it has been established that proper tillage and irrigation of soils has a positive effect on the development of useful flora and fauna.

Keywords: *microscopic fungi, agrochemical indicators, vegetation, invertebrates, organic matter, ecological edificators.*

INTRODUCTION

The study Karamaryam plateau's soils, which has a diversified agriculture, is great practical interest, especially for the purpose of growing subtropical, industrial and grain crops on these soils, as well as theoretical interest caused by insufficient coverage the issues of the genesis, geography and classification Azerbaijan soils. Chestnut type soils occupy a significant place among the soils of the Karamaryam Plateau. The parent rocks are deluvial deposits of clayey and heavy loamy mechanical composition. Chestnut soils from the surface are usually somewhat leached from carbonates. In the illuvial horizon, a noticeable effervescence is observed and carbonates appear in the form of loose white spots. The nature of the distribution of silt particles and physical clay indicates their accumulation in the upper and especially the middle parts of the profil [3.5.6].

The Ca:Mg ratio changes with Mg due to the presence of minerals of the montmorillonite group rich in this element in the parent rock. The soil-forming process here takes place in more arid conditions. The vegetation cover is represented by wormwood-ephemeral associations. Poor development of vegetation cover, seasonal accumulation of organic matter, comparative dryness of the soil profile, as well as weaker leaching of easily soluble salts and carbonates. For the chestnut soils of the Karamaryam Plateau, the following features are the most characteristic: high carbonate content, elevated level of the effervescence horizon, and weak alkalinity [5.7].

The area, agrochemical and biological properties of lands suitable for agricultural use in the natural zones of the plateau have been determined. Work is underway to attract these lands to agriculture. Vegetation is one of the factors in the humus formation process and soil protection from leaching. In addition to retaining rainfall, plants also increase the permeability of the soil, which leads to surface runoff and a small part of it that enters the soil and causes soil erosion [2].

MATERIAL AND METHODS

Soil samples were prepared for laboratory analysis, herbariums were prepared from plant samples, and invertebrates were extracted and dried from alcohol solutions. At the final stage, the generally accepted modern methodology of soil science and soil biology was applied. Photographs of phytocenoses recorded on the site were taken, model-experimental main plots (biotopes) were selected. The composition of phytomass in natural (grass-differently growing) and cultivated agrocenoses of alfalfa and cereal plants (wheat) was specified (stubble, surface (green), root mass, underground (brown) mass were studied. When classifying plants according to life forms in registered phytocenoses, the method of Raunkiaer and Serebryakov was used. To determine the physicochemical properties of soils, soil sections were laid to a depth of 0–200 cm, morphological features were recorded in the field, and a preliminary classification was determined. Samples from soil sections were taken into sterile bags, starting from the lower layers, and dried in accordance with the standards. Isolation of samples of fungal strains was grown on Wort agar and Czapek's medium and incubated in the dark at 28°C [1.4.8].

After 3-7 days of incubation, the developed mycelium is examined under a microscope and transferred to Petri dishes. Microbiological analyzes, determination of the group composition and number of microorganisms were carried out according to the rules generally accepted in microbiology.

RESULTS AND DISCUSSION

Gray-brown soils have a fairly clear cut profile, and when mixed with humus, they have a darker brown tone. The C:N ratio varies from 7.0 to 9.0. The amount of humus in the upper horizons reaches 2.9-3.4%, and below it gradually decreases and reaches 1% in the 80-100 cm layer.In the upper horizon, the humus composition is dominated by humic acids (14.97–16.50%). The ratio between humic acids and fulvic acids varies within 1.0-1.5, in the lower 30-60 cm horizon 0.4-0.8.The mechanical composition of the soils is heavy loamy and clayey. In layer B of the profile <0.001 mm 35-46%, <0.01 mm 67-75%.The silt content in physical clay is 55%. In merged horizons, the degree of silt reaches 60-63%. These soils are saturated with bases. The composition of exchangeable bases is dominated by calcium 11.50-33.54 mg-eq. In gray-brown (chestnut) soils in natural cenoces, the amount of humus was 2.9-3.8% in the soil layer of 0-19 cm, the profile decreased to 0.24% in the soil layer of 180-200 cm, and the nitrogen content in the soil layer was 0-19 cm. Soil layer -19 cm was 0.29%. When analyzing the content of humus and nitrogen in individual genetic layers, their uneven distribution becomes clear. So, at heights of 18-37 cm, 37-54 cm and 54-107 cm, the content of humus and nitrogen fluctuated within 1.45-0.59% and 0.12-0.07%, respectively. In the horizons of 107-151 cm and 151-180 cm, i.e., in the horizons located close to the soil-cultivating rocks, the content of humus and nitrogen decreases sharply, i.e. 0.44-0.27% and 0.06-0 .05%. The high content of humus and nitrogen in the mineralized cenoses was 3.28 and 0.26%, respectively, on the horizon of 0-29 cm and gradually decreased to the lower layers and was in the range of 3.12-2.24% and 0.23-0.17 % at depths. 29-57 cm and 57-102 cm. At depths of 102-150 cm and 150-170 cm, the quantitative indicators of humus and nitrogen decrease to 1.87-0.27% and 0.15-0.05%. Comparing the quantitative indicators of humus and nitrogen between the studied cenoses, one can clearly see the positive effect of plowing the soil and planting leguminous plants on cultivated cenoses.

Horcheum leporinum, Avena pilosa, Avena sativa, Agropyrom elongatum, Bromus japonicus, Zerna rubens, Phleum paniculatum, Cynodon dactylon, Vicia crassa L., Medicago minima, Trifolium medicagym, Vicia faba, Trifolium ambiguum, Galium odoratum, Plantago ovata, Plantago major L., Veronica offcinalis, Taraxacum officinale, Anthemis candidissima, Alium erubescens, Artemisia fragrans, Artemisia vulgaris, Arthemisia absinthium, Daucus carota, Apium graveolens L., Cirsium heterophyllum, Carthamus oxyacantha, Carduus arabicus, Erigeron crispus, Alhagi pseudalhagi, Cirsium esculentum, Cicorium glandulosum, Poa bubbosa, Inula helenium L., Achillea L., and etc. are whidespread.

9.3% of registered fungi are true biotrophs. Since the soil itself is not alive, observing these fungi in research may seem counterintuitive at first. In fact, the reason for the observation of these fungi is that several biotrophic fungi overwinter in the soil as plant residues, and the presence of decaying plant residues in soil samples is real. The structural features of micromycetes in terms of frequencyf occurrence made it possible to identify dominant, common, random, or rare species both in general and in individual biotopes. Only 5.8% of registered fungi are characterized as dominant, 27.9% as common and 66.3% as rare or random species, and their frequency of variability varies greatly. In soils contaminated with industrial products, Aspergillus niger, A. vesicolor, Cladosporium herbarum, Penicillium chryzogenum, Lanosum dominate and predominate. In clean soils, Aspergillus niger, Chaetomium globosum, Mucor globosus and Trichoderma harzianum are the dominant groups. Soil mushrooms such as Torula, Candida, Pichia, Aureobasidium, Phyllosticta, Ascochyta, Septoria, Sordaria, Sportsrix, CladosPorium, Verticillium, Fusarium, Trichoderma, Stachybot, Gliocladium, Acremonium, Penicillium, Rhizopus, Mucor, Sphaerotheca, Monilia, adapted to dry conditions. ecosystems of the Goychay region, in modern studies it is also noted in gray-brown soils with a wide distribution area.

Invertebrates play an important role in providing ecosystem services. Most soil invertebrates play an important role in nutrient cycling and degradation by feeding on dead or decaying plant and animal matter in the soil, breaking it down and releasing nutrients from the material into the soil, increasing soil organic matter. Data on invertebrate assemblages in natural and cultural cenoses made it possible to divide the discovered populations into dominant and minor groups (Table1.2.).

Table 1.

Primary edificators of invertebrates in newly irrigated cereal and alfalfa agrocenoses

Daminant groups	Minority groups
Orthoptera; Hemiptera; Coccinellidae; Cryllidae; Noctuidae; Castropoda; Carabidae; Scarabaeidae; Lumbricidae	Isopoda; arachnidae; Curculionidae; Diplopoda; Diptera

Table 2.

The main edificators of invertebrates in natural cenoses

Daminant groups	Minority groups
Tettigonidae; Hemiptera; Cerambucidae; Tenebrionidae; Coccinellidae; Cryllidae; Castropoda; Arachnidae; Alleculidae	Diptera; Isopoda; Lumbricidae; Carabidae; Curculionidae; Lepidoptera

CONCLUSION

The study of the current ecological state of the unique soils of the Karamaryam Plateau is very important for the development of agriculture in Azerbaijan and the satisfaction growing food supply of the population. The study of the main ecological edificators helps to determine the current state of soil types and subtypes here. As a result of a comparative study of the main indicator indicators of uncultivated soils of natural cenoses and cultivated soils of agrocenoses, it has been established that proper tillage and irrigation of soils has a positive effect on the development of useful flora and fauna.

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NATURAL AND ECONOMIC ASPECTS OF LAND RESOURCES MANAGEMENT IN MIL-MUGHAN ECONOMIC REGION

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The Mil-Mughan economic region was established on July 7, 2021 by the decree of the President of the Republic of Azerbaijan Ilham Aliyev. The total area is 567121 hectares. It includes Beylagan, Imishli, Saatli and Sabirabad administrative regions. It is considered a developed agricultural region of the country. Heat supply is high. Irrigation is required. In general, the geographical conditions of the region are considered favorable for the development of various sectors of the economy. 41.31% of agricultural land in the Mil-Mughan economic region is arable, 0.68% perennial plantations, 51.41% pastures, and 6.6% household plots. The potential fertility of agricultural land was assessed. Regardless of the level of land resources management, the main stages of its implementation are as follows: collection and analysis of information on the legal, economic and natural state of territorial lands; identify and predict changes and trends in land resources; develop and implement ways of rational use of land resources; collect information about the result of the activity, draw conclusions, find new opportunities for effective use and start a new cycle of the process. The economy of the Mil-Mughan economic region depends on the amount of water resources. The management of water resources requires the following measures: to abandon furrow irrigation and switch to progressive irrigation (drip, rain) systems; to concrete soil channels or carry out drinage with pipes of large diametre; to create centralized sewage systems of cities and large settlements, to establish a system for wastewater treatment and to use technical water in agriculture and commercial enterprises; desalination and use of brackish (ground and collector) waters. One of the most important ways in the management of land resources is the creation of the following agro-industrial integrations by carrying out specialization in agriculture: grain growing, cotton growing, horticulture-vegetable farming, cattle-breeding. The problems of expanding residential areas and reducing land suitable for agriculture and ways to solve them were touched upon.

Key words: *Management of Land and Water Resources, Mil-Mughan Economic Region*

INTRODUCTION

The Mil-Mughan economic region was established on July 7, 2021 by the decree of the President of the Republic of Azerbaijan Ilham Aliyev. The total area is 567121 hectares. It includes Beylagan, Imishli, Saatli and Sabirabad administrative regions. It is considered a developed agricultural region of the country: the proportion of cotton growing, horticulture and cattle-breeding is higher. This is due to the favorable relief, climate and soil conditions of the area. The height of the area varies from -15 m to 150 m. The relief (98.5%) consists mainly of areas with a slope of less than 3^0. Soil-forming rocks consist of alluvial, delluvial and proluvial deposits. The climate belongs to semi-desert and steppe climate type. Heat supply is high. The amount of total radiation is 130-133 kcal/cm^2, the average annual temperature is 14.0-14.5^{0}C. The number of frost-free days is more than 250 days. The indicator $\sum T>100$, which is important for the development of plants, is 4500^{0}C. The average long-term relative humidity does not exceed 73%. Precipitation in the economic region is 360 mm. Most of the precipitation falls in autumn and winter. Evaporation is up to 1030 mm. Such climatic conditions necessitated the use of irrigation. The main sources of fresh water are the Kur and Araz rivers. The lands of the region are irrigated with water of the Yukhari Karabakh, Kohne Khanqizi, Boztepearkh and Bash Mughan canals. The vegetation consists of dry steppe vegetation. Desert, semi-desert, sloppe and sloppy-meadow, wetland, forest (tugai) vegetation are also common here. Gray-brown (chestnut), gray and light gray, gray-meadow and light gray-meadow, calcareous and weakly calcareous alluvial-meadow soils are common in the territory [4, 6, 10]. In general, the geographical conditions of the region are considered favorable for the development of various sectors of the economy. However, further development of land resources management on a scientific basis would increase agricultural production in the Mil-Mughan economic region and raise the economic level of the region.

MATERIAL AND METHODS

During the research, statistical data of the State Statistics Committee, reports of soil surveys of the Imishli, Beylagan, Saatli and Sabirabad regions and the legend of the “Soil maps” of the regions at a scale of 1:50000 were used. Estimate indicators of potential soil fertility (bonitet score) are obtained from the research works of the author in 2011-2015 and other sources. Assessment work was carried out on the basis of accepted methodologies.

RESULTS AND DISCUSSION

The Mil and Mughan plains are considered one of the ancient agricultural centers of Azerbaijan. In the 20th century, the construction of irrigation and collector-drainage systems became large-scale, and the area of irrigated land increased [5]. Although this led to an increase in productivity, it led to the emergence of environmental problems (salinization, alkalinization, irrigation erosion, etc.) in the soil [1, 2, 3, 7, 8, 9].

Within the economic region, 71.4% (405015 ha) of land is agricultural, 1.25% (7069 ha) is forest, 27.3% (155037 ha) is other lands (lands under residential areas, communication lines, etc.). 167,124 hectares (41.31%) of agricultural land in the Mil-Mughan economic region are arable lands, 2,776 hectares (0.68%) - perennial lands, 208,399 hectares (51.41%) - pastures, 26,716 hectares (6. 6%) - household plots (Figure 1). 30.1% (121998 ha) of agricultural land is concentrated in Imishli region, 26.0% (105319 ha) - in Saatli region, 24.6% (99627 ha) - in Sabirabad region, 19.3% (78071 ha) - in Beylagan region [11 , 12, 13].

The lands of the Mil-Mughan economic region, especially the irrigated lands, have high potential fertility: *Under arable lands+ fallow lands +prennial lands:* gray - 90 points; light gray - 80 points; gray-meadow - 103 points; light gray-meadow - 97 points; meadow-gray - 88 points; light meadow-gray - 89 points; calcareous alluvial-meadow - 79 ha; weakly calcareous alluvial-meadow - 103 points; swampy - meadow - 99 ha; saline - 63 points. *Under hay field + pasture:* gray-brown - 66 points; gray - 75 points; light gray - 70 points; gray meadow - 82 points; light gray-meadow - 82 points; meadow-gray - 75 points; light meadow-gray - 82 points; calcareous alluvial-meadow - 67 points; weakly calcareous alluvial-meadow - 86 points; swampy-meadow - 84 points; saline - 55 points.

Scientific management is the driving force of progress in modern human society. Management of land resources is one of the biggest concerns of the state [14, 15, 16].

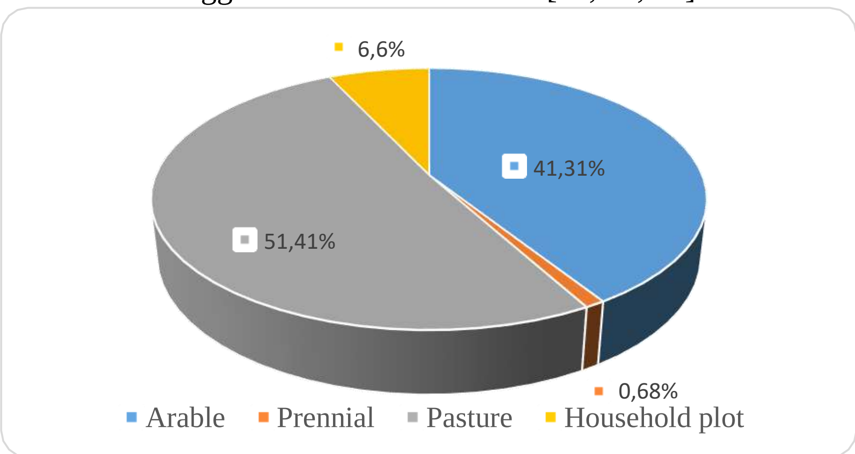

Figure 1. Distribution of agricultural lands in Mil-Mughan economic region (%)

Management is an element of material culture that connects and coordinates various spheres of the economy and social life. Depending on the degree of complexity of the controlled system, mechanisms and elements of influence are complex and multi-stage. From this point of view, land resources management should be considered as a multi-stage (multi-level) process. The levels of land resources management consist of the following (Figure 2):

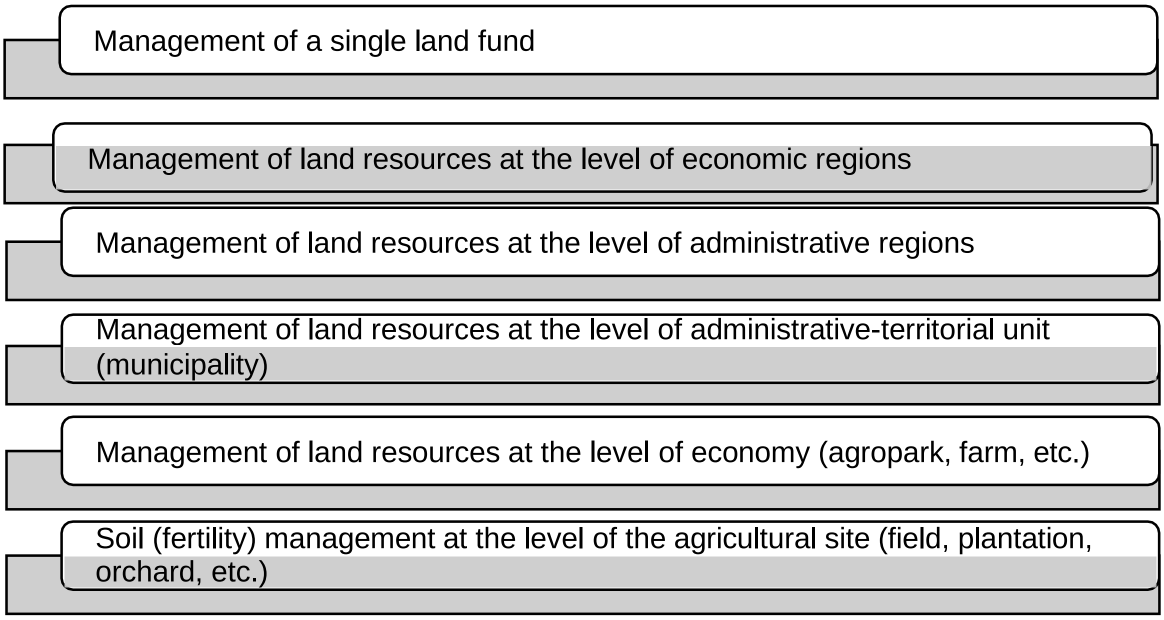

Figure 2. Levels of land resources management

Regardless of the level of land resources management, the main stages of its implementation include: collection and analysis of information on the legal, economic and natural state of territorial lands; to identify and predict changes and trends in land resources; to develop and implement ways of efficient use of land resources; collect information about the result of the activity, draw conclusions, find new opportunities for effective use and start a new cycle of the process. Since land has legal, economic and natural aspects, its management also requires a complex approach:

Management of land resources at the level of economic region and administrative regions primarily involves the following measures:

✓ to increase the level of specialization and concentration through the creation of large economic forms (agricultural parks, cooperatives, farmer uions, etc.);

✓ to deepen agro-industrial integration by bringing the processing of agricultural products closer to producers;

✓ effectively fight soil salinization, alkalinization and irrigation erosion, improve the structure of farmland and switch to modern irrigation systems;

✓ to reduce soil losses due to the correct placement of production centres, communication lines, warehouses, refrigerators, etc., give preference to soil protection projects when creating protective forest strips;

✓ to manage indicators of soil fertility with the help of modern agrotechnical and reclamation measures;

✓ prepare and implement nature protection measures (water protection, soil protection and forest protection projects).

Water resources management. The economy of the Mil-Mughan economic region depends primarily on the amount of agricultural water resources. Therefore, the management of land resources should be considered together with the management of water resources. The protection and enhancement of water resources is one of the most important tasks facing the economic region. Water resources management requires the following measures: to abandon furrow irrigation and switch to progressive irrigation (drip, rain) systems; to concrete soil channels or carry out drinage with pipes of large diametre; to create centralized sewage systems of cities and large settlements, to establish a system for wastewater treatment and to use technical water in agriculture and commercial enterprises; desalination and use of brackish (ground and collector) waters.

Creation of agro-industrial integrations. One of the most important ways in the management of land resources is the creation of the following agro-industrial integrations through the implementation of agricultural specialization in the Mil-Mughan economic region:

Grain farming agro-industrial integration. In the Mil-Mughan economic region, grain farming (wheat, barley, corn for grain, etc.) has a different weight in administrative regions. 33.5% of grain crops (25953 ha) and 34.8% of the harvested crop (112751 tons) are concentrated in the Sabirabad region. In other administrative regions, this figure is as follows: Saatli: sowing - 27.9% (21616 ha), harvest - 28.6% (92741 tons); Imishli: sowing - 21.4% (16565 ha), harvest - 20.2% (65619 tons); Beylagan: sowing - 17.3% (13447 ha), harvest - 16.3% (51951 tons). The growth zone in this direction is practically exhausted. The transformation of winter pastures into grain planting has led to a decrease in the feed base of livestock in some places. The following directions of the development prospects of the grain farming agro-industrial complex of the Mil-Mughan economic region are possible:

✓ to increase productivity (currently 41.5 centner/ha) on farms (60-65 center/ha) using modern agricultural technology, introduction of crop rotation with the introduction of grain, cotton and fodder plants in order to protect and increase soil fertility;

✓ creation modern elevators and mills or increasing the capacity of existing ones for product storage and processing;

✓ establishment of enterprises for the production of finished products (packed flour, pasta and vermicelli, packaged bread, etc.);

✓ expansion of broiler farms and creation of new ones on the basis of grain production.

Cotton farming agro-industrial integration. 40.3% (40,365 ha) of cotton farming, 38.4% (110,327 tons) of the harvested crop in the republic belong to Mil-Mughan economic region. This indicator is distributed by administrative regions as follows: Beylagan: sowing - 21.4% (8630 ha), harvest - 22.5% (24862 tons); Imishli: sowing - 20.2% (8170 ha), harvest - 17.8% (19688 tons); Saatli: sowing - 35.4% (14305 ha), harvesting - 34.8% (38788 tons); Sabirabad: sowing - 22.9% (9260 ha), harvest - 24.8% (27396 tons). In this integration, land resources management has more opportunities: without increasing cotton areas, it is possible to increase its yield (currently average yield is 24.1-29.6 centner/ha) to 60-70 centner/ha, increasing the yield by 2-3 times; cotton planting requires a high rate of irrigation. Taking into account the shortage of water resources in the Mil-Mughan economic region, the most important element of management should be the introduction of programmed-progressive irrigation systems in cotton plantings. It is possible to build enterprises for the production of textiles, cotton oil, potash and other industrial products in the administrative regions.

Horticulture-vegetable farming agro-industrial integration. Despite having a high weight in the republic, horticulture (area: 7196 ha; output: 235193 tons) - vegetable growing (area: 5719 ha; output: 138952 tons) agro-industrial integration in the Mil-Mughan economic district, has not been fully developed and they are considered agricultural areas with great prospects for development to its potential. This is due to the fact that, firstly, in terms of vegetable yield (200 centner/ha), the Mil-Mugan economic region lags behind a number of economic regions (Karabakh - 260 centner/ha; Gazakh-Tovuz - 244 centner/ha; Lankaran-Astara - 204 centner/ha); secondly, despite the high potential, vegetable crops in the economic region are mainly grown in the open field, the network of greenhouses is not sufficiently developed here; thirdly, there are opportunities for development in the food industry based on horticulture and vegetable growing.

Cattle-breeding agro-industrial integration. The Mil-Mughan economic region ranks first in the republic in terms of cattle, primarily bovine cattle (13.1% or 346,827 heads in the republic). There are enough potential opportunities for the development of sheep and poultry farming in the economic region. The main fodder base of cattle breeding (bovine and small-horned cattle) of the Mil-Mughan economic region is rough and green fodder obtained from winter pastures and forage plants. Poultry farming was formed on the basis of imported feed and local grain products. There are 208,399 hectares of pastures in the Mil-Mughan economic region. 155,436 ha or 74.6% of these are state-owned winter pastures, and 52,963 ha or 25.41% are municipal pastures around settlements. Cattle-breeding agro-industrial integration may have the following prospects for land and other resources management: a) the creation of cultural fodder areas on 20-25% of the areas of winter pastures (on an area of 40-45 thousand hectares) by carrying out complex reclamation measures and using of intensive irrigation and fertilizer; b) carrying out selection work between bovine and small-horned cattle, as well as obtaining breeds with high meat, wool and milk yield through fertilization; c) the creation of large, medium and small poultry farms and the expansion of existing ones in the future.

Land management of settlements. In order to reduce the rate of over-expansion of settlements and protect land resources, the following measures should be taken: in cities and urban-type settlements, the construction of multi-storey residential buildings should begin, and the area of land created for individual housing construction should be reduced; using the possibilities of modern architecture and urban planning, preference should be given to industrial and catering establishments projects with a small capacity [87].

Measures of nature protection. It is necessary to take measures to protect the natural landscapes where tugai forests, desert, semi-desert, dry steppe, meadow and wetland vegetation are common in the riverbeds and to determine their optimal size in order to maintain the self-recovery mechanism.

CONCLUSION

An ecological characteristic of the Mil-Mughan economic region is given and the potential fertility of agricultural lands is assessed (arable lands + fallow lands + perennial lands; hayfields + pastures). The elements (components) of land resources management at the level of economic and administrative regions were analyzed. The ways of managing land resources within the framework of agro-industrial integration (grain growing, cotton growing, horticulture-vegetable farming, cattle-breeding) in the Mil-Mughan economic region are indicated. The problems of expanding residential areas and reducing land suitable for agriculture and ways to solve them are touched upon. The ways of protection and enhancement of water resources in the Mil-Mughan economic region are indicated.

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TOURISM KINDS AND ECOTOURISM POTENTIAL IN A LANDSCAPE COMPLEX ON THE SOUTHERN SLOPE OF THE GREAT CAUCASUS

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In the article, the types of tourism and the potential of ecotourism in the landscape complex on the southern slope of the Greater Caucasus were investigated. Comprehensive research works were conducted in the foothill forestry, Bunut forestry, and Vandam forestry areas of Mikhligovag village and it was determined that they are suitable for ecotourism potential. In connection with the situation created in the forest landscape complexes of the southern slope of the Greater Caucasus, the permissible recreational loading limit for forests has been determined. Recreational loads are divided into safe, dangerous, critical and catastrophic loads.

***Keywords**: ecotourism, the Greater Caucasus, forest ecosystem, landscape complexes, recreational loads*

INTRODUCTION

The durable ecotourism programs are realized in some countries of the world. Ecotourism is a responsible tourism kind directed to the local human's life standard and the environment improvement. To develop ecotourism in the Gabala, Oghuz and Shaki districts on the southern slope of the Great Caucasus is an important tourism kind.

There is a beautiful condition for the durable tourism management in the Gabala, Oghuz and Shaki regions and such program can be prepared:

- preparation of the guide booklet with the rules for the ecotourists;
- to prepare excursions and business plan;
- to plant tree seedlings in the special places under the motto "let it be your sign" in the spring and autumn seasons.

There is a good condition for development of the tourism's different kinds in the landscape complex on the southern slope of the Great Caucasus Tourism can be divided into the following categories. Scientific and Congress tourism-performing different kinds of the Congresses, meetings, scientific and practical trainings, exhibitions. Adventure tourism - a tourism kind which is physically hard, and dangerous for life. Such adventure tourism can be developed in the landscape complex on the southern slope of the Great Caucasus.

Village tourism - rapidly developing social and economical tourism. The natural environment, landscape complexes, social and economical development, historical and cultural relations and other components delight the men and teach them to love a nature in a tourism area. While saying Village tourism the following ideas can be concern:

- the urban population's temporary visit to the village places;
- while the tourists go to the villages they see a local life standard;
- the living period can involve whole season.

The landscape complexes assume scientific-practical import ace from ecotourism assessment point of view. Landscape complexes are of scientific and practical importance from the point of view of ecotourism evaluation. Ecotourism can be developed without harming flora and fauna. If you act according to the thought and planned rules, it can be said with certainty that the protection of the principle of environmental sustainability of ecotourism is the most important issue.

MATERIAL AND METHODS

From our side, soil cutting samples were taken in different parts of the territory of Gabala region, biometric indicators of trees were studied, and information was obtained by analyzing their structure and chemical properties. As a result of the observation of the study, the landscape changes in the territory of the Gabala region of the Southern slope of the Greater Caucasus were noticeable, even if they were slight. In these areas, tourists can use ecologically clean water sources.

RESULTS AND DİSCUSSİON

Using forest ecosystem services can be beneficial for tourists, but with minimal impact on the environment. Thus, among the national resources of Azerbaijan, forest cover has a special importance. Despite the fact that the degree of forest coverage of the territory of the republic is less than 10%, the role of forest ecosystems in the formation of the country's natural conditions, meso- and microclimate, soil and water resources is quite large. Despite the elimination of very serious problems in the state sector in the field of protection, restoration and increase of our forest resources for many years, and the adoption of important laws, there is still a lot of work to be done in this field. Illegal cutting of forests by the population in the plains and foothills caused special concern due to the severe economic situation that arose in the country 20-25 years ago. The destruction of the forest cover intensified erosion processes in all parts of the republic, increased aridification, reduced water resources, and created the basis for the deterioration of meso- and microclimate conditions.

Problems related to the protection, restoration and increase of forest cover are typical for the administrative regions located on the southern slope of the Greater Caucasus. In general, in the southern slopes of the Greater Caucasus, the fall of spring-summer precipitation in the form of showers, the high inclination of the relief and the sensitivity of the soil-rock layer to flood processes make forest protection and forest restoration more urgent in these areas. The preservation of the natural environment of the forest means that tourists can enjoy the natural environment [2,3].

Gabala region has wonderful conditions for tourists. So, for recreation, the forest ecosystem is protected in the mountainous area around the Gamarvar hot water sanatorium, which belongs to Gamarvar forestry. The mountainous area around the Gamarvar hot water sanatorium, which belongs to the Gamarvar forestry, is a very favorable environment for tourists. Gamarvar (Chomchebulag) mineral spring is a thermal-mineral water that rises to the surface at an altitude of 1388 meters, in the valley of the Bum river, 5 km north of the village of Gamarvar. Natural temperature is 39.2 degrees. It is rich in sulfur and iron compounds. The vegetation in the area is very rich. So, in the forests there are mixed trees such as juniper, blackberry, birch, juniper, walnut, apple, pear, and shrubs such as blackberry, hawthorn, blackberry, rose hip, and barberry.

In the Bum village, surrounded by the forest, there is a shooting recreation area. Tourists can enjoy ecotourism and adventure tourism in the area from the bank of the Hamzali river to the mountain. Tourists can use forest and river ecosystem services at an altitude of 1333 m above sea level in the northwestern part of Bum village of Gabala region. Comprehensive studies were conducted in the foothill forestry, Bunut forestry, and Vandam forestry areas of Mikhligovag village and it was determined that they are suitable for ecotourism potential [3,4].

Cars cause more damage to forests than tourists (trees, bushes and grass are damaged). Mechanical effects lead to hardening of the soil and destruction of perennial grasses. As a result of the hardening of the soil, one part of the soil remains dry and the other part becomes moist, which worsens the nutrition of the trees. Weakening of nutrition prevents the growth and development of trees. This is especially true in coniferous forests. Hardening of the soil destroys its structure, reduces the porosity, and worsens the living conditions of soil microorganisms.

The landscape complexes of the southern slope of the Greater Caucasus react differently to different impacts and recreational loads. Therefore, safe loadings for one natural complex may be critical for others. Recreational use of forests is of great importance for increasing the resource potential of society. Relaxation in nature relieves work stress and has a positive effect on people's ability to work. However, recreation around the city significantly damages the ecology. Recreational loadings are increasing in forest areas, as a result of which the quality of forests deteriorates or complete degradation occurs. At this time, the sanitary-hygienic, water protection and soil protection functions of forests weaken, and their aesthetics decrease.

CONCLUSİON

In connection with the situation created in the forest landscape complexes of the southern slope of the Greater Caucasus, the permissible recreational loading limit for forests has been determined. Recreational loads are divided into safe, dangerous, critical and catastrophic loads:

1) safe loadings are loadings that do not cause irreversible changes in the natural complex. The permitted recreational loading limit determines the sustainability limit of the natural complex [4,5];

2) loads are considered dangerous even if they exceed the limit of sustainability of natural complexes. Detection of dangerous download is in progress;

3) loads in landscape complexes with sharp destruction of plants are called critical loads. The calculation of critical loads is refined;

4) catastrophic loadings cause disruption of relationships between natural complexes and their components. We have determined the natural and anthropogenic factors that cause this.

Ecotourism assessment of landscape complexes is of scientific and practical importance. Ecotourism can be developed without harming flora and fauna. If you act according to the thought-out and planned rules, it can be said with certainty that ecotourism is the most reliable type in which the principle of environmental sustainability is protected.

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THE INTERRELATION OF SOCIAL CONSEQUENCES OF CLIMATE CHANGE IMPACT ON SOCIETIES

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In the last three decades, there has been growing interest to investigate the social consequences of the accelerated climate change on societies (e.g, Dietz, et al. 2020; Verner, 2010; Pielke, et al., 2005; Stehr, et al., 1995). Climate change as one of the most important global issues of the world, according to the Article 1 of United Nations Framework Convention on Climate Change (UNFCCC), can be defined as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time period" (UNFCCC, 2015). Since the dawn of the Industrial Revolution, humans have been producing increasing amounts of carbon dioxide and other powerful heat-trapping gases. As these greenhouse gases build up in the atmosphere, they essentially wrap an artificial blanket around the planet, trapping more and more of the Earth's heat. Since pre-industrial age the planet's average temperature has increased approximately 1.2 degree and based on current policies, the Intergovernmental Panel on Climate Change (IPCC) estimates that global warming will probably reach 3.2 degree by 2100 (Hayhoe, 2022). As a result of global warming communities are vulnerable to dramatic changes in temperature and precipitation, rising sea levels, melting glaciers, etc. Yet it is difficult and challenging to count the overall damage caused by global warming, its consequences on societies could be estimated. These consequences encompass social challenges such as poverty and well-being, mental and physical health problems, climate change-induced migration, increased gender inequality caused by weather extremes, the impacts on life expectancy and quality of life, food insecurity and nutrition that are considered only small parts of climate impacts on societies and serious threats to the future of mankind.

A great deal of previous studies have reported factors influencing the social life of people as a result of social consequences of climate change that will be threat to mankind if the measures be unimplemented untill 2030. One of these social consequences is related to health and well-being that influences the other consequences as well. As a common determinant of climate change the heat affects the health of all populations in the world and those "climate-sensitive health risks" create environment for hundreds of diseases. One study indicating the social consequences of malaria has found that climate change influences the spread of malaria by creating environment conducive to mosquitoes, making it difficult to combat the disease (Ghebreyesus, 2022). According to the study of World Health Organization (WHO) at least 5 percent of global malaria cases (21 million cases) would be demonstrated as consequences of climate change in 2030. This fact gives a view that increase in temperature, precipitation, migration, disbalance between urbanization and rural areas creates natural environment for infectious diseases and one of the recent examples Covid-19 pandemic has revealed clear deficiences in our public health systems. Another study focusing on social consequences of climate change has found that rising inequality, disbalance between urbanization and rural areas and the depletion of natural resources are the factors related closely with climate change that would be considered influencing the people's health directly or indirectly and it makes the countries to prepare comprehensive interventions towards it (Vicedo-Cabrera, 2022). These factors make the governments, scientists and all the people rethink the relation of health and well-being with other social factors such as inequality, poverty, clean water and sanitation, etc. and how climate change encompasses all these fields. One of the interesting studies relating social consequences of climate change has revealed that besides the factors that make large impact on public health, the factors such as inadequate health infrastructure, migration, lack of safe water and sanitation, and poor water storage pactices increase the health risks as well and give us the reason to rethink on interrelation of social consequences of climate change (Verner, (2010). In order to understand the social consequences of climate change and counter adverse health effects from climate change Verner (2010) considers education very effective policy and to reduce climate-induced health risks he suggests policies to focus on measures like improving capacity to monitor and predict disease patterns, building asset base of the poor, and decreasing vulnerability of groups. There is another notable study which indicates that the climate change impact on societies depends on time scales like "slow" and "fast" time periods (Stehr & Hans von Storch 1995). While slow variations seem to have little social and economic impact on societies, fast variations appear to make irreversible changes like social, economic, cultural changes such as desertification, emerging values, agricultural yields that seem to be multi-year anomalies (Stehr & Hans von Storch 1995). However, in the view of Beniston (2010), since the changes in extreme weather patterns and climate put vital resources at risk, humans are affected by the changes in ecosystems, spread of opportunistic species which prove the fact that human beings are not only receptors of environmental changes but also drivers of this change. All of this research emphasizes the increasing and significant effects of climate change has had on the social aspects of societies.

Despite of the increasing and significant effects of climate change, there is still lack of comprehensive research in revealing the complex analysis and interrelation of social consequences of climate change impact on societies though previous studies (e.g Ghebreyesus, 2022; Vicedo-Cabrera, 2022; Dietz, et. al 2020) investigated social aspects of climate change such as human health challenges (infectious disease exposure, non-communicable diseases and mental health), food and nutrition challenges, emerging climate refugees challenges, etc.

To address the abovementioned research gap, this paper focuses on the interrelation and complex analysis of social consequences of climate change and formulates recommendations for preventing possible adverse effects of social consequences of climate change impact on societies.

To reveal the interrelation of social consequences of climate change impact the integration of statistical analysis and qualitative case studies are the main methods applied in this research. The discussion of how governments and scientists can build teamwork to prevent the damages of possible effects of social consequences of climate change and protect their population, and the analysis of the data from the international sources such as UNFCCC, WHO, IPCC, and national governments statistical data comprise the methodology of this study as well.

This study aims to provide answers to the following questions: *a)how can we find solution to prevent possible adverse effects of social consequences of climate change on societies in the context of interrelation of social consequences, b)which methods could be used to identify the interrelation of social consequences of climate change, c)can social consequences of climate change be considered as driving forces of negative effects of economic and ecological impacts of climate change on societies?* All these questions will help us to review the interrelation and possible effects of climate change on societies and suggest solutions to protect it from catastrophic damages it can cause. Protecting the Earth-home to all humanity is no longer only an environmental priority but also has become central to securing a liveable future for all people. Considering all these facts, this research will contribute to shed light on social aspects of climate change impact on societies and propose solutions to adapting policies of governments, international organizations, regional or local communities in combating with predictable adverse effects of social dimensions of climate change impact on societies as well as the countries' development goals.

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IMPACT OF IRRIGATION ON SHANGE OF MORPHOGENETIC DIAGNOSTIC ALLUVIAL-MEADOW-FOREST SOILS IN THE DRY STEPPE ZONE OF THE KUR FLOOD-LAND

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Impact of irrigation on alluvial-meadow-forest soils of the dry steppe zone in the Kur flood-land has been studied. The field soil work was performed in 2020-2021. Turbidity of river and field waters was determined. Suspended sediments and their water-soluble parts are distinguished by a fairly rich humus (0.9-1.7%), gross nitrogen (0.07-0.12%), higher calcareous (5.1-10.2%). Suspended sediments of the river and field waters have a significant influence on irrigated soils where rather powerful cultivated layer (45-50cm) is formed in their profile and they are clearly distinguished by the indicators of the irrigated sediments. The results of the conducted studies show that in the arable horizons (AU'a=0-30cm) the content of humus (2.7-3.1%) and nitrogen (0.20-0.23%) is somewhat reduced. However, with the accumulation of agro-irrigation sediments, the establishment of the direction of the cultural soil-forming process, the content and stock of organic matter gradually increase in the soil profile (225-260t/ha).

Keywords: *alluvial-meadow-forest soils, soil profile, irrigation, soil cultivation, carbonates, humus*

INTRODUCTION

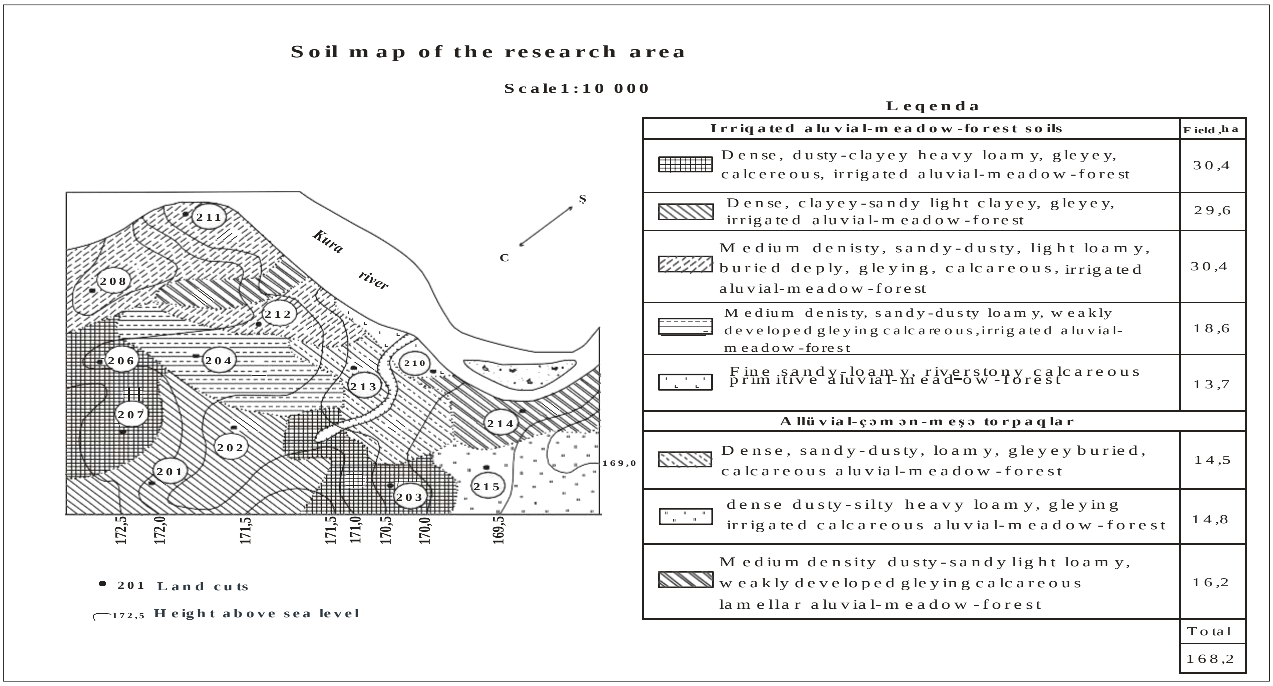
The importance of river valleys has long been known for the development of agriculture in the ancient East [2]. The first information about early agriculture is confined to places with a favorable moisture regime and high natural soil fertility, such as floodplain-alluvial lands. However, the genetic features, classification position, and diagnostic parameters of virgin and irrigated floodplain-alluvial soils are poorly studied compared to zonal soils [6]. Favorable relief conditions, a dry subtropical climate, as well as the resources of the water regime formed by a dense river network, have made it possible for the population to use cut forest areas for irrigated crops since ancient times [3]. A comprehensive study of the composition and properties of irrigated soils is of great importance, since the floodplain zone of the Kur river, a major supplier of vegetables, grain and fodder base in Azerbaijan, is of great economic importance. The purpose of the study is to study the impact of irrigation on the change in the morphogenetic parameters of irrigated alluvial-meadow-forest soils in the floodplain zone of the Kur river.

OBJECT AND METHODS OF RESEARCH

The Kura River is a major artery of eastern Transcaucasia. According to M.A. Musaibov [8], the width of the floodplain, together with the first floodplain terrace, ranges from 0.5 to 5.6 km and is relatively well divided into genetic zones.

The soil-forming rocks here are carbonate clay-loamy and sandy loamy layered alluvial deposits. Depending on the microrelief, the groundwater level ranges from 1.0-2.5 m to 2.0-2.5 m and is weakly mineralized (1.5-2,0 g/l). The climate is arid semi-desert subtropical, with an annual rainfall of 380-430 mm, a moisture coefficient <0.3, and an average annual air temperature of 12.0-13.2°C. The vegetation cover, mainly consisting of tugai-liana forests, under the influence of human economic activity, significant areas have been cut down and have undergone fundamental changes. Irrigated areas are used for vegetable, fodder, grain and orchards.

At the object of study (2020-2021), were selected characteristic plots with an area of 15 hectares, in each of which more than 10 soil sections were laid at a depth of 1.3-1.5 m and their detailed soil maps were compiled (1:10000). The following analyzes were carried out in soil samples: granulometric composition by the method of N.A.Kachinsky (rubbing with a solution of sodium pyrophosphate); the content of humus and nitrogen according to the method of I.V. Tyurin; absorbed cations according to K.K.Gedroits; pH of aqueous suspension - pH potentiometer; the content of CO2 carbonates with a calcimeter; fractional and group composition of humus according to the method of I.V.Tyurin in the modification of V.V.Ponomoreva and T.A.Plotnikova. Samples to determine the quality of river waters, turbidity and runoff of suspended sediments were taken in spring and summer periods during 2020-2021 using a bottle bathometer (GR-16, Russia).



RESEARCH RESULTS AND DISCUSSION

The results of the research and their discussion by V.P.Smirnov-Loginov [11] who conducted research in the soils of the lowland forests of Azerbaijan, these soils were first described as "tugai", where the annual precipitation is only 250-300 mm, and where the appearance of forest vegetation is caused by special hydrological features of the area. Therefore, lowland forests are confined to river floodplains, receiving the water they need from spring and summer floods and from lateral infiltration of river water.In his studies in the arid zones of Azerbaijan, including the floodplain of the Kur river, H.A.Aliyev [1] was against calling soils located in lowland forests "tugai". He called them alluvial-meadow-forest, which are formed in combination with alluvial-meadow and alluvial-marsh soils of river floodplains.

Our comparative geographic studies and their detailed mapping made it possible to significantly refine the structure of the soil cover, classification position and nomenclature of the alluvial-meadow-forest soils of Azerbaijan, including the floodplain strip of the Kur river, and stop in more detail on their morphogenetic diagnostics. Irrigated variants of these soils were identified as an independent type [3,5,12,13].

The classification and nomenclature of alluvial meadow forest soils are based on the ideas of G.V.Dobrovolsky [6], and also "Classification and diagnostics of soils of the USSR" [10], World Reference Base (WRB) [14], “Classification and diagnostics of Russian soils” [9].

Alluvial-meadow-forest soils are characterized by a normal genetic profile, a well-developed dark gray humus-accumulative horizon (AUz=25-30cm), with a granular-nutty structure, which is weakly compact-ted in the middle part of the profile (AU"a=20-25cm) unstable lumpy structure, where the middle and deep layers are clearly distinguished with bluish and brownish-ocher spots of varying degrees of gleying. In the lower layers of the soil profile, a buried humus horizon (AU_g^h=85-120cm) is observed, which is confirmed by the alluvial origin of these soils. Humus composition in the upper horizons forms 4.2-4.5 5 and decreases with dept to 0.8 %, and in buried horizons (AU_g^h=85-120cm) increases to 2.2 % again. A quantity of total nitrogen in the mountains AU=0.21-0.26 % (Tabl 1). These soils sre characterized with calcareous ($CaCO_3$=9.2-12.8%) of all the3 soil profile, but without visible calcareous segregations.

Table 1

Chemical indicators of suspended sediments in the river waters of the Kur flood-land

Sampling site	Quantity of suspended sediments, g/l	Humus, %	Nitrogen, %	C:N	$CaCO_3$,%	Water suspension pH
Aghstafachay river	5.02	1.61	0.113	8.3	5.12	7.8
Tovuzchay r.	4.18	1.44	0.101	8.2	7.45	7.7
Jeqamchay r.	6.45	1.74	0.116	8.6	6.74	7.5
Shamkirchay r.	5.78	1.52	0.098	9.0	8.14	7.6
Turyanchay r.	7.64	0.90	0.073	7.1	10.22	7.8
Goychay r.	4.75	1.48	0.105	8.2	9.40	7.7
Girdmanchay r.	8.57	1.64	0.122	7.8	6.74	7.6
Kur r. (Poylu)	4.62	0.74	0.076	6.7	5.17	7.8
(Tovuz)	5.08	0.81	0.060	7.8	4.97	7.7
(Shamkir)	1.32	0.72	0.049	8.5	5.14	7.8
(Minhachevir)	2.43	0.34	0.029	6.8	2.15	7.8
(Zardab)	2.32	0.65	0.052	7.3	4.34	7.2
(Salyan)	3.56	0.57	0.044	7.5	6.28	7.8

Alluvial-meadow-forest irrigated soils. In the object of research, under the influence of long-term irrigation with muddy river waters, the soil profile is constantly growing. In contrast to the forest variants, a rather thick cultivated layer (AU'a+AU"a=45-50cm) of dark gray color has formed here and humus is relatively deeply stretched (70-90cm), signs of irrigation sediment are clearly distinguished. Subarable horizon (AU"a=22-25cm) is distinguished by a noticeable compaction and a blocky lumpy structure. It is known that, with the degree of turbidity, the physicochemical parameters of suspended sediments also significantly affect the morphogenetic diagnostics of irrigated soils [4]. It was revealed that suspended sediments are quite rich in humus (1.0-1.7%), nitrogen (0.07-0.12%), and also contain a significant amount of $CaCO_3$ (5.1-10.2%). Suspended sediments are formed from highly humus mountain-meadow and mountain-forest soils of the underlying limestones.

Table 2

Morphogenetic diagnostic of alluvial-meadow-forest soils

Cut num-ber	Horizon, depth, cm	Humus, %	Nidrogen, %	CaCO, %	Water suspen-sion pH	Absorbinq capacity, mmol/eg	Granulometric composition, %, mm	
							<0,001	<0,01
Alluvial-meadow-forest soils (under tuqai forest)								
213	AO 0-3	Forest litter						
	AU'zca 3-18	5.43	0.36	7.5	7.5	36.1	20.7	50.8
	AUzca 18-37	3.17	0.25	8.7	7.8	34.7	18.3	52.5
	Bca 37-58	1.34	0.14	1.3	8.1	33.8	17.2	54.7
	B/Cgca 58-83	0.68	to.as	14.5	8.3	25.4	10.5	32.5
	AU'gca 83-120	2.08	"-"	10,2	8.1	30.5	17.2	44.4
	Cgca 120-155	0.45	"-"	14.3	8.4	23.4	6.7	16.0
Alluvial-meadow-forest soils (under perennial alfabfa)								
202	AUaca 0-25	3.75	0.25	11.0	8.0	30.7	2.5	58.5
	AU"aca 25-48	3.10	0.22	11.2	8.2	26.6	29.3	64.9
	Bgca 48-72	2.89	0.16	157	8.4	28.5	27.4	65.2
	B/C 72-95	0.89	to.as	17.5	8.5	20.0	17.1	43.4
	AU^hgca 95-118	2.51	"-"	14.9	8.3	26.9	22.4	56.6
	Cgca 118-150	0.62	"-"	15.4	8.6	19.8	15.2	38.9

(under qrain whent))								
207	AU’aca 0-28	3.18	0.23	12.3	8.2	27.2	23.7	60.8
	AU”aca 28-50	2.75	0.20	12.6	8.3	29.5	25.5	63.2
	Bgca 50-75	1.89	0.17	13.8	8.3	28.1	27,8	62.5
	B/Cgca 75-87	0.95	to.as	15.5	8.4	20.6	16.6	38.3
	AU^hgca 87-110	2,27	“-“	12.7	8.2	25.8	22.5	48.7
	Cgca 110-145	0.54	“-“	14.2	8.5	17.4	9.4	21.2
(under tomato)								
204	AU’aca 0-23	2.93	0.21	10.8	8.1	24.3	20.7	53.6
	AUaca 23-40	2.67	0.19	14.6	8.2	22.6	24.3	57.8
	Bgca 40-65	1.58	0.13	16.5	8.4	23.5	24.6	52.7
	B/Cgca 65-90	0.75	to.as	16.2	8.4	21.2	18.0	36.2
	AU^hgca 90-115	1.92	“-“	13.2	8.2	28.4	23.2	54.5
	Cgca 115-150	0.76	“-“	15.8	8.4	22.0	12.5	32.8

Analysis of the salt composition of irrigated river waters showed that they are characterized by high hydrocarbon content (HCO_3=0.12-0.21%), which leads to a noticeable alkalinization of irrigated soil profiles.

According to the regimes of irrigation of agricultural crops in the Republic of Azerbaijan, the following irrigation norms are recommended: for vegetables -4500-5000 m^3/ha (number of irrigations 6-8 times), alfalfa - 3000-4000 m^3/ha (4-5 times), and for cereals 1000-1500 m^3/ha (3 times). Irrigation is carried out by furrow method 500-700 m^3/ha [7].

The granulometric composition of irrigated soils exposed to the above turbid river waters for a long time is heavier than forest soils. A common feature of irrigated alluvial-meadow-forest soils is a significant gleying of the middle parts of the soil profile, where the amount of physical clay (<0.01 mm) reaches up to 62.5-65.2%. A sharp increase is observed in the content of silty particles (<0.001mm=28.2-30.6%). In the subsurface horizon, the density usually increases to 1.42-1.48 g/cm^3.

Irrigation processes significantly change the content and nature of the distribution of carbonates along the soil profile. Compared to forest soils, in the upper layers (0-25 cm) of irrigated soils, the $CaCO_3$ content is 3-5% higher. This can be explained by the high carbonate content of irrigation water sediments. A fairly high content of $CaCO_3$ (13-17%) is observed in the middle part of the soil profile of irrigated soils. In the cultivated layers of irrigated soils, the value of the exchange capacity is 22.0-26.5 mmol-eq, then with depth there is a gradual drop of 17.4-22.0 mmol-eq. Usually in the lower buried humus horizons ($AU^h{}_g$) its value reaches 25.8-28.4 mmol-eq. Compared to forest soils, the upper horizons of irrigated soils are alkaline (pH=8.0-8.5).

Table 3

Group and fractional composition of humus of alluvial-meadow-forest soils (%) of total C

Section №	Horizon, depth, cm	C, %	Bitu-men	Decal-cinate	C, % humus carbon									$C_{h.a}$:$C_{f.a}$
					humic acids				fulvic acids				humin	
					fractions									
					1	2	3	sum	1	2	3	sum		
Alluvial-meadow-forest soils														
213	AU'r 3-18	3.15	5.28	6.73	24.18	5.36	3.61	33.15	21.36	4.95	3.67	29.58	35.12	1.12
	AU"z18-37	1.84	3.12	4.52	16.31	3.28	2.15	21.74	13.62	3.03	2.10	18.75	27.24	1.16
Alluvial-meadow irrigative soils														
202	AU'a 0-25	2.18	3.65	2.58	20.19	8.24	2.64	31.07	11.83	6.79	3.15	22.89	43.15	1.36
	AU"a25-48	1.80	2.93	1.72	15.12	6.65	2.13	23.90	10.89	5.53	2.90	18.90	41.07	1.25
204	AU'a 0-28	1.84	4.02	1.95	18.37	8.84	3.08	27.29	12.19	4.37	2.07	19.18	38.24	1.42
	AU" 28-50	1.60	3.15	1.56	13.15	5.94	1.76	20.85	10.24	3.34	1.43	16.01	40.97	1.30

The results of the conducted studies show that in the arable horizons (AU'a=0-30cm) the content of humus (2.7-3.1%) and nitrogen (0.20-0.23%) is somewhat reduced. However, with the accumulation of agro-irrigation sediments, the establishment of the direction of the cultural soil-forming process, the content and stock of organic matter gradually increase in the soil profile (225-260t/ha).

Of great importance is also the determination of changes in the qualitative composition of humus in the process of irrigation and cultivation. In the fractional-group state of humus in forest soils, the first fraction of humic (13.7-14.2%) and fulvic acids (16.2-18.4%) dominates significantly, where the ratio of $C_{h.a}$:$C_{f.a.}$

almost equal (1.15-1.24). In irrigated soils, there is a noticeable increase in the content of humic acids (30.5-34.6%) in the composition of humus and the ratio $C_{h.a}$:$C_{f.a.}$ increases to 1.30-1.42.

It should be noted that the increase in the proportion of humic acids in the composition of humus during cultivation occurs mainly due to fraction II, which are mainly associated with calcium and mobile forms of R_2O_3. In irrigated soils, the content of humin also increases sufficiently (40.2-45.3%).

The results of comparative studies indicate certain differences in the gross chemical composition of forest and cultivated alluvial-meadow-forest soils. Soils under forests of mountains. AU' contain 55.4-58.8% SiO_2 with a gradual decrease to soil-forming rocks (50.8%).

Table 4.

Gross chemical composition of alluvial-meadow-forest soils, % from calcined substanse

Section №	Horizon, depth, cm	LOI	SiO_2	Al_2O_3	Fe_2O_3	P_2O_5	CaO	MgO	K_2O	Na_2O	SO_3	$\frac{SiO_2}{Al_2O_3}$	$\frac{SiO_2}{Fe_2O_3}$	$\frac{SiO_2}{R_2O_3}$
Alluvial-meadow-forest soils														
213	AUz 3-18	9,74	58,84	17,68	9,60	0,18	3,48	4,04	1,58	0,92	0,74	5,67	16,35	4,21
	AU"z 18-37	6,52	55,45	17,43	8,42	0,14	4,15	4,98	1,24	0,78	0,52	5,40	17,48	4,12
	Bg 37-58	7,04	53,96	18,52	8,14	0,11	6,11	5,12	1,03	0,65	0,08	4,94	17,63	3,86
	Cg 120-155	9,27	50,83	15,48	7,26	0,08	8,46	6,15	2,26	0,94	1,49	5,57	18,82	4,30
Alluvial-meadow irrigative soils														
202	AU'a 0-28	6,08	53,16	18,54	8,62	0,29	4,75	5,35	2,18	0,78	0,56	5,16	18,81	3,92
	AU"a 28-50	5,24	54,05	20,54	9,07	0,22	5,36	4,62	2,46	0,62	0,48	4,51	15,90	3,51
	A/B 50-85	4,95	53,21	19,07	10,23	0,17	5,02	4,18	2,01	0,84	0,72	4,74	13,86	3,53
	Cg 118-150	9,72	55,13	17,63	8,56	0,15	8,78	5,06	1,83	0,78	0,87	5,31	17,02	4,05

In irrigated soils, there is a slight decrease in the content of SiO2 (3.5-5.0%) in the upper arable horizons compared to forest soils. It is obvious that the difference in the content and distribution along the SiO_2 profile on forest and irrigated soils is determined, on the one hand, by the leaching effect of irrigation water, and, on the other hand, by the composition of irrigation sediments in developing soils. The results of the analysis show a noticeable differentiation of the forest soil profile, mainly in CaO, somewhat less Al_2O_3 and Fe_2O_3.

A depletion of the CaO content in the upper parts of the soil due to the removal of silicate Ca and an increased content of CaO in the underlying horizons were revealed, which can be explained by the enrichment of soil-forming rocks with calcium carbonate. The soil profile has a higher content of R_2O_3 compared to the soil-forming rocks. Forest and irrigated soils almost do not differ in Fe_2O_3 content. The low molecular ratio of SiO_2:R_2O_3 in forest and irrigated soils (3.5-4.5) makes it possible to attribute them to the silicate type of weathering.

CONCLUSIONS

Suspended sediments of irrigation waters are characterized by rather rich humus (0.9-1.7%), gross nitrogen (0.07-0.12%), high carbonate content ($CaCO_3$=5.1-10.2%).

Irrigated soils are distinguished by relatively high carbonate content (15-17%), absorption capacity (24-27 mmol-eq) and heavier granulometric composition (<0.01mm=60-67%).

In arable horizons (AU'a=0-25cm), the content of humus (2.8-3.1%) and nitrogen (0.21-0.24%) is somewhat reduced. However, with the accumulation of agro-irrigation sediments, the establishment of the direction of the cultural soil-forming process, the content and stock of organic matter gradually increase in the soil profile (230-245t/ha).

The humus state of the soil under the forests is characterized by significant mobility, where the first fraction dominates in the fractional-group composition of both humic acids and fulvic acids and the ratio of $C_{h.a}$:$S_{f.a.}$ is almost equal (1.15-1.24). In the profile (0-100 cm) of irrigated soils, the humus content noticeably increases and in the composition of its humic acids (30-34%) the ratio of $C_{h.a}$:$S_{f.a.}$ reaches 1.30-1.37.

The gross chemical composition shows that in irrigated soils there is a slight decrease in the content of SiO_2 (3.5-5.0%) in the upper arable horizons compared to forest soils. The maximum content of CaO (6.1-8.8%) is observed in loose soil-forming alluvial deposits, which are sufficiently enriched in calcium carbonate. Soils are also rich in R_2O_3 content, resulting in a narrow SiO_2:R_2O_3 molecular ratio (3.5-4.3).

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ESTIMATION OF AGROECOTOURISM POTENTIAL IN DASHKESEN DISTRICT, AZERBAIJAN

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Agroecotourism, which combines agricultural activities and ecological tourism, has gained significant attention as a sustainable development approach that promotes rural economies while preserving natural resources. This paper aims to assess the agroecotourism potential in Dashkesen District, Azerbaijan. By analyzing the district's natural and cultural assets, agricultural practices, infrastructure, and market opportunities, this study provides insights into the feasibility and potential benefits of developing agroecotourism in the region. The findings contribute to informed decision-making and the formulation of strategies for sustainable rural tourism development. Title: Estimation of Agroecotourism Potential in Dashkesen District, Azerbaijan agroecotourism, a unique combination of agriculture and ecotourism, has gained significant attention in recent years as a sustainable and economically viable form of tourism. This study aims to estimate the agroecotourism potential in Dashkesen District, Azerbaijan, by assessing its natural resources, cultural heritage, and agricultural activities. The research methodology involved a comprehensive analysis of primary and secondary data sources, including field surveys, interviews with local stakeholders, and review of relevant literature. The natural resources of Dashkesen District, such as its diverse landscape, favorable climate, and rich biodiversity, were evaluated to identify their attractiveness for tourists seeking nature-based experiences. Additionally, the cultural heritage of the region, including historical sites, traditional practices, and local crafts, was examined to determine its potential to enhance agroecotourism offerings. The study also investigated the agricultural activities in Dashkesen District, focusing on the production of local crops, livestock farming, and traditional food processing techniques. These agricultural practices were analyzed in terms of their ability to provide immersive and educational experiences for tourists. The results of the study indicated that Dashkesen District possesses significant agroecotourism potential. Its natural resources, including the magnificent landscapes of the Greater Caucasus Mountains, the stunning Gyz Galasy (Maiden Tower) Canyon, and the abundance of flora and fauna, can serve as major attractions for ecotourists.

Keywords: *agroecotourism, Dashkesen District, Azerbaijan, rural tourism, sustainable development*

INTRODUCTION

There are many types of tourism that you may have heard of or even experienced first hand. Culinary tourism, business tourism, sports tourism, and even medical tourism – you name it. What makes agroecotourism stand out is that it is heavily focused on protecting the environment and reducing our carbon footprint while still providing an enjoyable holiday. For guests, agroecotourism is an escape from busy city life. It gives them the opportunity to be surrounded by nature and immerse themselves in a new culture. Not only does this provide endless activities for travelers, but it also supports local farmers. Agroecotourism can provide jobs in areas that normally have high levels of poverty, improve the food supply chain, strengthen traditional farming practices, and promote the local heritage through art. Furthermore, it’s a great cause to promote because it works on conserving natural habitats and increasing landscape diversity. Because agroecotourism teaches people to be more responsible when it comes to their consumption habits, this change in mindset can be transformative for our society. From crystal clear mountain lakes to lush rainforests, agroecotourism offers the opportunity to enjoy the unique beauty of nature that must be preserved for future generations. In our case, we are considering a region located in a country that covers 9 out of 11 climate types, Dashkesen. Geographical location coordinates is defined at 40°31'29"N latitude and 46°04'40"E longitude. The height above sea level is 1624 m. [Google Earth, 2022]. The region is surrounded by hills, with agricultural fields and semi-forests. These fields mainly grow wheat, barley, and clover. There is also a park and a national landmark in the area. Geographical location coordinates were defined at 40°30'19"N latitude and 46°04'51"E longitude. The height above sea level is 1496 m. [Google Earth, 2022].

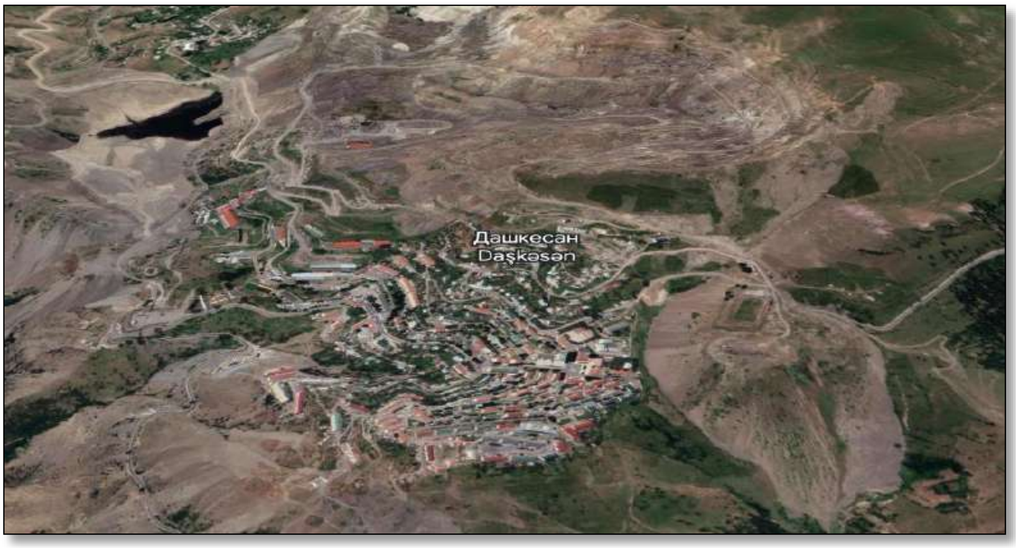
Climate: The climate of Dashkesen, Azerbaijan, is classified as a humid continental climate. Here are some key climate parameters for the area:

1. Temperature: Dashkesen experiences warm summers and cold winters. The average temperature in summer (June to August) ranges from 20°C to 25°C (68°F to 77°F). In winter (December to February), temperatures drop significantly, with averages ranging from -3°C to -8°C (26°F to 18°F).
2. Precipitation: Dashkesen receives moderate rainfall throughout the year. The wettest months are typically April, May, and November. The annual precipitation averages around 600 to 700 millimeters (24 to 28 inches).
3. Snowfall: Due to the cold winter temperatures, Dashkesen often experiences snowfall from December to February. Snow cover can be significant, particularly in higher elevations.
4. Humidity: The relative humidity in Dashkesen varies throughout the year, with higher levels during the winter months and lower levels in summer. Humidity ranges from 60% to 80% on average.
5. Wind: Dashkesen can experience moderate winds, especially in the spring and autumn seasons. However, wind speeds are generally not extreme.

It's important to note that these climate parameters are approximate and can vary from year to year. For more precise and up-to-date information, it's recommended to refer to local meteorological sources or climate databases.

MATERIAL AND METHODS

These studies were carried out using Google map and Google Earth (coordinates, altitude and area). Climate data was reported using Meteoblue and Weatherspark (mean high and low temperatures, cloud cover, precipitation, tourism score)



Map 1. Dashkesen View from Google Earth based on 2022 Orthophoto

The Aero geodesic measurements were collected using this map. Thus, square, coordinates and elevation were determined with the aid of these aerospace materials. Unfortunately, there is not much information about this place in the scientific literature, only about the first observatory and reserves.

Figure 2. Tourism Potential in Dashkesen

In order to define the period suitable for tourism in Dashkesen along the year, figure 2 was given. To characterize how pleasant the weather is in Dashkesan during the year, we calculate two points for trips. The tourism score takes into account the presence of clear, rainless days with expected temperatures between 18°C and 27°C. Based on this score, the best time of year to visit Dashkesan for general outdoor recreation is from late June to early September, with the highest score occurring in the last week of July. The best time for visitors begins from the 1st of June and lasts from the 1-10th of September. Generally, from the beginning of May to the end of September visiting is possible. For forest lovers the camps can be organized. The calm climate gives the tourists a great opportunity to rest on the shore along the whole summer. The maximum tourism score (Weatherspark, 2022) changes between 8.0 and 8.8.(weatherspark)

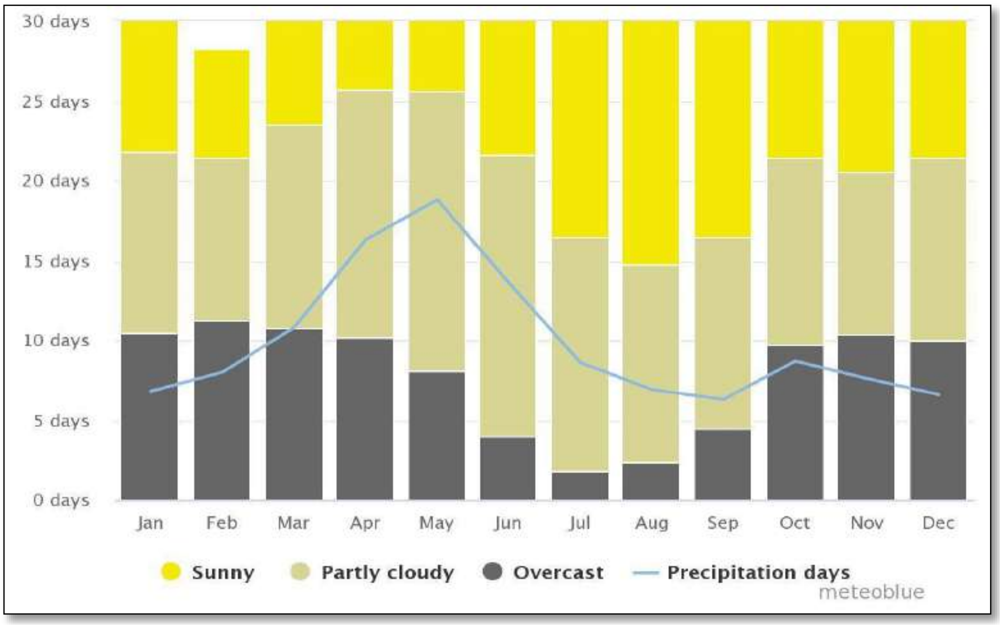


Figure 3. Cloudy, sunny, and precipitation days in Dashkesen

The graph indicates the number of sunny, partly cloudy and foggy days, as well as days of precipitation. Days when the cloud layer does not exceed 20% are considered sunny; 20-80% of the cover is considered partly cloudy and more than 80% is considered overcast. (Meteoblue)

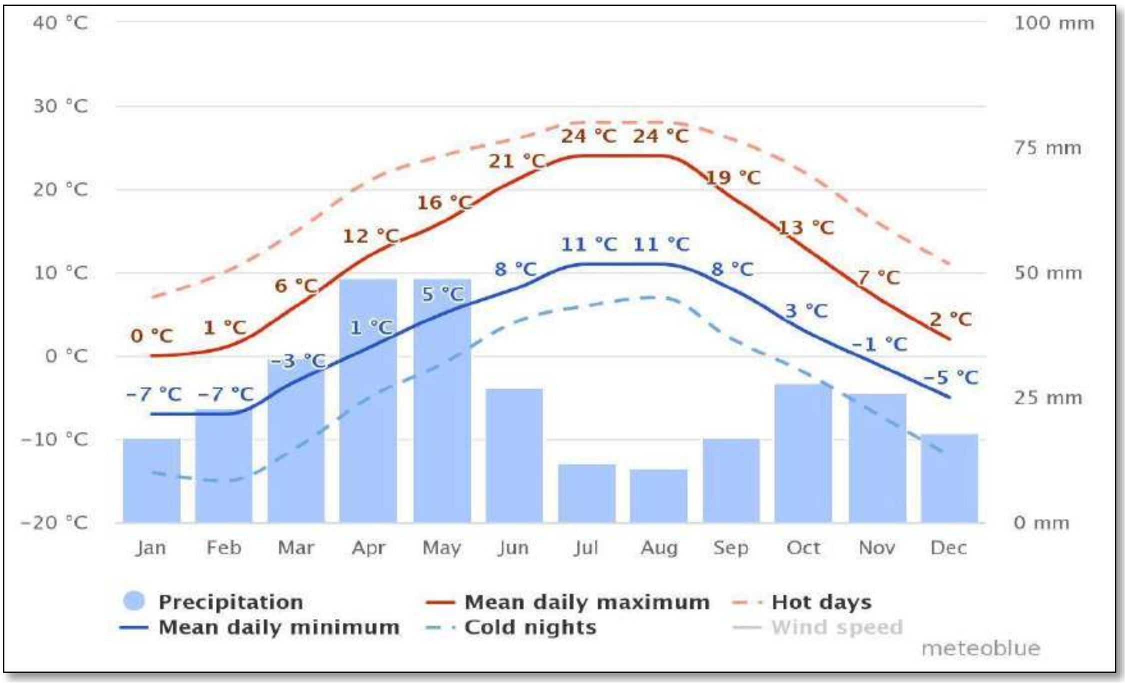


Figure 4. Average temperatures and precipitation in Dashkesen

The "mean daily maximum" (solid red line) shows the maximum temperature of an average day for every month for Dashkesan. Similarly, "Minimum Mean Daily Temperature" (solid blue line) indicates the minimum average temperature. Hot days and cold nights (The dotted red and blue lines indicate the average temperature on the hottest day and coldest night of each month for 30 years. When planning your vacation, you will be aware of the average temperature and prepared for both the hottest and the coldest nights. cold days.

RESULT AND DISCUSSION

When studying Dashkesen, it was found that the area is suitable for agroecotourism. Nature untouched by man is very attractive for tourists, but there are also disadvantages that reduce the potential - infrastructure and anthropogenic pollution of territories. These tasks are solved in several stages:

• The first stage - cleaning of territories from garbage and waste

• Second phase. The construction of infrastructure is the final stage of this dimension. In order to develop the tourism sector in the region through the use of Dashkesen natural resources (construction of cottages, hotels and entertainment centers, parasailing on the lake, etc.).

The territory of the Dashkesen district is a resort area in terms of climatic and geographical parameters. A lot of sources were studied to determine the climatic state of the surrounding area, and in the end it turned out that the wind potential makes it possible to build infrastructure for ecotourism.

Dashkesen is a district in Azerbaijan located in the central part of the country. The district is known for its natural beauty, including mountains, landscapes, and rivers. It is home to diverse plant and animal species, which are of interest to eco-conscious tourists. The cultural and historical heritage of Dashkesen district is also attractive to tourists. Visitors can explore historical monuments, architectural structures, and traditional villages where locals preserve their customs and traditions

Thus, Dashkesen has a huge ecotourism potential that has never been appreciated before. Today, the tourism sector is being improved as an alternative sector that brings economic benefits to the republic. Thus, the reclamation and cleanup of the Dashkesen area is worthy of the development of the ecotourism sector in the region.

CONCLUSION

In conclusion, I would like to say that if the following tips are followed in Dashkesen, then agritourism is guaranteed in this place.

Development of a marketing strategy: Create an effective marketing strategy aimed at attracting the target audience. Include in it the promotion of unique agrotourism opportunities, the attractiveness of the natural and cultural attractions of the area.

Infrastructure and Amenities: Develop and improve infrastructure for agrotourism, including roads, transportation links, hotels, restaurants, and other amenities. Ensure a comfortable stay and safety for visitors.

Variety of activities: Offer a variety of activities for tourists such as farm tours, participation in harvesting, participation in traditional craft activities, winemaking and other agricultural practices. This will help create interesting and memorable experiences for visitors.

Training and advice: Provide training and advice to local farmers and agrotourism entrepreneurs. Help them develop skills in hospitality, business management and improving the quality of the services offered.

Collaboration and partnerships: Establish partnerships with local communities, farms, local organizations and tour operators. Create partnerships to share resources, knowledge and experience, and to promote agrotourism in the region.

Acknowledgement

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THE ROLE OF ECOTOURISM POTENTIALS IN SOCIO-ECONOMIC DEVELOPMENT OF OGHUZ DISTRICT, AZERBAIJAN

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Ecological tourism has been one of the fastest growing areas of the world tourism industry in recent times. This type of tourism has become a sector that is formed according to the natural resources and lifestyle of the local population and is supported by its contribution to the sustainability of socio-economic development. The creation of tourism infrastructure means not only tourism but also the economic development of the region and the country as a whole, helping to solve problems related to employment and raising the standard of living. For the Republic of Azerbaijan, the development of ecotourism is of great importance in terms of the development of alternative activities in rural areas and the provision of employment. This area has a positive effect on the development of villages and agriculture, the creation and development of socio-cultural service areas, and the improvement of the level of services provided by them, ensuring the employment of the population and increasing their income.

From this point of view, the article is analyzed the development possibilities of ecotourism in the socio-economic development of Oghuz district. Also, given the existing problems revealed in the revitalization of this district, the development of economic areas, increasing competitiveness, and social and cultural services in rural areas, as well as ways to solve these problems, a number of proposals have also been put forward.

Keywords: *Ecotourism, Oghuz district, Sustainable development, Income, Social and economic impact*

INTRODUCTİON

Ecotourism has gained significant attention worldwide as a sustainable approach to tourism development, promoting the conservation of natural resources while fostering local socio-economic development. Oghuz (located in the Shaki-Zagatala eco-geographical region at the southern foot of the Greater Caucasus, with the gps coordinates of 41° 4' 22.0512" N and 47° 27' 54.2412" E., Latitude:41.0714, Longitude:47.4653) is an area rich in ecological diversity and cultural heritage, offering immense potential for the development of ecotourism (Google Earth). The role of ecotourism in the socio-economic development of Oghuz District was explored in this introduction and highlighted its potential to generate employment opportunities, preserve local cultures, protect the environment, and contribute to the overall well-being of the local communities.

Oghuz District is blessed with abundant natural resources, including lush forests, pristine rivers, and diverse wildlife. These ecological assets create a unique environment that attracts nature enthusiasts and adventure seekers, making it an ideal destination for ecotourism. The responsible development of ecotourism in Oghuz District can harness this potential, providing a source of sustainable revenue for the local economy.

One of the primary benefits of ecotourism is its ability to create employment opportunities for the local population. As ecotourism activities expand in Oghuz District, there is a growing demand for skilled guides, interpreters, hospitality staff, and craftsmen, among others. This surge in employment not only reduces unemployment rates but also empowers local communities, contributing to poverty alleviation and improving the overall standard of living. The promotion of ecotourism in Oghuz District can also serve as a catalyst for the preservation of local cultures and traditions. Indigenous communities residing in the region have deep-rooted connections with the natural environment and possess a wealth of traditional knowledge. Through ecotourism, these communities can share their customs, arts, crafts, and traditional practices with visitors, fostering cultural exchange and preserving their heritage for future generations. Furthermore, ecotourism plays a crucial role in environmental conservation. Oghuz District boasts fragile ecosystems and biodiversity hotspots that require protection from unsustainable practices. By promoting responsible tourism practices, such as low-impact accommodations, waste management, and guided nature tours, ecotourism ensures the preservation of the district's natural resources, minimizing negative impacts and promoting sustainable development. The socio-economic benefits of ecotourism extend beyond the local level. As Oghuz District becomes recognized as an ecotourism destination, it attracts domestic and international tourists, increasing revenue for local businesses, transportation services, and the hospitality industry (M. Honey, 2017). This inflow of tourist spending stimulates economic growth, supports small-scale enterprises, and encourages investments in infrastructure development, benefiting the district as a whole. The development of ecotourism in Oghuz District has the potential to drive socio-economic growth while promoting the conservation of natural resources and cultural heritage. By harnessing its rich ecological diversity, providing employment opportunities, preserving local cultures, and protecting the environment, ecotourism can contribute to the overall well-being and sustainable development of the district and its communities. However, it is essential to implement responsible and community-based approaches to ensure the long-term success and benefits of ecotourism in Oghuz District (F.Sh.Azizov,A.Ch.Ismayilova,2019).

MATERİAL AND METHODS

Many materials were used to conduct this investigation. Thus, the study made considerable use of academic papers, books, research articles, the Google Earth program, data from official institution websites, and other scholarly sources. Some official information was obtained from a number of government agencies, research institutions, or conservation organizations through the ANAS Sheki RSC's official documents (Oghuz branch of Sheki Regional Culture and Tourism Department, Oghuz District Executive Authority, Social-economic Development Analysis and Forecasting Department, Oghuz District Employment Center, Oghuz District Statistics Office) in the Oghuz district.

It's important to note that ecotourism learning methods depending on the specific destination, organization, or program. Therefor, the specific approach and activities chosen depend on the goals, resources, and context of each ecotourism program or organization.

The climate of the Oguz district in Azerbaijan is characterized as a continental climate with distinct seasons. Summers (June to August): Summers in Oguz are typically warm to hot with average daytime temperatures ranging from 25°C to 30°C (77°F to 86°F). July is usually the warmest month. However, temperatures can occasionally reach higher values, especially during heatwaves. Humidity levels are generally moderate, and the region experiences relatively low precipitation during this season. Autumns (September to November): Autumn in Oguz is mild and pleasant, with gradually decreasing temperatures. September and October still have some warmer days with temperatures ranging from 15°C to 25°C (59°F to 77°F). However, November starts to bring cooler temperatures, ranging from 5°C to 15°C (41°F to 59°F). Precipitation levels increase during this season, with occasional rain showers. Winters (December to February): Winters in Oguz are cold, and temperatures can drop below freezing point. Average daytime temperatures range from 0°C to 5°C (32°F to 41°F), while nighttime temperatures can drop below -5°C (23°F). Snowfall is common during this season, and the region experiences higher precipitation compared to other seasons. Springs (March to May): Springs in Oguz are relatively mild, with temperatures gradually increasing. March can still be chilly, with temperatures ranging from 5°C to 10°C (41°F to 50°F). However, April and May bring more pleasant weather, with temperatures ranging from 10°C to 20°C (50°F to 68°F). Precipitation levels decrease compared to winter but are still moderate. It's important to note that these are general climate characteristics, and actual weather conditions can vary from year to year. For more accurate and up-to-date weather information, it's recommended to refer to local weather forecasts or climate data sources. As if the climate data of the district teh annual monitoring and analyses result have been given below in Figure 1.

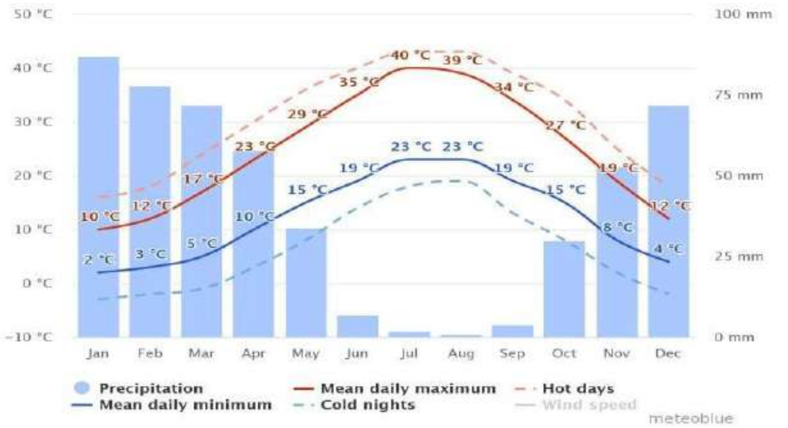
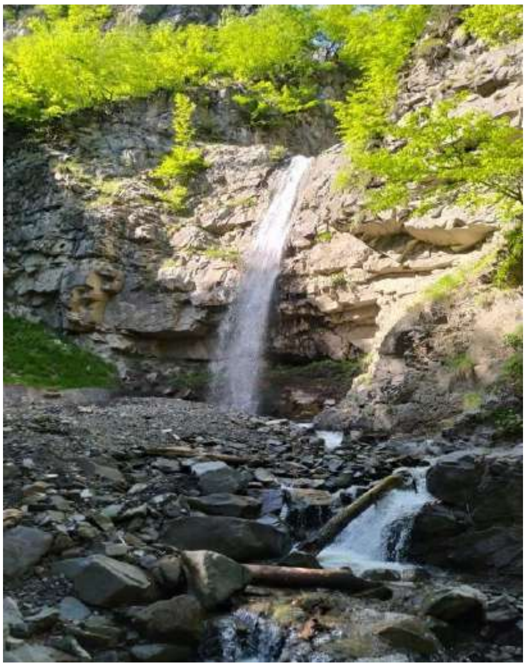


Figure 1. Average Climate data of Oguz district

RESULT AND DISCUSSION

The studied area is very rich in ecological tourism resources. Thus, Oghuz district, known for its natural beauty and cultural heritage, offers several potential uses for this type of tourism. The northern part of the Oguz district, which is mainly mountainous, is included in the southern slope of the Main Caucasus range; the central part is in the Ganikh-Haftaran valley; and the southern part is included in the front highlands of Acinohur. Among the natural monuments in the region, the Dashail pass, formed by the Dashail river, stretches from the north of Bash Dashail village to the Qdim pass. Khachmaz Pass connects three mountain roads near Khachmaz village. Gdim Pass (2,906 m), Gedim Pass (2,000 m), Fiy Pass (3,100 m), and Malkamud Pass (3,800 m) can be included in the routes as tourist centers (B.A.Budagov,1990). The establishment of sanatorium-resort establishments that carry out the processes of recreation and treatment-prophylaxis in areas with favorable landscape and climate characteristics is of great importance for the promoteon and socio-economic development of regions with tourism potential. The uniqueness of the natural geographical conditions of the Oguz region (mineral-thermal springs) in this regard opens wide opportunities for the development of wide-profile tourism infrastructures and has the possibility of being used for resort-recreational purposes that can operate throughout the year. Oguz district is rich in hot and cold mineral water springs with various concentrations of sulfurous and organic substances, which are among the hydrogeological monuments. From this point of view, the Gobur valley area of Bash Dashail village is one of the most outstanding places with its charming nature. Gosha spring, Hajasaf spring, and Qzlar Yaylag springs come to the surface in the valley and have important tourism implications. Khalkhal, Bugusshor, and Agbulag thermal and mineral springs in the region have the potential to be used as tourist facilities. With the exception of the Khalkhal thermal spring, each of the other springs has the possibility of being used as a source of drinking water by the local population. At the same time, Baş Dashail village is one of the regions with many facilities that serve the development of ecological tourism. Düzen spring, Haji Ata spring, Soltan spring, sulfurous water spring, etc. have surfaced in the area and are potential resources that enable the development of tourism.

3) There are a large number of waterfalls and canyon-like valleys on the rivers (Alicanchay, Khalkhal, Dashail, Oguz, Nazarchay, and Galachay), which are among the hydrological monuments that determine the development of ecotourism in the territory of the region. The possibility of purposeful use of these hydrological facilities increases the importance of developing various production and service areas in the field of tourism. From this point of view, waterfalls have wide possibilities of use as existing natural tourism objects. The most notable waterfalls in Oguz region are Dashaıl and Kordara waterfalls 25 km northwest of the district center, north of Bash Dashaıl village, Guruchay **(Photo 1)**, GalaDuz waterfalls in the Oguz section of Shahdag National Reserve, a large waterfall of the same name on the Nazar river and several smaller ones. – Zeynab **(Photo 2)**, Tandir, Dor-dor, Sehran, etc. are waterfalls. Those waterfalls not only create a beautiful landscape here, but also indicate the potential of the area for ecotourism. Parvane and Girdal waterfalls on the Galachay bed in Filfilli village, Khalkhal waterfall of the same name in Khalkhal village, located 15 km northeast of the district center, between the Karachay and Kordara rivers, are among the natural hydrological objects.



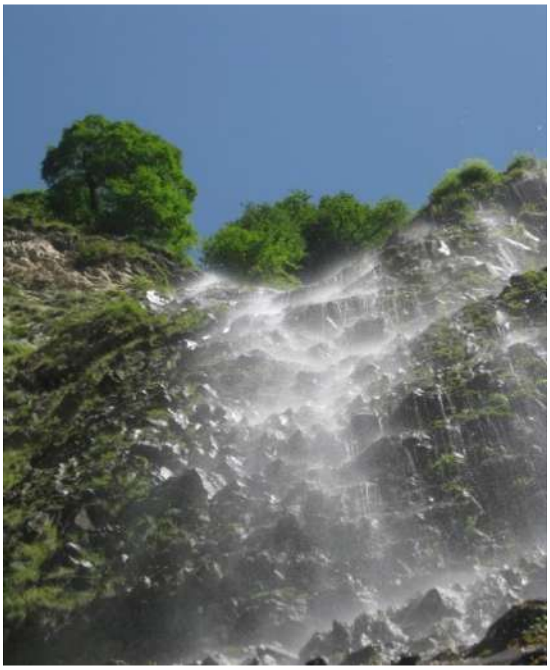


Figure 2. Guruchay Waterfall **Figure 3. Zeynab Waterfall (Khachmaz)**

The district we described is one of the unique regions known for its archaeological and historical-architectural monuments reflecting centuries-old history. Currently, there are 39 state-registered historical, architectural, and cultural monuments in the region. In this regard, Albanian temples, synagogues, barrows, fortification towers, and ancient mosques are the main potential sources that can stimulate the development of tourism in the area, being of great interest to tourists from the point of view of history. Here are some of the notable monuments and excavations we mentioned:

- Karimli Mounds: These mounds, located near the village of Karimli, date back to the beginning of the 1st millennium BC. They are home to an ancient cemetery, or necropolis, from the Bronze and Early Iron Ages.
- Garabaldir Necropolis: Situated near the city of Oguz, close to the village of Garabaldir, this necropolis contains cemeteries dating back to the 4th to 1st centuries BC, representing the Bronze and Early Iron Ages.
- Gavurgala Fort: Located 2 km from the village of Khachmaz, on the top of Galachay, this fortified structure dates back to the 17th century.
- Balashum Settlement: Situated 4 km northeast in the forest, the Balashum settlement dates back to the 11th–12th centuries(F.V.Gadyrov,1984).
- Juma and Khachmaz Mosques: These mosques, constructed in the 19th century, hold historical and cultural significance in the district.
- Haji Rashid and Adil Bridges: These bridges, also from the 19th century, are important cultural and historical monuments.
- Mukhas Tower: Located on the road to Dashail village, in front of the Dashail pass, the Mukhas Tower is a three-story tower dating from the 12th to 14th centuries.
- Malug Castle: Found in the flat area of the Malug residential area, the Malug Castle dates back to the 11th century.
- Surkhai Khan Castle: Situated in the village of Upper Filfilli, this castle is from the 18th century and is attributed to Surkhai Khan **(Photo 4).**
- Jalut Albanian Monastery: Dating back V-VI centuries, the Jalut Albanian Monastery holds great importance as a historical architectural monument in the region **(Photo 3).**

These historical sites and architectural monuments offer valuable insights into the district's ancient past and contribute to the development of tourism in the area.

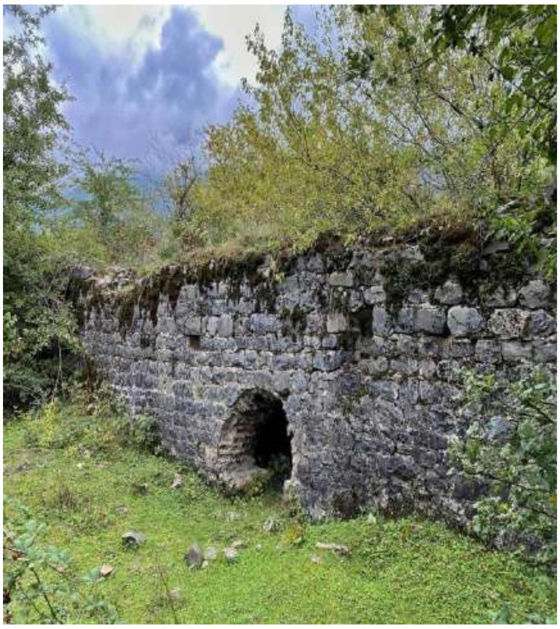


Figure 4. Jalut Albanian monastery

Figure 5. Surkhaikhan Castle

5) National Parks are natural areas suitable for ecological tourism. The difference between national parks and others is that nature is protected here in a comprehensive manner, and tourists are allowed to enter the area, get acquainted with nature, and enjoy the aesthetics. In this regard, there are enough opportunities for the development of ecotourism in the Oguz section of the Shahdag National Park (G.Mammadov,M.Khalilov,E.Yusifov,V.Karimov,2012). The park is situated in the Greater Caucasus Mountains, offering stunning landscapes, diverse flora and fauna, and numerous outdoor activities. Hiking, horseback riding, mountain biking, motorized vehicles, picnics and camping are popular and promising fields within the realm of ecotourism.

CONCLUSION

The research shows that there is a great need to create a health center and a tourism-recreational complex that can operate in all seasons of the year in each thermal and mineral water field registered in the research area. By establishing such enterprises in areas with thermal and mineral water sources, it can help prevent the migration of the local population to cities or foreign countries in search of employment opportunities. This can lead to a more balanced development across different regions of the country, reducing the strain on urban areas and promoting growth in rural or less developed areas.

To enhance the tourism experience in Oghuz district, it is crucial to prioritize investments in improving the transportation infrastructure, including maintaining and upgrading roads. Although the region is rich in natural, historical and cultural monuments, people have to use horses or go on foot to go to some areas. In this case by providing well-maintained and safe roads, tourists can travel smoothly and enjoy their visit, leading to positive experiences, repeat visits, and positive recommendations.

To fully leverage these favorable conditions for tourism development and ecotourism, it is important for the Oghuz district to invest in infrastructure, promote sustainable tourism practices, ensure visitor safety, preserve the natural environment, and collaborate with local communities. With careful planning and management, the region can attract tourists seeking unique experiences, contribute to the local economy, and promote the conservation of its natural and cultural treasures.

In conclusion, addressing the issues of unemployment, the well-being of the local population, and socio-economic development in the ecotourism research area requires a holistic and sustainable approach. With the development of this tourism industry, economic opportunities can arise in the Oghuz district. This growth can lead to job creation, increased investment in infrastructure, and the emergence of supporting industries such as hospitality, transportation, and local handicrafts. This, in turn, can boost the overall economic development of this district.

Acknowledgements

I'd like to express my sincere appreciation and gratitude to someone who has been a constant source of support, encouragement, and motivation throughout the process of writing this article. She is Ulviyya Mammadova. Her unwavering belief in me has played a significant role in keeping me motivated and focused.

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INFLUENCE OF CLIMATE CHANGE ON THE FOREST BELT IN THE SOUTHEASTERN PART OF THE GREATER CAUCASUS

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In contrast to the southern slope of the Greater Caucasus (the territory of the Balakan, Zagatala, Gakh, Sheki, Oghuz, Gabala administrative regions), the southeastern part, which we chose as the object of study, has undergone more intense anthropogenic changes throughout the entire mountain forest zone. Therefore, the existing forest composition here cannot be considered completely natural. Thus, with the upper mountain-forest belt in the Pirsaatchay depression, only the right-bank slope at the upper forest boundary remained. However, beech-oak mesophylls, beech-oak xerophytic and other mixed forests on brown mountain-forest soils are widespread in the middle and low mountains within the study area.

In the southeastern part of the Greater Caucasus, forest formations are divided into mesophilic, xerophilic, and arid forest formations. Here the forest zone is located between the xerophyte-steppe zone of low mountains and the subalpine mountain-meadow zone. Beech-hornbeam-oak mixed forests are mesophilic in nature and form on brown mountain forest soils. Here, beech forests are taken as the leading plant. According to researchers, the main conditions for the development of beech forests are the duration of the growing season of at least 5 months, the maximum air temperature of more than 5 degrees on 245 days a year, and the average annual rainfall of at least 500 mm. Beech is considered a mesophilic tree genus. On fairly moist soils, it creates clean and productive light forests, but does not prefer dry and very wet places. Beech is a relatively cold-resistant tree species that grows to the subalpine zone. However, the climate of the beech forest belt in Azerbaijan differs significantly in places. Thus, in some areas of beech forests, the average annual temperature rises to 10.6 degrees, and the temperature of the hottest month - up to 22 degrees (Gabala).

Among the oak species in the southeastern part of the Greater Caucasus, the Iberian oaks are more common. The average annual temperature in the Iberian oak forest zone is 10.3-13.3 degrees, precipitation is 430-1327 mm, in the eastern oak zone 600-1400 mm. The Iberian oak is drought tolerant. The fact that the Pyrenean oak grows in conditions of relatively low rainfall and low relative humidity indicates that it is a xerophilous tree species. These climatic conditions cause the Iberian oak to completely form the belt.

Arid-type forests develop in the arid climate in the foothills of our republic, where most of the growing season lacks moisture, and are of great water-regulating and soil-protective importance. The juniper tree, which is the main component of dry forests, belongs to the cypress family. It happens in the form of an evergreen tree or shrub, and sometimes in the form of a bush lying on the ground. Since juniper trees have high phytoncidal properties, they purify the air and improve the climate of the area. In our research complex, the population of the foothill zone, where arid forests are common, has been engaged in intensive agriculture and animal husbandry since ancient times. In this regard, the original forest cover of the arid type here has undergone anthropogenic change, and the existing plant formations are mainly of the derived, steppe-xerophyte type.

Keywords*: hornbeam tree, ash-tree, forest transformation, climate changes, fullness of the forest*

INTRODUCTION

The forest is an original and unique corner of nature. It lives and develops according to its own laws. For its own existence and development, the forest creates favorable conditions for itself, provides itself with food and water. The dominant tree species in the forest are called edificators or forest dominants. They are considered the bulk of the organic remains of the forest, as well as the entire biosphere, and play an important role in the cycle of substances and environmental change.

The dominant tree species are biologically always the "winners" in the struggle for life. Although, for one reason or another, they temporarily transform into other types of trees, they again take their place after a certain period. For example, as a result of climate change, illegal logging and unsystematic livestock grazing in the forest, the productive oak forest is being replaced by its valuable parrotia persica forest.

In the southeastern part of the Greater Caucasus, mountain-forest landscape complexes cover spaces between 600-700 m and 2000-2200 m absolute heights and are mainly distributed in the interfluve of Girdimanchay and Pirsaatchay. Deforestation in the Gobustan-Dyubrar zone of the territory is associated with the aridification of the climate, the lithological basis, as well as the economic activity of the population in the historical period. In the southeastern part of the Greater Caucasus, the slope processes of the mountain-forest complex have undergone significant changes as a result of landslides, avalanches and economic activity. Landslide processes have been widely developed in the forest belt, especially in the Girdimanchay and Aghsuchay hollows. The mountain-forest landscape complex is characterized by cold wet winters, mild warm and dry cold winter climates with a uniform distribution of precipitation.

In the southeastern part of the Greater Caucasus in the forest belt, 3 subzones can be distinguished depending on the variety of natural conditions, especially temperature and humidity. The meadow-forest half-belt of the highlands covers the heights of 2400-2300-1800 m of the forest belt. Alpine meadow forests are widespread in the region, in the upper reaches of the Girdimanchay, Pirsaatchay, Gozluchay and in the Lahich basin. The relief of the area where this type of forests is spread is intensively fragmented, the slope of the slopes in Girdimanchay and Pirsaatchay basins exceeds 40 degrees.

The upper border of forests is zoned depending on the influence of a number of factors. In mountainous conditions, the forest cover extends up to a certain height. Above this height, the conditions for the development of woody plants worsen, and the place of the forest is occupied by subalpine and alpine vegetation. Regarding the definition of the upper forest boundary, many experts believe that the upper forest boundary corresponds to the July isotherm of 10 degrees. That is, above the altitude, where the average July temperature is 10 degrees, there are no longer conditions for the development of forest plants, they are replaced by grass or steppe plants. If we apply this pattern to certain mountainous regions of our republic, that is, if we take the July isotherm of 10 degrees as the climatic boundary of the forest, then on the southeastern slope of the Greater Caucasus, which has a wet winter and with a cold climate, this boundary is 2600-2650 meters, in Kalbajar and Lachin regions with a cold climate, it should exceed 2800 meters in the regions, and in the continental climatic zone of Nakhchivan, where the summer is dry, 3000 meters. In our republic, especially on the southeastern slope of the Greater Caucasus, the upper climatic boundary of the forest has undergone great changes as a result of the influence of human economic activity. At present, it can be said that the natural border of the forest is everywhere violated and reduced as a result of anthropogenic factors. The height at the upper limit of the existing forest in this area corresponds to the height with an average July temperature of 14-17 degrees.

In the southeastern part of the Greater Caucasus, the forest cover in the entire mountain forest belt has undergone more intensive anthropogenic changes. In the Pirsaatchay basin, the upper mountain-forest belt was completely destroyed, and the middle mountain-forest belt was preserved only on the right-bank slope. The forest cover of the Gozluchay depression is less than 5%. Here there are small, heavily disturbed forest areas at absolute heights of 1400-1800 m. In the areas east of Gozluchay, in the Chikilchay and Chebotarchay hollows, it consists only of shrubs of a derived type. On the territory of the southeastern part of the Greater Caucasus, in many quarters, forests of hornbeam, hornbeam-linden, hornbeam-oak were formed in the last 50-60, and in some places even 100 years, in places where valuable beech forests were cut down. Beech and other trees and shrubs have a wide range of ecological indicators (survivability) and adaptability, which allows them to occupy ecological gaps that are easily formed in places where beech forests are cleared. In accordance with biogeocenological laws, artificial or natural replacement of the leading dominant plant leads to a change in the entire structure created by it.

Forest composition and biometric characteristics of hornbeam-beech-oak mixed forests in the southeastern part of the Greater Caucasus

Field of practice	Type of forest	Position	Trees and shrubs	Grass cover	Probable main tree type
1	Black-faced layered hornbeam-beech	Near Shamakhi observatory, west 15-25^0, 1400 m above sea level	60% beech, 40% hornbeam, single birch and ash, height=21m, diameter=24cm, maximum diameter=32cm, blackberry, blackberry groups: h=3-7m, d=4-14cm	Umbelliferae, snowdrops	Beech black longline
2	Dead cover beech	Nameless left tributary of the Gozluchay, north -40^0, 1770 m above sea level	50% beech, 30% oak, 20% beech, some birch, density of the forest is 0.4-0.5; h=18m, max.h=20m; d=42cm, max.d=60cm	Snowdrops, violet flower	Dead cover beech
3	Dead cover beech	Girkhbulagchay, Aghsuchay watershed, north 30-35^0, 1850 m above sea level	80% hornbeam, 20% beech, h=28m, max.h=30m, d=32cm, max.d=56cm, forest fullness 06-09	Occasionally violets	High-stemmed beech

MATERIAL AND METHODS

The object of study is the southeastern part of the Greater Caucasus. We carried out field research according to the method of academician G.Sh.Mammadov and professor M.Y.Khalilov. We carried out biometric and phytocenological observations in individual forest hayfields, studied the species composition, density, diameter and height of trees using appropriate technical means. We analyzed the reports of the foresters of the southeastern part of the Greater Caucasus.

RESULTS AND DİSCUSSİON

On the southern slope of the Greater Caucasus, a wide range of beech is located on the northern slope of the Pirgulu Reserve. To the east of the reserve, we observed the remains of a beech forest formed by pines in an area called "Gonakkend Forest" on the right bank of the Pirsaat River. The Gozluchay basin, located to the east of it, is almost devoid of forests; herds of sheep are also driven from Shirvan to the pastures of the Gonakkend (Guba) zone from the basin of the Saridash tributary of the Gozluchay. Thus, rains falling in the form of showers in spring, summer and autumn cause great damage to forests. As a result, the forest is thinned, young trees and shrubs are destroyed (table 1).

As can be seen from the table, beech forms mixed forests. In all areas beech is tall and flat compared to walnut. At experimental station no. 3, the tree cover is sparse. However, it also contains mature and old beech nuts, which is explained by the systematic cutting down of trees in the area. Here oak makes up 20% of the tree cover, but sometimes it dominates. Forest density reduced to 04-05. Natural renewal occurs due to beech and oak, sometimes hornbeam. This case confirms that in the future the beech forest will be replaced by hornbeam and oak forests [5].

The hornbeam has a wider amplitude of distribution and is also part of the oak. In many areas, pine forests are of a derivative type and have been transformed in place of beech and oak forests as a result of intense anthropogenic impact. This is also confirmed by the grass cover characteristic of beech forests common in these areas [1].

The transformation of beech forests in the southeastern part of the Greater Caucasus occurred as a result of the process of deforestation and reforestation and the complete destruction of beech forests. For example, on the left bank of the Kurmukchay, a secondary hornbeam forest was formed on agricultural land abandoned after use. A small amount of beech, oak and aspen interferes with the composition of the forest [4].

In the southeastern part of the Greater Caucasus, the replacement of beech trees by shrubs occurs near settlements under the influence of human activity. Depending on the cutting conditions, deforested slopes are replaced by various thickets, often brambles and ferns [3].

The transformation of a beech forest into thickets of hazel and, vice versa, the renewal of a beech forest occurs approximately after 1-2 generations, when the anthropogenic impact stops, and after 1-2 generations a complete root tree is formed [2].

Dense thickets of walnut trees were noted by us in the basin of the left bank of Kurmukchay at an altitude of 950-1050 m above sea level in areas where agricultural plants were once cultivated, but were not used later. Tree species (oak, hornbeam, birch) make up 16-20% of the hazel composition. This indicates that if negative processes are not prevented, in the near future the hazel bushes will die under the dense canopy of trees.

CONCLUSION

The landscape complex of beech-hornbeam mesophilic forests of the middle mountains covers the heights (1200-1600)-900(1000) m of the study area and consists of beech-hornbeam forests with productive forest plants. The optimal climatic conditions of this zone are very favorable for the development of the forest. In contrast to the alpine-meadow landscape belt, denudation processes are weakly expressed due to dense vegetation in this belt. The intensity of avalanche, landslide and erosion processes is weak. Suitable climatic conditions form thick, predominantly mountain-forest brown soils in the area, forming a mesophilic forest formation, and a mountain-forest brown earth cover forms a xerophilic forest formation.

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WAYS TO SOLVE ENVIRONMENTAL PROBLEMS OF POLLUTED LANDSCAPES OF THE ABSHERON PENINSULA

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The article discusses ways to solve environmental problems of technogenically polluted landscapes of the Absheron peninsula using bioresources of the region. A systematic analysis of biological resources in the Absheron industrial region has been carried out, which can potentially be used to develop biotechnologies for increasing the fertility and biological activity of oil-contaminated soils after their purification from the main part of pollution, as well as in bio-purification technologies of water systems. Among the regional bioresources, the following have been investigated: excess active sludge from bio-treatment plants; effective microorganisms (fermi-start); whey; yeast mash; vegetable waste. These wastes can be used as secondary resources and for the production ofbiocompost in bioremediation technologies of technogenically disturbed soils of the region.

The obtained results showed that the introduction of microbial biological preparation "fermi-start" and excess activated sludge into compostable organic raw materials contributes to a more dynamic and intensive course of the composting process, improves the sanitary and bacteriological parameters of the composting material - humus, provides deodorization of technogenically disturbed soils.

Keywords: *Absheron Peninsula, technogenic nature of soils, contaminated water, biotechnology, bio-waste, composting, biological soil treatment, biotreatment of water.*

INTRODUCTION

The Absheron industrial region, with a total area of 2,110 km^2 and a population of 3.4 million people, is located on the western shore of the Caspian Sea in Azerbaijan and is considered a region with critical environmental stress due to high population density and concentration, so over 70% of the industrial potential of oil–producing, oil refining, metallurgical, etc. is located in this territory. industries. In this regard, on the one hand, the biological productivity of the soil is reduced to a minimum, on the other hand, these lands negatively affect the ecology of the environment [1; 2].

The total area of the polluted territory in the Absheron industrial region is over 20 thousand hectares, of which 1006 ha are occupied by lakes and 6880 ha are lands. The content of total hydrocarbons in the soil cover of the Absheron Peninsula is almost 9.3 million tons [3, 4] and these indicators are increasing every year. As a rule, the technogenic landscapes of the Absheron Peninsula differ greatly from adjacent habitats in many respects - structure, biological activity, features of the circulation of matter and energy, the absence of bioactive soil cover (oil sands), as well as economic value [5; 6]

The territory of the Absheron Peninsula can be attributed to the ecological risk zone (P) - territories characterized by a strong decrease in the stability and productivity of landscapes, a maximum of instability that can lead to degradation of landscapes, which implies a reduction in economic use and improvement [7].

Taking into account the presence of acute environmental problems in a significant part of the territory of the Absheron Peninsula, it becomes extremely urgent to conduct comprehensive research in the field of ecology of this territory, in order to create conditions for the long-term sustainable development of this interconnected and interdependent biosystem

System analysis forms the basis of a scientifically based approach to solving industrial and environmental problems that are of an intersectoral, interdisciplinary nature. In this case, a goal is set and the ways and methods of achieving it are justified in the process of research. Effective ecosystem management can be formed only in the presence of reliable and complete knowledge and information about various properties of ecosystems, their specific characteristics, and the ability to adequately use existing information to make management decisions.

In this regard, there are great opportunities for using a systematic approach in the process of developing and implementing integrated regional programs that can potentially provide the maximum coordinated concentration of efforts, incentives and material and technical means to achieve scientific and technological progress.

The analysis of the area, the nature of pollution, their placement and qualitative indicators of oil-contaminated landscapes of the Absheron Peninsula indicate the need for systematic research on the selection of modern methods of rehabilitation of technogenically damaged soils and water systems, the choice of the most appropriate technologies, taking into account their ecological, technological and economic indicators to achieve the final result - restoration and improvement of their bioecological functions [8]. At the same time, the rehabilitation of all technogenically damaged components of the landscapes of the region and the enhancement of their natural bioecological functions is of social and ecological importance.

The purpose of the study is to develop the scientific basis for the effective use of the bioresources of the region to restore the biological and ecologicalfunctions of the soil cover and water systems of the territory of the Absheron Peninsula

OBJECT AND METHODS OF RESEARCH

The object of research is the territory of the Absheron Peninsula as a whole as a single biosystem - soils, reservoirs and groundwater.

The research method is a system analysis using the principle of phasing [9; 10]. Methods of microbiology, biotechnology, laboratory modeling of biotechnologies were used.

RESEARCH RESULTS AND DISCUSSION

Within the framework of the set goals, a systematic analysis of biological resources in the Absheron industrial region has been carried out, which can potentially be used to develop biotechnologies for increasing the fertility and biological activity of oil-contaminated soils after their purification from the main part of pollution, as well as in bio-purification technologies of water systems.

The results of the research have shown that in the Absheron region there are a number of organic substances - waste from food and industrial production, which can potentially be used as components for the manufacture of biocomposts for their introduction into technogenically disturbed soils of the region in order to restore their biological functions, activity and productivity, taking into account the real natural and climatic conditions of the region - arid semi-desert zones with limited natural resources.

Among the regional bioresources in the process of developing biotechnologies, the following have been studied: excess active sludge from bio-purification treatment plants; raw sediments of primary sedimentation tanks; effective microorganisms; biohumus; zeolites; yeast mash; plant waste (plant litter, mown lawn grass, fallen needles, sawdust, etc.).

System analysis of the volumes of regional waste of biological origin in the region showed that:

•the resources of excess activated sludge in the region amount to about 14,600 tons;

•the resources of plant waste are about 36,000 tons;

• the resources of whey are about 15,000 tons;

• the resources of tree litter and lawn grass clippings are over 36,000 tons;

• yeast mash resources are over 10000t/year;

In the model works, excess activated sludge (EAS) was used from the Gousanin aerator station, where the municipal waters of Baku are cleaned. The capacity of this aerator station is over 600,000 m^3 of municipal wastewater per day, over 45 tons of EAS (in dry weight) are generated daily. Excess activated sludge is not used in the region, it is discharged into adjacent soil areas of the treatment plant, where it has an adverse effect on air and groundwater during the rotting process [11].

Industrial production of vermicompost and a biological product of effective microorganisms (AgroBioTech company), which includes various groups of microorganisms, has been established in the region.

As a basis for the preparation of modified biological products, samples of plant waste were tested – fallen leaves of various plant species, mown grass, plant sawdust.

System analysis and calculations have shown that currently the area of green spaces in the region is about 12,000 ha and continues to expand. The value of the fall is on average 2-4 t/ha [12]. Taking into account the average value of the fall of 3t/ha, the annual volume of the fall in the region is on average: 12000ha x 3 t/ha = 36000t.

Plant litter contains such important elements as nitrogen and ash substances, and also contains lignin, cellulose and hemicellulose, which are necessary for the accumulation of humus in the soil - an indicator of soil fertility.

These wastes can be used as secondary resources in the process of composting and obtaining biocompost in bioremediation technologies of technogenically disturbed soils of the region.

Based on the literature data, their component composition (carbon, nitrogen, protein, carbohydrates, etc.) was revealed for all selected regional bioresources. The results of the system analysis showed that all the analyzed materials contain biologically active substances: proteins, carbohydrates, various groups of microorganisms, etc., which can be effective in complex composting.

The results of laboratory modeling showed that the modified biocompost, which can be obtained on the basis of regional biological resources, can be effectively used together with mineral fertilizers once a year for 5 years for basic plowing in the amount of 5-10 tons/ha, depending on the degree of residual contamination with petroleum hydrocarbons.

The introduction of fermi-start microbial biologics and EASinto compostable organic raw materials with a high content of aerobic microorganisms contributes to a more dynamic and intensive course of the composting process, improves the sanitary and bacteriological parameters of the composting material - humus, provides deodorization of technogenically disturbed soils [13].

When composting waste, hydrocarbon-oxidizing microorganisms are introduced, as well as cultures of microorganisms synthesizing hydrolytic, lipolytic, proteolytic and other enzymes that decompose oil pollutants, fats, proteins, carbohydrates that are part of the fermi-start biological product. The use of sewage sludge in composting makes it possible to obtain compost material with a high content of nitrogen and phosphorus. The result is a modified compost containing both organic substances that improve the structure of soils subject to oil and petroleum products contamination, increase the humus content in these soils, as well as hydrocarbon-oxidizing microorganisms that contribute to the decomposition of residual hydrocarbons in contaminated soil. Thus, innovative modified biologics for multipurpose use have been developed as part of the research. The use of compost as biofertilizers in technogenically disturbed soils makes it possible to improve their biological and chemical properties, the structure of the soil cover and increase the content of humus substances in the soil [14]. It is also very noteworthy that when composting regional biomaterials and their use in integrative biotechnologies for the restoration of technogenically polluted soils, smaller volumes of "greenhouse" gases (including carbon dioxide) will be released into the atmosphere than occurs when these bio-wastes are burned or exported to landfills, for example, tree litter, etc.

The results obtained give grounds to propose the most effective technology for increasing fertility and restoring biological activity of technogenically disturbed soils of the Absheron Peninsula and achieving the efficiency of using all regional bioenergy resources. On the other hand, the efficient and maximum use of regional bioresources will allow laying the foundation for a closed-cycle biotechnological economy in the region.

As part of the research, the scientific foundations of biotechnology for the purification of surface and groundwater in the Absheron Peninsula from oil, petroleum products, phenol and heavy metals have been developed [15]. For this purpose, the use of so-called "adsorbing biobones" is proposed for the purification of surface water systems, the biological basis of which is the biocenosis of activated sludge and the biological product "Fermi-start" immobilized on adsorbents. The use of waste, for example, cotton husk, rice husk, sawdust, that is, various regional resources, is proposed as adsorbents. These substances of plant origin are characterized by a high sorption capacity in relation to oil. Adsorbents are completely natural, non-toxic and environmentally friendly. Adsorbing biobones are characterized by a well-developed microporous structure and high strength, which allows them to effectively adsorb and encapsulate - enclose in so-called "capsules", that is, isolate oil, petroleum products and all absorbed chemicals upon contact, including heavy metals. The results of the study under model conditions showed that the degree of water purification from pollutants reaches 95-98%.

Also, for the purification of groundwater in the region, a biotechnology for their purification has been developed, based on the removal of pollutants from the soil surface (sources of groundwater pollution) and the creation of a system of so-called "barrier biofilters" by pumping developed microbial preparations into the groundwater. So microbial biological products are pumped into the groundwater through special perforated pipes. The most promising use for these purposes, both from economic and technological positions, is the use of excess activated sludge as a source of various groups of microorganisms – both aerobic and facultatively anaerobic. The main task at this stage is to reduce residual contamination in soils to an environmentally acceptable content by methods of intensification of biodegradation of organic pollutants - aeration with the use of air mixtures and the introduction of microbial biological products.

Bio-purification of groundwater will prevent the penetration of pollutants into the coastal strips of the Caspian Sea and their negative impact on aquatic biocenoses as a result of the decomposition of the main part of pollutants directly in the groundwater horizons.

Thus, an essential feature of the developed biotechnologies is the ability to simultaneously solve complex environmental problems associated with increasing soil fertility and restoring ecological, biological and sanitary-hygienic properties of water systems exposed to technogenic effects (Fig.1).

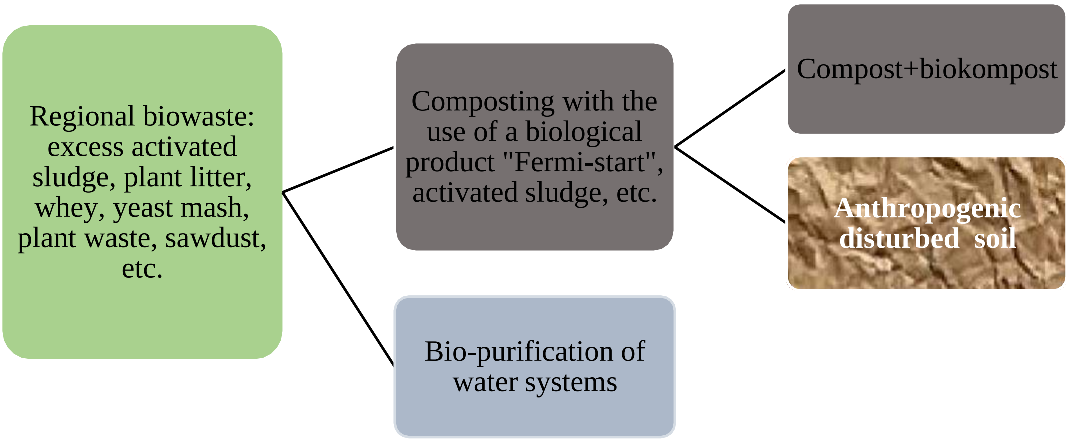

Fig. 1. Scheme of technology for cleaning landscape components – soils and water systems

CONCLUSIONS

The results of the research have shown that in the Absheron region there are a number of organic substances - waste from food and industrial production, which can potentially be used as components for the manufacture of biocomposts for their introduction into technogenically disturbed soils of the region in order to restore their biological functions, activity and productivity, taking into account the real natural and climatic conditions of the region - arid semi-desert zones with limited natural resources.

The results obtained give grounds to propose the most effective technology for increasing fertility and restoring biological activity of technogenically disturbed soils of the Absheron Peninsula, on the other hand, effective and maximum use of regional bioresources will allow laying the foundation for a closed-cycle biotechnological economy in the region.

All the proposed scientific developments can be practically used in the development of regional targeted environmental projects to improve and restore the quality of soils and water systems in the region.

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LAKE ZABRAT ON THE FLYWAYS OF WATERBIRDS

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As is known, Azerbaijan is rich in various types of ecosystems, among which the most labile ecosystems are stagnant waters and wetlands. They change seasonally depending on climatic conditions. Many of them attract migratory water birds, stopping at them for nesting, wintering, during migration.

One of these lands is Lake Zabrat, where, in order to determine the species composition, abundance and nature of the stay of migrant birds, we conducted field studies in the spring and early summer of 2022-2023. Based on the results of our own research and literature sources, the article provides data on 14 species of birds, both migrants and sedentary, belonging to 7 orders. The conservation statuses of 7 species included in the IUCN Red List are given.

Key words: *Bird migrations, Endangered species, Lake Zabrat.*

INTRODUCTION

There are more than 200 lakes, large, small and flooded areas on the Absheron Peninsula. Most of them are ephemeral lakes with an area of less than 0.1 sq. km.

Lake Zabrat is located at the junction of the Absheron and Sabunchu regions between the village of Mukhamedli and the village of Zabrat.

The Absheron Peninsula itself is characterized by an arid climate, a high degree of urbanization, saturation with lakes, and, moreover, is one of the most polluted areas of the republic.

Many lakes have been negatively affected by human activities - some large lakes have been drained and various shopping centers, residential complexes, etc. have been built. At one time, thousands of migratory birds flew to these lakes, among which were species from the Red Book of the IUCN Red Book and the Red Book of Azerbaijan. They were attracted and are now attracting migrants to our lakes due to relatively mild winters, the food supply of lakes that practically do not freeze.

Around the lake there are residential buildings, both old buildings and newly erected houses that do not have sewer outlets and all household waste is poured into the lake. In autumn, on days of heavy rains, which are not so abundant in Absheron, the lake overflows its banks and floods large areas.

Disappointing data were obtained as a result of chemical and biological analysis of lake water samples, conducted by employees of the Ministry of Ecology and Natural Resources. The amount of ammonium ions, synthetic surfactants, petroleum hydrocarbons and pathogenic bacteria is many times higher than the norm. Of course, these wastes poison both the birds themselves and their food resources. But sometimes, in water bodies, certain organic pollutants can enhance the food resources of some bird species, due to the fact that rich organic matter contributes to the appearance of plankton and benthos organisms.

In accordance with a presidential decree, funds were allocated for the construction of rainwater and sewerage infrastructure. A 1 km long pipeline will be laid from Zabrat Lake to Kurdakhani Lake. Excess water will flow into Lake Kurdakhany, and from there into the sea.

MATERIAL AND METHODS

The object of our work was the brackish closed lake Zabrat. In order to study the current ecological state of the vegetation cover and the dynamics of wetland groups of birds, we carried out field work in the spring and early summer of 2022-2023.

The article uses analyzes of literature data and the results of our research. Identification of bird species provided according to Svensson, L. et al. Collins Bird Guide, 2nd edition 2010.

RESULTS AND DISCUSSION

On the lake, we noted 14 species of birds belonging to the orders Anseriformes, Charadriiformes, Columbiformes, Apodiformes and Passeriformes.

Table 1

Systematics and nature of the stay of bird species on Lake Zabrat

Orders	Familes	Species	Character of settlement	IUCN Red List Criteria
Anseriformes	Anatidae	Splatula clypeata – Northern shoveler		
	-//-	Anas platyrhynchos – Mallard	Wintering	LC
	-//-	Anas crecca – Green-winged teal	On migration and wintering	LC
	-//-	Oxyura leucoephala – White - headed duck	Wintering rare	EN
	-//-	Aythya fuligula – Tufted duck	Wintering	LC
Charadriiformes	Recurvirstridae	Himantopus himantopus - Black-winged stilt	On migration and nesting	LC
	Scolopacidae	Tringa glareola - Wood sandpiper	For nesting and partially for nesting	
	Charadriidae	Arenaria interpres – Ruddy turnstone	Rare and irregular	LC
	Laridae	Chroicocephalus qenei – slender-billed gull Chr.ridibundus – Black-headed gull	Migrant	
Columbiformes	Columbidae	Columba livia – Rock pigeon		
Apodiformes	Apodidae	Apus apus – Common swift		
Passeriformes	Corvidae	Corvus cornix - Hooded crow	Migrating and partially wintering	
	Motacillidae	Motacilla alba – White wagtail	Migrating and partially wintering	LC

As you know, ducks are divided into three groups: noble, diving and earthen. The first two groups are large, the earth group is small. On the lake, noble ducks were represented by the following species: mallard, gray duck, wigeon, pintail, shoveler, as well as small species - teal-codfish, teal whistle. According to Sultanov (2000), the autumn migration of noble ducks occurs in August -

September until the end of December, for diving ducks - September - October and until the end of December, spring - from February to the end of March. As you can see, their time of flight does not intersect.

It is pleasant to note that in such a rare species as white-headed duck, 54 individuals were noted on the lake (Table 2).

Table 2

Number and seasonality of bird species on Lake Zabrat

Orders	**Families**	**Species**	**Number**
Anseriformes	Anatidae	Northern shoveler	**25**
	-//-	Mallard	**12**
	-//-	Green-winged Teal	**30**
	-//-	White - headed duck	**54**
	-//-	Tufted Duck	**65**
Charadriiformes	Recurvirstridae	Black-winged stilt	**4**
	Scolopacidae	Wood sandpiper	**4**
	Charadriidae	Ruddy turnstone	**2**
	Laridae	Slender-billed gull	**3**
Columbiformes	Columbidae	Rock pigeon	**15**
Apodiformes	Apodidae	Common swift	Numerous
Passeriformes	Corvidae	Hooded crow	15
	Motacillidae	White wagtail	4

The duck is a relict species and today its conservation status is an endangered species. https://www.iucnredlist.org/species/22679814/119403602.

The number of the world population of the white-headed duck is 7.9 - 13.1 thousand individuals (Bird Life International, 2016). Biologists around the world are trying to save populations of white-headed ducks.

We consider it necessary to note the importance of preserving any wetlands: streams, rivers, swamps, fresh and salt lakes, various shallow-water ecosystems of Azerbaijan, since more than 10 million water birds from North Asia and Europe to Africa, South - Western Asia and vice versa. It should be noted that the currently existing ways of settling in short repeat the historical ways of their settling - which is the conservatism of birds.

It is necessary to protect any "piece" of land and water area, even if they do not yet have a protected status, but provide conditions for arriving and sedentary bird species.

CONCLUSION

1. At the result of conducted research, on the lake Zabrat we noted 14 species of birds belonging to the orders Anseriformes, Charadriiformes, Columbiformes, Apodiformes and Passeriformes; 7 species of birds included in the IUCN Red List.

2. We consider it necessary to note the importance of preserving any wetlands: streams, rivers, swamps, fresh and salt lakes, various shallow-water ecosystems of Azerbaijan, since more than 10 million water birds from North Asia and Europe to Africa, South - Western Asia and vice versa. It should be noted that the currently existing ways of settling in short repeat the historical ways of their settling - which is the conservatism of birds.

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MODERN STATE OF SALYAN PLAIN SOIL AND INCREASE WAYS OF ITS FERTILITY

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The comprehensive information about Salyan plain soil located in the Kur-Araz valley which has a good situation for growing of the main agricultural plants of the country in the article. The researches indicate that presence of the definite changes, less precipitations, soil salinization, water insufficiency etc. negatively affected getting a high and stable product from agricultural plants in the valley as a result of the climate changes occurring in the world in recent years. They decrease soil fertility and development and productivity of the agricultural plants. It was determined that a quantity of salt in the soil and subsoil mineralization are more in the places near the surface. The location depth of the groundwater in the plain changes depending on relief. The soil is grey soil type, its water leakage ability is various. Here sulphatic –chorine type of salinization is available, but chlorine type of the salinized soil is found in some places. The water-physical characters of the plain soil deteriorated because it exposed to different types of salinization. Realization of agromelirative measures is important for improvement of the it was known from the results obtained in the sections of the selected experimental area in the village of Seyidsadikhly municipal soil in the Salyan plain that the plain soil is clayey and loamy for granulometric compostion. An amount of salt was 0.11-0.20% for dry residue. In the same samples CO_3 ion wasn't observed, a quantity of HCO_3 was 0.012-0.024%, but Cl ion was 0.007-0.112%. CO_3 ion was't observed in the drains water passing by the side of the area, a quantity of $HCO_3$was 0.195g/l; Cl was 3.668g/l. A quantity of salt in the drainage water was 3.56g/l. This shows that the same soil belongs to unsalted type. The absorbed bases were defined in the experimental area and the consequences indicate that their sum is 24.17-27.87 mg.eq at 0-50sm of the soil layer, but 27.02-33.87mg-eq at 0-100cm of layer. A value of pH in soil solution changed by 7.6-7.7 and productivity obtained from cotton plant was 30-35c/h.

Key words*: *irrigation, salinization, fertility, groundwater, productivity.

INTRODUCTION

The agrarian field which is one of the most important and leading areas of the country economy is very important in development of agriculture. A principal aspect in sustainable development of the agrarian field is a growth of the produced crop capacity, at the same time increase of rationality. Improvement of soil used under agricultural plants is one of the main problems for the rapid growth of the population and their food problems. The measures condited in a direction of preservation and restoration of the soil fertility used under sowing are bearingg fruit as a result of the agrarian reforms successfully conducted in the country. Added to the "Measures Plan for 2020-2022 on Ensuring Rational use of Water Resources"approved by yhe Decree of the President of the Azerbaijan Republic No.2340 dated Desmber11, 2020, regarding the improvemeny of the natural state of the soil, the fight against degradation and desertification decisions are being implemented. It is know that the plantgrdning products in the country are mainly obtained from irrigated soil, it is important to properly manage the soil in terms of maintaining its melioration status .At present the soil cover seriously exposed to changes as a result of negative processes, this is also reflected in the loss of soil fertility and resources and complication of the soil cover structure. Salinization, solonetzification and eroding of the soil in some agricultural zones caused decrease of the fertility and productivity of the agricultural plants.[4,5].At present enlargement of the soil area, population growth and increase of need for water are causing problems. The factors as the higest air temperature in the country located in the dry climate zone, the last quantity of precipitation, 2-4 times more evaporation compared to rain, precipitations in the cold months, soil salinization, etc. make irrigation farming inevitable. Development of irrigation farming higher productivity of the agricultural plants, inclusion of new agricultural areas in the agricultural cycle are facing a water shortage.[9].

As it is known, the soil cover of the republic is rich. Besides, the soil was degraded, fertility reduced as a result of the ecological problems in a modern period. Fertility reflects in productivity of the plant grow on soil surface, in nutrient richness, majority of humus, and good ecological features of the soil. The productivity obtained from the agricultural plants reduced as a result of fertility decrease. At present one of the specialists' duties is to get higt and stable product from agricultural plants.[2].

RESEARCH OBJECT AND METHOD

An experimental area in the municipal soil of the Seyidsadikhly village in Salyan is 2.5 hectares, the sol under cotton was selected as an experimental area, the soil sections were applied, the coordinates were noted. The water sample was taken from the drain at the edge of the field and chemical analyses were performed in a laboratorial condition.The chemical analysis was implented according to the widely used method.[1].

ANALYSIS AND DISCUSSION

It is known that most of the agricultural products produced in the Republic are growing in the Kur-Araz valley. Therefore, the measures in that area should be approached very carefully, irrigation norms and regimes should be taken into account, prevention of soil from salinization and solonetzification should be controlled. It was known during the observations that the soil fertility was lost and the same zones were out of the agricultural circulation as a result of irrigation in some zones of the valley , especially in the inclined zones. The upper fertile layer of the soil is leached, their water-physical featyres deteriorated as a result of irrigation erosion, and this negatively affects an ecological balanse. Consequently, this is a reason for degradation and desertification of the soil.[3].

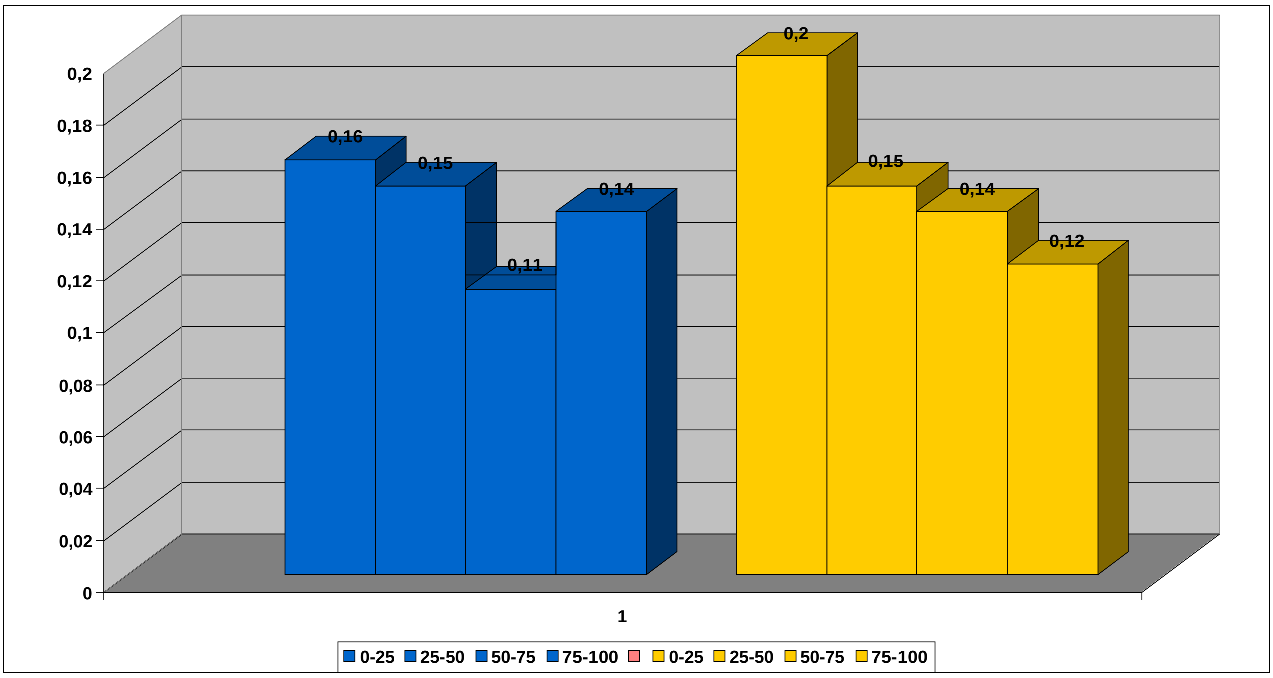
At present more than 40% of the zone has been eroded to one or another degree in the irrigated zone of the republic[7]. This process is observed with the reduction of humus substance which is an important index of soil fertility. A quantity of the salt that is easily soluble in water affects the soil fertility, and this creates a condition for the soil salinization. The soil salinization quickly occurs in the places where an intensive irrigation farming is performed. The soil salinization leads to destruction of mineral nutrition and substanse exchange in the cultural plants.

Dander of the secondary salinization of the ameliorated soil is formed in the incorrect condition of irrigation. 149 000 hestares of the Salyan plain soil are used under agricultyral plants because it is situated in the Kur-Araz valley. Its relief consists of plain. An annual temperature of the air is 1.8-2.5^{0}C. Here. Plant cover is formed of halophyte, xerophyte, ephemer plants. Natural plant cover was thoroughly studied by A.G. Grosheym in 1929. Halophyte, xerophyte, hydrophile plants spread in the plain. A level of the groundwater is located in different depths depending on relief. The salt quantity and water mineralization are several times more in the places of the ground water level near the surface(1.0-1.5m).The researches show that the ground water has different mineralization in the research zone.[6]The plain soil belongs to grey soil type and different types of soil-meadow –grey, grey-meadow, meadow-bog and other soil dominate. The long researches show that the soil of the Salyan plain mainly belongs to sulphate- chlorine typr of salinization, but in some places chlorine type of salinization was found. The soil og the plain is clayey, loamy for granulometric composition. The plain soil possesses a varius water-leakage ability. The soil of the Salyan plain is characterized to a different degree. The soil researches indicate that the morphogenetic features of the soil in this zone changed as a result of construction of the collector-drainage and irrigation networks and intensive development of the irrigative agriculture [11,10].The soil sections were applied with the purpose of the salt quantity in 2121 and the concise water weight analyses were implemented in them. The result were given on the table.

Table 1.

Consequences of the concise water weight analyses in the soil of the experiment area.

Number of section	Depth, cm	Mg.ekv/%			Dry residue, %	pH
		CO_3	HCO_3	Cl		
1 $N39^{0}32^{1}38,80^{11}$ $E48^{0}55^{1}30,60^{11}$	0-25	no	0,40 0,024	2,80 0,098	0,16	7,6
	25-50		0,40 0,024	2,80 0,098	0,15	7,6
	50-75		0,40 0,024	1,40 0,049	0,11	7,7
	75-100		0,40 0,024	1,20 0,042	0,14	7,7
2 $N39^{0}32^{1}39,60^{11}$ $E48^{0}55^{1}30,40^{11}$	0-25	no	0,20 0,012	2,40 0,084	0,20	7,6
	25-50		0,20 0,012	3,20 0,112	0,15	7,7
	50-75		0,20 0,012	0,20 0,007	0,14	7,7
	75-100		0,20 0,012	1,80 0,063	0,12	7,6
Dren suyu $N39^{0}32^{1}40,01^{11}$ $E48^{0}55^{1}29,80^{11}$		no	3,20 0,195	104,8 3,668	3,56	



Graphic 1. Change of the salt quantity in the soil under cotton

It is seen from the table that the salt quantity of the soil in the experiment area was 0.11-0.20% for dry residue in 2021. CO_{3-} ion isn't found in the samples. An amount of HCO_3-ion was 0.012-0.024%, Cl –ion is 0.007-0.1125. CO_{3-} ion isn't found in the drain water passing through the edge of area, HCO_3 quantity is 0.195g/l, but Cl-is 3.668g/l. It is clearly seen that the soil of the experiment area isn't salinized. The salt type is sulphate-clorine and sulphate in the experiment soil for Cl: SO_4according to the consequences of 2021.[3].The absorbed bases were fixed in the soil of the experiment area. A sum of the absorbed at 0-50cm of soil was 100gr.24.17-27.87 mg-eq, but at 0-100cm of layer it was 27.02-33.87 mg-eqi.[7].The productivity getting from "Bayaz altun" cotton sort was 30-35c/h in the experiment area.

Generally the researches indicated that the soil of the experiment area possessed un salinized type and it was very good for growing of the agricultural plants. Conduction of the ameliorative measure is important for increase and protection of fertility.

CONCLUSION

During the researches it was determined that the salt quantity was 0.11-0.20% and this belonged to the unsalinized type of the same soil. The salt type was sulphate in this soil. The productivity getting from cotton was 30-35c/h. A value of pH changed by 7.6-7.8 in the soil under cotton.The absorbed bases were 24.17-27.87 mg-eq in 100g of soil. Conduction of the ameliorative measures is important for uncrease and protection of soil fertility in the experiment area.

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APPROPRIATE AGRICULTURAL SITE SELECTION BY USING OF RS AND GIS TECHNOLOGY (SOIL AND HYDROLOGY PARAMETERS) FOR CHOLISTAN REGION

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A multi-criteria study was conducted to choose the land for agriculture. Soil samples from various points were taken and tested in laboratory. The soil samples comprise nine distinct soil parameters, including Calcium, Nitrogen, Phosphorous, Potassium, organic matter, Iron, EC, PH, and Synthetic Absorption Ratio. Each parameter is given weight based on how these parameters interpolated separately. Reclassified as suitable, moderate, and less-suitable agricultural land based on their relative weight used the Analytical Hierarchy approach to define weighted. Consistency for the evaluation of the established criteria, ratio and index are defined. If the consistency ratio for the result is less than 0.10, the outcome is considered more dependable. Maps are produced as a result of the multi-criteria analysis used to determine if a piece of land is suitable for agriculture. The multi-criteria analysis result is more in line with hypothesis when compared to the soil survey of Pakistan. Cholistan is a desert and it shows the variations in results due to soil nature. On the basis of our theory, around 70% of the results are correct. 55% of the land is appropriate for agriculture, 43% is intermediate, and the remaining 2% is unsuitable for agriculture.

Keywords: *Agricultural land, Cholistan, Hydrology Parameter, RS & GIS, Soil Parameters*.

1. INTRODUCTION

Being aware of the destitution of Cholistan region, the Government of Punjab ordered the current study to expand irrigated agriculture and to irrigate the deserted region on the Hakra Branch of Eastern Sadiqia via an appropriate transportation route. The research region, which has a total area of around 696,819 acres, is made up of Cholistan and the abandoned territories on the right distributary to the Hakra Branch. It is close to the Bahawal canal and Eastern Sadiqia (ES) Canal situated in the districts of Bahawalpur and Rahim Yar Khan. In south-eastern region of Punjab, next to the "Thar Desert" of Sindh province and the "Rajputana Desert" of state of India, the Cholistan Desert covers an area of roughly 6.50 million acres and found between latitudes of 28° 10' 24.2" and 28° 43' 20.05" and longitudes of 70° 23' 0.44" and 71° 11' 53.09".

Sutlej-Hakra Rivers formed an alluvial deposit in this region. It is thought that the region had irrigation for agriculture between 1200 and 600 B.C., and that it afterwards became barren land as a result of the river's bed drying up after the Hakra river changed its course over time. The region's poorest residents now reside in this area, which has a severely deteriorated ecosystem. The evapotranspiration is considerable (mean annual 2,473 mm), the ground water is brackish, and crop production is not practicable without supplemental irrigation due to the low and unpredictable yearly precipitation of 180 millimeters. Nearly 0.185 million individuals, who bravely endure these terrible climatic circumstances, depend on raising livestock on Cholistan's range regions for their livelihood. The inhabitants and their cattle are forced to rely on rainwater stored in "Kunds" and "Tobas" which ends up being utilized in approximately three months, because there is no traditional water supply available. After this time, the inhabitants and their animals must migrate to established areas.

The main obstacle to a healthy agricultural in Cholistan, which is essentially fertile, is an acute shortage of water. The goal is to come up with practical solutions to this obstacle. Cholistan has not received any extra provisions in the Water Accord (1991), so the province's anticipated flood-water share must be used to satisfy the project's demands for water. Additionally, it would be required to use the proper conveyance methods to transport flood water via different basins of the river to Cholistan. The Cholistan region experiences typical extreme dry zone weather, with high temperatures in the summer of up to 45°C and low winter temperatures below freezing. Sporadic and little rainfall, between 100 and 250 mm, occurs primarily from July to September. For a period of 3 to 4 months, the people and their animals can get water from kunds, ponds and tobas that store rainwater.

2. MATERIAL AND METHODS

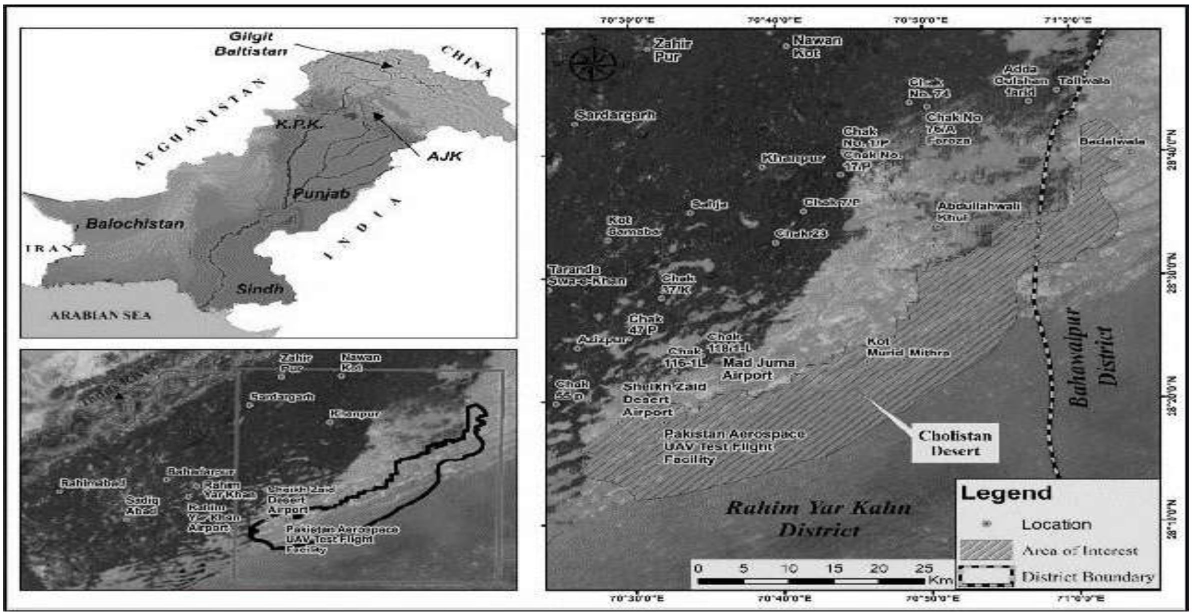


Figure 1.1 Study Area Map

In this research, we use both Geographic Information Systems (GIS) and RS technologies to investigate the most suitable agricultural site selection in the Cholistan area. We inspect and evaluate the region's soil and hydrology factors. In Cholistan, it is thought that irrigation-based agriculture thrived there between 600 and 1,200 B.C. However, the area became a wasteland as a result of the River Hakra's altered course and subsequent drying up. The alluvial formation of Sutlej-Hakra river system makes the Cholistan region. As indicated by the neighbouring irrigated lands of Abbasia Canal System, Eastern Sadiqia Canal System, Panjnad Canal System, and Bahawal Canal System, the soils are typically fertile and well adapted to productive irrigated agriculture.

Hakrandwala Dahars, red Dahars, white Dahars and Sand dunes represent the many types of soil that make up the area. There is no vegetation on the incredibly hard clay of the white Dhars. kankar and Sand make up the Hakrandwala Dahars, which has comparatively little vegetation. The third variety, or Red Dahars, are the most prevalent and take up the greatest space in Cholistan. Due to the rich soil that exists on the area, various types of vegetation can flourish there. Additionally, a closer look at the location reveals that the area is beneficial, productive, and flat. It is a reasonable assumption to make that this area will be just as suitable for farming as the current nearby lands that are watered by the Desert Branch, Abasia link Canal and Bahawal Canal Systems.

2.1. Study Area

In our research working on the entire cholistan desert was not possible. So, a small portion of it was chosen. In this study, we discovered suitable agricultural land in a small section of the Cholistan desert. Figure 1.1 depicts a study area map.

Currently, the entire area is a wasteland with no water, either from the canal system or from groundwater sources, the latter of which is mostly saline and unfit for irrigation or drinking. If irrigation water is made available, the area has a fair potential for agriculture with irrigation.

According to Figure 1.1, which represents the study area of Cholistan and it is located between two districts: Bahawalpur and district Rahim yar khan.

2.2. Objectives

The objectives of the study were to Perform image classification, suitable land selection by using GIS analysis, sustainability assessment using AHP, and verifying Result with Soil Survey of Pakistan maps.

2.3. Data Acquisition

Historical information and scanned maps of study area.

Field data collection (SAR, pH, EC and Soil samples measurements) from NESPAK institute. The soil testing was conducted in laboratory. From samples we obtained soil's chemical and physical and properties.

Landsat Satellite images were download from Earth Explorer.

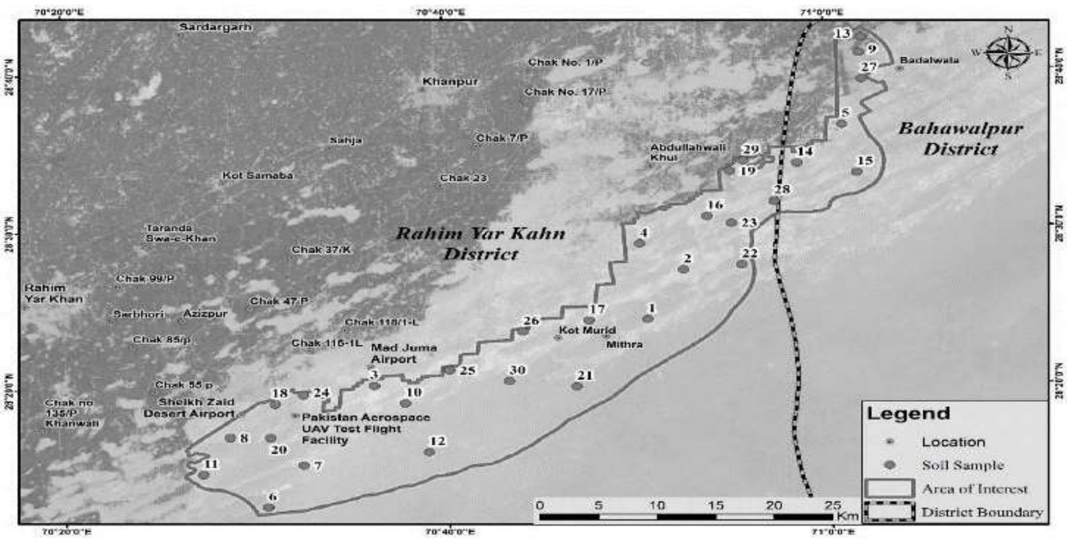
Temperature, Rainfall value Collected from meteorological department.

2.4. Methodology

In methodology we did Image Classification, Image Interpolation, Image Reclassification and Define weight utilizing AHP Technique. Then we did Weighted sum, Raster to Feature, Dissolve and finally the Area calculation. We also compared our results with Soil Survey of Pakistan Maps.

In this research we also utilized different software like, Global Mapper, Erdas Imagine, Google Earth, Arc Map, Microsoft Office and ENVI.

3. RESULTS AND DISCUSSION



1.2. Soil Sample Points

This section contains all of the results analysis performed in the study. Tables and maps are used to display the results. Discuss the physical and chemical properties of the soil to determine whether it is suitable for agriculture. Surface samples were tested for EC, pH, SAR, N, P, K, OM, and other parameters. In the table In this study, we used a small portion of the Cholistan region. Rahim Yar Khan and Bhawalpur District are the study areas. Figure 1.1 depicts the main location.

3.1. Soil Sample Points

30 randomly selected soil samples were collected from the survey and tested in a soil laboratory. NESPAK completed all of these tasks. Create a shape file in Arc Map using the data that has been prepared in a database. These are the points depicted in Figure 1.2.

3.2. Reclassification Maps

Soil chemical parameter values are assigned to soil points. These rasters can be cropped and reclassified based on their criteria because each value is individually interpolated. Figure 1.3 and 1.5 Figure depicts the reclassification results.

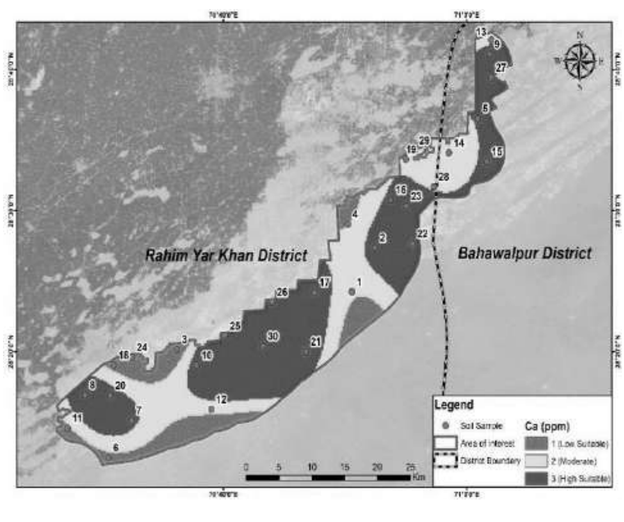


Figure 1.2 : Reclassification Maps for Ca

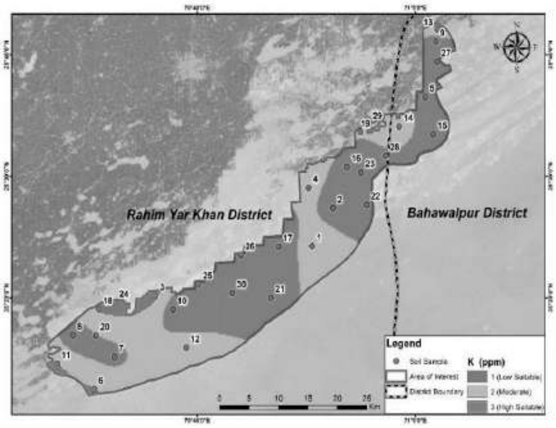


Figure 1.3: Reclassification Maps for EC

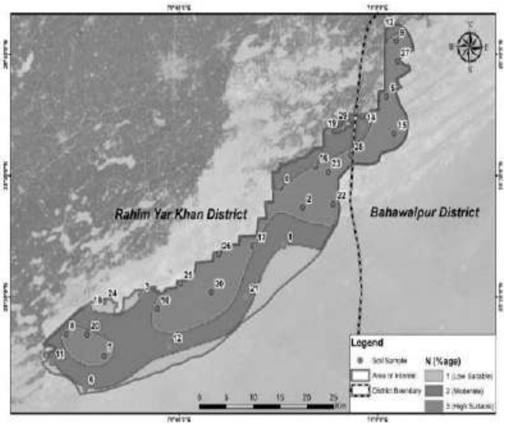


Figure 1.4: Reclassification Maps for K

3.3. Raster Calculator

In the raster calculator, multiply each parameter by its priority vector and then add them. Figure 1.6: Spatial Variability of Soil Parameters Displayed in Maps shows the resulting raster.

3.4. Result

The resulting raster is shown in Figure 1.6. Three land classes are depicted on this map based on a multi-criteria analysis. Three suitability-rating classes are shown in Figure 1.6 for the entire project area, with the following nomenclatures:

Suitability Class 3: Well Suited

Suitability Class 2: Moderately suitable

Class 1 Suitability: Not Suitable

According to the findings, 55% of the land is highly suitable for agriculture, while 43% is moderately suitable for agriculture. Furthermore, the remaining 2% is unsuitable for agriculture. These findings were confirmed by soil survey maps from Pakistan, as shown in Figure 1.7.

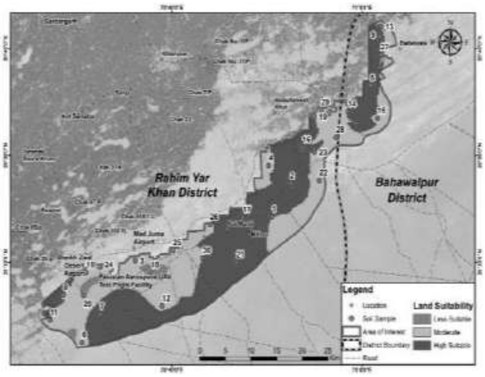


Figure 1.5: Reclassification Maps for N

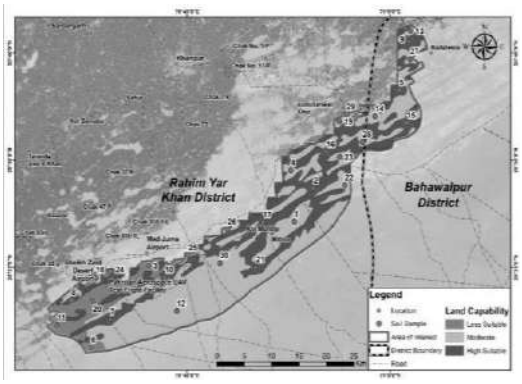


Figure 1.6: Suitable Land for agriculture

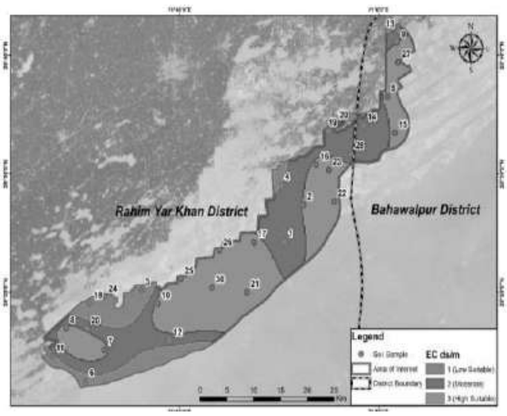


Figure 1.7: Suitable Land for agriculture from Soil Survey of Pakistan

4. CONCLUSION

Tables 1.1–1.2 below provide an overview of the component land capacity classes estimated from the Cholistan studied area's land capacity relationship under hypothetical settings.

Table 1.1

MCA's Statistic Summary for Land Capability Classes

Name	Class	Area (Meter)	Area (Kilometer)	Area (Hector)	Area (Percentage)	Area (Acre)
Low Suitable	1	17773514.08	17.77	1777.35	2%	4391.84
Moderate	2	334714791.87	334.71	33471.48	43%	82708.03
High Suitable	3	424617036.81	424.62	42461.70	55%	104922.87

Table 1.2

Pakistan's Soil Survey's Summary of Statistics for Land Capability Classes

Name	Class	Area (Meter)	Area (Kilometer)	Area (Hector)	Area (Percentage)	Area (Acre)
Low Suitable	1	82140530.31	82.14	8214.05	11%	20296.93
Moderate	2	411848362.04	411.85	41184.84	53%	101767.73
High Suitable	3	283204831.72	283.20	28320.48	36%	69979.91

The aforementioned table reveals that while roughly 70% of the findings are fairly accurate, 30% of those findings are either incorrect or may be. The research area has been held accountable for the discrepancy in the results because the soil parameters evaluated there are not constant over time and may also vary because of desert conditions.

It is clear that Class 3 land accounts for only 55% of the study area, while Class 2 land accounts for 43% and Class 1 land accounts for 2%. The Class 3 land is free of hazards, but it has some limitations in terms of workability and seedbed preparation due to its clayey texture. These lands would be ideal for the majority of the areas' proposed crops. 55% of the study area is made up of class III lands. Due to its slightly sandy consistency, Class III land faces certain limitations in terms of its nutrient holding capacity. After appropriate development of the land and the implementation of the innovative water conservation approach, these areas can be put under cultivation.

As per, Pakistan's soil survey report results, land of Class III cover 36 percent of the study area. Low delta crops such as gramme, pulses, oil seed, and isbghol would be grown on Class III lands. The area should be transformed into Special Use Land to allow for the irrigation-based production of a variety of crops.

In the Greater study area, Class II land covers 53 acres. Class II lands are made up of undulating to rolling shifting sands and are unsuitable for agricultural purposes. It ought to be stabilized through the growth of appropriate plant species. In the future, crops discrimination will be evaluated using the same methodology and crop-specific criteria.

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ZONATION MAPS BASED ON GIS TECHNOLOGY: A CASE STUDY OF SOILS OF SIALKOT DISTRICT, PUNJAB PAKISTAN

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During the conceptualization and planning phases of civil engineering projects, geotechnical investigation studies are conducted. It is essential to the development of sustainable building designs, but it also drives up project costs and length of construction. In order to save time and resources, we can use already existing Soil maps can save a significant amount of time and money. The study proposes the use of ArcGIS to create spatial interpolation of the data retrieved from geotechnical investigation reports of over 70 different building site locations of district Sialkot. This will significantly aid in geotechnical characterization of the respective area. Furthermore, the research area & subsurface soil has been investigated in terms of soil type and resistance to standard penetration (SPT-N). The Spatial Analyst extension of ArcMap & Inverse Distance Weighting (IDW) algorithm was used to create zonation maps at various depths. During the feasibility stage of a planned project in the study region, these maps can be used to quickly estimate the type and strength of the soil and develop a preliminary ground model, which enables the project to be safer and cost-effective.

Keywords: *ArcGIS, Geotechnical Zonation, IDW, Sialkot District, Spatial Analysis*

1. INTRODUCTION

Pakistani soil has different engineering and physical characteristics, depends on their mode of composition and their parent material (Kamal *et al.* (2016). The soil in the Punjab region is primarily alluvial deposits. Alluvial deposits include small and old deposits that have different geotechnical characteristics. Active flood plains are usually made of fine sand and silt. Old flood plains usually consist of a thin layer of shallow / rich clay beneath fine sand with varying amount of silt (Rashid, 2015). For the better, safe and sustainable engineering design of construction project required geotechnical properties of soils (Masoud, 2015). These geotechnical properties of soils can be grouped into engineering and physical properties. These engineering properties of soils are required in design calculations while physical properties represent the soils behavior at in-situ level (Abdi *et al.*, 2018). Physical properties of soils generally influenced by the geology of the area (Mohammed, 2018). Geotechnical data for construction and civil engineering projects gets from site investigations. Lab tests perform on the data and produce useful inform such as soil bearing capacity soil types etc. (El May *et al.*, 2010).

Geotechnical information is difficult to manage and organize due to its complexity. In our study, we found geotechnical data in multiple locations and various formats. Some data descriptions were incomplete, so we used GIS to make the datasets readable, understandable, and easily updated (Athira & Sankar, 2019). Geotechnical data, such as geotechnical reports, borehole logs, and spreadsheets, is commonly used in civil engineering projects for design and planning purposes (Malik, 2015). This information plays an important role in safe design of buildings and infrastructure (Ahmad *et al.*, 2013). GIS technology provides scientists with the opportunity to tackle new challenges across various fields, including climate change, earthquakes, water resource distribution, and mountain classification. Moreover, the diverse methodologies employed in GIS, such as fuzzy logic, artificial neural networks, and multicriteria decision analysis, have resulted in the generation of accurate and precise data (Wan-Mohamad & Abdul-Ghani, 2011). In short, GIS enables problem-solving and provides a fresh perspective on data. It facilitates data connectivity, sharing, and comprehension. Additionally, the advancement of computer science has led to increased utilization of GIS for spatial data manipulation and information management (Kolat, 2010).

GIS is extensively used in natural resources management, including natural hazards assessment, land-use planning, wildlife habitat analysis, timber management, and riparian zone monitoring. It serves as a powerful tool for urban land-use planning and addresses global-scale challenges like desert expansion, global warming, natural disasters, and vegetation disparities. Additionally, GIS aids in assessing landslide hazards through statistical models (Ahmed *et al.*, 2020). For hazard evaluation, GIS has been used to assess the potential risk with reference to bushfires, as well as estimating hurricane hazards (Perugini & Bodzin, 2020). The last few decades GIS has developed as the prime medium for graphic representation of geospatial data, including geologic, geotechnical and hydrologic information routinely used by geotechnical and geo-environmental and civil engineers (Wan-Mohamad & Abdul-Ghani, 2011). ArcMap10 was designed to manage different amounts and types of information. Importantly, the software allows the data to be represented spatially by referencing the data to its own geographical reference.

Objectives

- Zonification of Sialkot on the basis of sub-surface variations in terms of soil type & strength characteristics.
- Preparation of guidelines for the geotechnical design of foundations that are sited in these formulated zones.
- To determine the thickness of subsurface soil layers beneath the study area.
- Determine the subsurface conditions of the study area by developing zonation maps at different depths with the help of geographic information system.

2. MATERIALS AND METHODS

2.1 Study Area

Sialkot, located at coordinates 32.4945° N latitude and 74.5229° E longitude, is a fast-growing industrial city in Punjab, Pakistan. According to the 2017 Census, its population is 3,893,672, with 29.36% residing in urban areas and 70.64% in rural areas (figure 1).

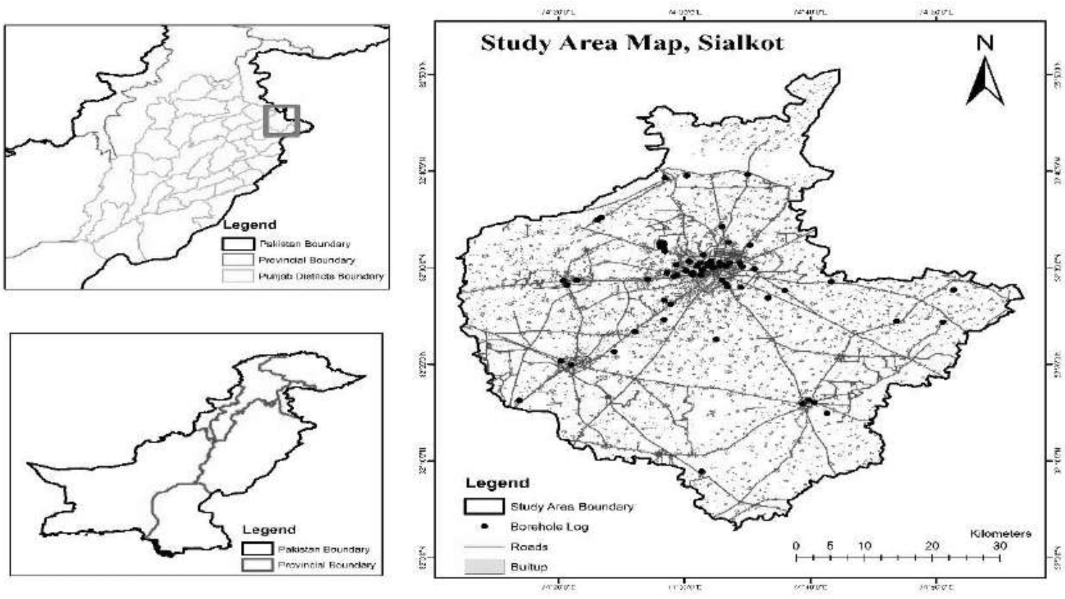

Figure 1. Study Area Map

The Study area is situated in the Punjab Plain and has moderate to low level of seismicity. The epicenters of earthquakes of moderate to low magnitude noted in the Punjab Plain are related with the subsurface fractures in the basement rocks which are concealed by the thick alluvial deposits.

2.2 Data collection and process

This study utilizes geotechnical data and geospatial data. Geotechnical data comprises reports from various civil and geotechnical engineering companies and departments, containing information on soil types and standard penetration test (SPT) values. SPT is an in-situ testing technique that determines soil properties such as relative density and bearing capacity. Geotechnical reports were collected from AJK Engineers in March 2020 and from SAFE in December 2019, covering the years

2018 to 2020 and 2018 to 2019, respectively. Another set of geotechnical reports from the Building Research St. was collected in November 2019, covering the years 2007 to 2017. The Digital Elevation Model (DEM) data was collected in December 2019 from the Alaska Satellite Facility (ASF). This study integrates two datasets in a GIS environment to facilitate the required research. It is divided into two main parts: the preparation of geotechnical data for GIS, involving stages such as data collection, processing, and analysis, and the application of GIS methodology to the geotechnical data. The GIS methodology includes steps like creating borehole log coordinates, preparing borehole data in GIS format, conducting spatial analysis, generating zonation maps, and validating them. For GIS related work, ArcMap was used. After interpolating the data, a raster surface is generated and classified using the reclassify tool in ArcMap. This process results in the preparation of zonation maps, dividing the study area into four zones: fill material, sand, clay, and high plasticity clay.

2.3 Statistical Analysis

For descriptive stats, Microsoft excel 2016 was used. A frequency histogram graph was also created at various depths to give a sense of the range of SPT-N values. The value of SPT-N rises with increasing depth.

3. RESULTS AND DISCUSSION

3.1 Statistical Explanation

Table 1 contains maximum value, minimum value, standard deviation, variance along with average values. At depth of 25 ft. maximum SPT-N is 32, whereas, the minimum SPT-N was is at the depth of 3 and 20 ft.

Table 1

Statistical description of SPT-N data

Depth (ft)	Min.	Max.	Avg.	Sum	SD	Variance
3	1	20	5.17	424	4.24	17.95
5	2	18	6.49	532	3.80	14.45
10	2	22	9.18	753	4.12	16.94
15	4	29	11.84	971	4.92	24.21
20	1	32	12.84	1053	5.57	31.02
25	3	34	14.26	1169	6.13	37.62
30	4	35	14.88	1220	6.46	41.76

3.2 Zonation maps on the basis of SPT-N values of soil

Zonation maps were prepared based on the SPT-N (Standard Penetration Test - N value) to provide a visual representation of the subsurface conditions. These maps serve as a useful tool for geotechnical engineers and construction professionals in understanding the ground characteristics at a particular site. The zonation maps divide the area into different zones, each with its own distinct description based on the range of SPT-N values found within. Zone 1 represents areas where the SPT-N values range from 0 to 5. This zone typically indicates very soft or loose soil conditions, suggesting poor load-bearing capacity. It is crucial to consider additional reinforcement or stabilization measures when constructing foundations or structures in this zone. Zone 2 encompasses SPT-N values ranging from 6 to 10. In this zone, the soil conditions are relatively soft, but they exhibit some improvement compared to Zone 1. While still requiring attention and appropriate design considerations, foundations and structures may have better stability within this range. Moving further, Zone 3 covers SPT-N values ranging from 11 to 15. The soil conditions within this zone are moderately firm, indicating a reasonable load-bearing capacity. However, it is essential to perform comprehensive site investigations and engineering analyses to ensure the stability and adequacy of foundations and structures. Zone 4 comprises SPT-N values ranging from 16 to 20. This zone indicates relatively firm soil conditions with good load-bearing capacity. Foundations and structures constructed within this range generally experience stable and favorable conditions, but design factors and site-specific considerations should still be evaluated. Finally, Zone 5 represents areas where the SPT-N values exceed 20. This zone indicates very firm or hard soil conditions with high load-bearing capacity.

Foundations and structures within this range are generally considered stable, but it is still important to consider other factors such as soil composition, geological features, and site-specific conditions for accurate design and construction planning. By using zonation maps based on SPT-N values, engineers and professionals can gain valuable insights into the ground conditions and make informed decisions regarding construction methods, foundation design, and appropriate measures to ensure the safety and stability of structures.

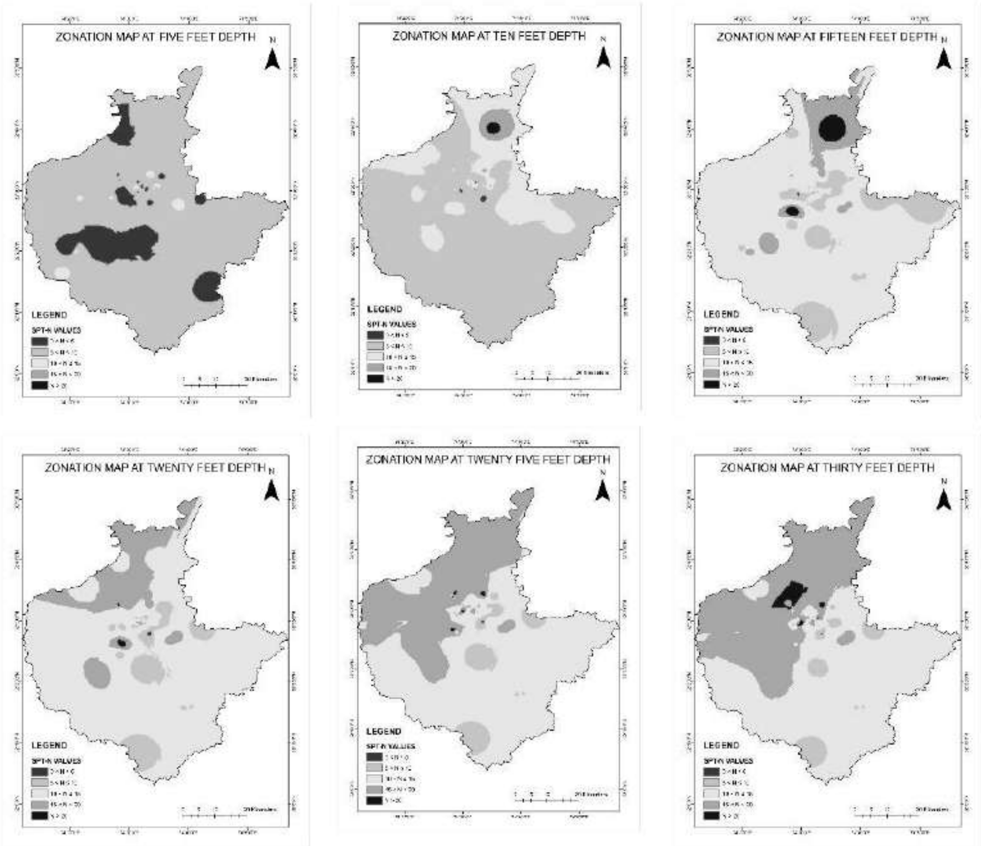

Figure 2: Zonation maps at different depths; a) 5 ft, b) 10 ft, c) 15 ft, d) 20 ft, e) 25, f) 30 ft.

Sambrail and some part of Daska and Sialkot area have high value of standard penetration test. Pasrur is at the southern side of the district which has the lower values of SPT-N test which means that the soil bearing capacity is lesser in these areas and soil strata is comparatively soft. Northern and north-west part of the district has high bearing capacity as these areas have high value of standard penetration test.

3.3 Validation of zonation of soil types

The soil type in the study area is classified on the basis of Unified Soil Classification System (USCS). The symbols used in this classification are CL (Lean Clay), CH (High plasticity clay), SM (Silty Sand), SP (poorly graded sand), ML (Silt), CL-ML (Silty clay), SP-SM (Poorly graded sand with silt).

The study area is divided into two sides: the northern side with sandy soil near the Chenab River, and the southern side, including Pasrur and parts of Daska, with clay and silty soils. Fill and high plasticity clay pose challenges in civil engineering. If these soils are found on-site, special attention from design engineers is necessary. To validate the soil zonation maps, five boreholes were used from unrelated projects that were not part of the initial analysis. In table 2, red color box shows that the predicted soil type value in GIS-based zonation map is different from the actual soil type in validation borehole. Whereas the blue color box shows that the actual soil type match with the soil type predicted in zonation map. Most of the soil type values match with actual and predicted in zonation maps.

Table 2.

Validation of zonation map

Address	D-0	D-3	D-5	D-10	D-15	D-20	D-25	D-30
G.G.P.S Bheelo Mahar Daska, Sialkot	Fill	Fill	Fill	Fill	SP	SP	SP	SP
Govt. College for Women Sambrial, Sialkot	CL	CL	CL	SP	SP	SP	SP	SP
ROC KINGRA MORE SIALKOT	CL/ML	CL/ML	CL/ML	CL/ML	CL/ML	CL/ML	CL/ML	CL/ML
Tower site	SM	SM	SM	SM	SM	SM	SM	SM
Gulshan-e-Iqbal park, Sialkot	FILL	CL	CL	CL	CL	CL	CL	CL

4. CONCLUSION

This study aimed to characterize and analyze the geotechnical properties of soil in Sialkot, with a focus on understanding its behavior and variation in the subsurface. It represents the first investigation into the geotechnical behavior of deep-layer soil in the area. To achieve this, Standard Penetration Test (SPT) N values were utilized to develop GIS-based zonation maps. These maps were instrumental in characterizing the soil stiffness in Sialkot, providing valuable insights at various depth intervals up to a depth of 30 feet. Additionally, a proposed Borehole Management Information System (BMIS) was introduced as a geotechnical information system specifically designed for Sialkot. This system aimed to efficiently collect, coordinate, tabulate, synthesize, and organize the vast amounts of geotechnical data obtained from drilling investigations. The ultimate goal of the BMIS was to present the data in a digital borehole log format, encompassing vital information such as borehole location, coordinates, depth, bore diameter, field test results, and stratigraphic columns. The implementation of the BMIS and the utilization of SPT-N values for zonation mapping contribute to the comprehensive understanding of the geotechnical characteristics of soil in Sialkot. This research provides a valuable foundation for future studies and engineering projects in the area, facilitating informed decision-making and effective design strategies in the field of geotechnical engineering.

These GIS-based geotechnical zonation maps provide guidance for the design and planning phase of engineering projects. They assist in identifying geotechnical properties required for foundation and excavation conditions. These maps also aid in the identification of suitable sources of construction materials. It is important to note that these guidelines are intended for preliminary planning purposes only. For the final design of any development or construction project, a thorough sub-surface inspection should be conducted to ensure site-specific considerations.

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OZONE LAYER DEPLETION – CAUSE, EFFECTS AND SOLUTIONS

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Earth's ozone layer, an early symbol of global environmental degradation, is improving and on track to recover by the middle of the 21st century.

Over the past 30 years, humans have successfully phased out many of the chemicals that harm the ozone layer, the atmospheric shield that sits in the stratosphere about nine to 18 miles (15 to 30 kilometers) above Earth's surface.

Key words: *ozone layer, CO2, atmosphere, warming, ecology*

INTRODUCTION

The ozone layer plays a vital role in making the planet habitable for us and other species. High in the atmosphere – between 10 to 50 kilometers above the earth's surface – the ozone layer absorbs most of the sun's ultraviolet radiation.

But, during the 1970s, '80s, and '90s, humans were emitting large quantities of substances that depleted the ozone layer. This led to the creation of ozone holes at the earth's poles, exposing life to higher levels of ultraviolet radiation and increasing the risks of skin cancer in humans.

During the 1980s, the world came together to form an international agreement to reduce – and eventually eliminate – emissions of these depleting substances. The political agreements were very effective. Since then, global emissions have fallen by more than 99%.

The ozone holes have stopped growing and are now starting to close.

Atmospheric ozone absorbs ultraviolet (UV) radiation from the sun, particularly harmful UVB-type rays. Exposure to UVB radiation is linked with increased risk of skin cancer and cataracts, as well as damage to plants and marine ecosystems. Atmospheric ozone is sometimes labeled as the "good" ozone, because of its protective role, and shouldn't be confused with tropospheric, or ground-level, "bad" ozone, a key component of air pollution that is linked with respiratory disease.

Ozone (O_3) is a highly reactive gas whose molecules are comprised of three oxygen atoms. Its concentration in the atmosphere naturally fluctuates depending on seasons and latitudes, but it was generally stable when global measurements began in 1957.

Groundbreaking research in the 1970s and 1980s revealed signs of trouble.

MATERIAL AND METHODS.

Ozone threats and the hole. In 1974, Mario Molina and Sherwood Rowland, two chemists at the University of California, Irvine, published an article in the journal Nature detailing threats to the ozone layer from chlorofluorocarbon (CFC) gases. At the time, CFCs were commonly used in aerosol sprays and as coolants in many refrigerators. As they reach the stratosphere, the sun's UV rays break CFCs down into substances such as chlorine.

This groundbreaking research - for which they were awarded the 1995 Nobel Prize in chemistry - concluded that the atmosphere had a "finite capacity for absorbing chlorine" atoms in the stratosphere.

One atom of chlorine can destroy more than 100,000 ozone molecules, according to the U.S. Environmental Protection Agency, eradicating ozone much more quickly than it can be replaced.

Molina and Rowland's study was validated in 1985, when a team of English scientists found a hole in the ozone layer over Antarctica that was later linked to CFCs. The "hole" is actually an area of the stratosphere with extremely low concentrations of ozone that reoccurs every year at the beginning of the Southern Hemisphere spring (August to October).

At the North Pole, a degraded ozone layer is responsible for the Arctic's rapid rate of warming, according to a 2020 study published in Nature Climate Change. CFCs are a more potent greenhouse gas than carbon dioxide, the most abundant planet-warming gas.

The ozone layer's status today. In a report released in early 2023, scientists keeping track of the ozone layer noted that Earth's atmosphere is recovering. The ozone layer will be restored to its 1980 condition - before the ozone hole emerged - by 2040. More persistent ozone holes over the Arctic and Antarctica should recover by 2045 and 2066, respectively.

This progress is thanks to the Montreal Protocol on Substances That Deplete the Ozone Layer, a landmark agreement signed by 197 UN member countries in 1987 to phase out ozone-depleting substances. Without the pact, the EPA estimates the U.S. would have seen an additional 280 million cases of skin cancer, 1.5 million skin cancer deaths, and 45 million cataracts—and the world would be at least 25 percent hotter.

RESULTS AND DISCUSSION CONCLUSION

Nearly all the ozone-destroying chemicals banned by the Montreal Protocol have been phased out, but some harmful gases are still used. Hydrochlorofluorocarbons (HCFCs), transitional substitutes that are less damaging but still harmful to ozone, are still in use in some countries. HCFCs are also powerful greenhouse gases that trap heat and contribute to climate change.

Though HFCs represent a small fraction of emissions compared with carbon dioxide and other greenhouse gases, their planet-warming effect prompted an addition to the Montreal Protocol, the Kigali Amendment, in 2016. The amendment, which came into force in January 2019, aims to slash the use of HFCs by more than 80 percent over the next three decades.

In the meantime, companies and scientists are working on climate-friendly alternatives, including new coolants and technologies that reduce or eliminate dependence on chemicals altogether.

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STRUCTURE OF SHIRVAN PLAIN MUNICIPAL LAND FUND AND WAYS OF EFFECTIVE USE

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As a result of the research, it was established that the following soil subtypes are common in the Shirvan Plain: dark gray-brown soils - 12,624.69 hectares (5.11%); ordinary gray-brown soils - 27578.95 hectares (11.16%); light gray-brown soils - 7867.21 ha (3.18%); ordinary meadow-gray soils - 28849.64 ha (11.68%); light meadow-gray soils - 3869.24 hectares (1.57%); dark gray-meadow soils - 7936.55 ha (3.21%); ordinary gray-meadow soils - 98916.69 hectares (40.04%); light gray-meadow soils - 20967.27 ha (8.49%); boggy-meadow soils - 4572.91 ha (1.85%); alluvial-meadow soils - 15867.8 hectares (6.42%); solonchaks - 17981 hectares (7.29%). The total area of the Shirvan Plain was 661991.94 ha, of which 198182.66 ha are in the state, 265693.66 ha in municipal and 198115.62 ha in private ownership. It was revealed that the lands in municipal ownership are mainly located in Agsu and least of them in the territory of Hajigabul district. As a result of research, we come to the conclusion that non-saline areas are mainly in Agsu, and very strongly saline soils - in Agdash, and highly saline soils are the least in Agsu. In Agsu, salt marshes are not observed. Poorly alkaline soils are mainly located in Zardab, and non-alkaline soils are in Goychay. Medium alkaline soils are found in Agsu and Ujar districts. It was found that poorly and moderately eroded soils are observed in the Kurdamir, Ujar and Zardab areas. The area owned by municipalities and allocated for the future development of residential areas may be increased in the future due to population growth.

Keywords. *Shirvan Plain, municipal lands, saline soils, meadow-gray soils, solonchaks, land fund.*

INTRODUCTİON

The achievement of state independence in our country caused fundamental changes in all spheres of socio-political and socio-economic life. It was from this period that land reform began to be carried out in our republic, and after the reform, three forms of ownership were created - state, municipal and private. Since it is very important to determine the price of land when buying and selling, leasing and pledging land plots, it became necessary to evaluate these land plots. From this point of view, for the effective use of land resources, their assessment has both scientific and theoretical and industrial significance. With this in mind, we assessed them in order to develop the foundations for the effective use of the municipal land fund of the Shirvan Plain.

MATERIAL AND METHODS

The Shirvan plain covers the northern part of the Kura-Araz plain and is located between 40005' and 40045' northern latitude and 47015' and 49030' longitude. It borders on the foothills of the Boza and Langebiz mountains from the north, northwest and northeast, with the subasar regions of the Kura River from the south and southeast, from the east by the conditionally accepted meridian 49030', with the lands of the Yevlakh region. West. The height of the earth's surface is not more than 50-100 m above sea level. The total area of the Shirvan Plain is 661,991.94 hectares, of which 198,182.66 hectares are in state ownership, 265,693.66 hectares are in the municipality, and 198,115.62 hectares are in private ownership. The assessment of municipal lands of the Shirvan Plain was carried out mainly in 3 stages: cameral-preparatory, field-laboratory and final-generalizing. A number of generally accepted methods were used in the research (Jafarov, 2007; Suleymanov, 2007).

RESULTS AND DİSCUSSİON

As a result of our discussions, it turned out that the soil subtypes common in the Shirvan Plain are distributed as follows: dark gray-brown soils - 12624.69 ha (5.11%); Gray-brown ordinary soils - 27578.95 ha (11.16%); light gray-brown soils - 7867.21 ha (3.18%); Ordinary meadow-gray soils -

28849.64 ha (11.68%); Light meadow-gray soils - 3869.24 ha (1.57%); Dark gray meadow soils - 7936.55 ha (3.21%); Ordinary gray-meadow lands - 98916.69 ha (40.04%); Open gray-meadow lands - 20967.27 ha (8.49%); Boggy-meadow soils - 4572.91 ha (1.85%); alluvial-meadow soils - 15867.8 ha (6.42%); Solonchaks - 17,981 ha (7.29%).

Our goal is to study the structure of the municipal land fund of the Shirvan Plain, the mechanism for distributing land owned by the municipality among land users and ways to use it effectively. Thus, municipal lands include all soils in use (land for common use, land for pastures and hayfields, arable land, land for prospective development of the village and land of the reserve fund, land used and leased by individuals or legal entities, forest belts and etc.) has been done. According to the information received, the land fund owned by the municipalities of the Shirvan Plain consists of numerous farms and has a variety of uses. Municipal lands distributed in the Shirvan Plain are located in the territories of Agdash, Goychay, Zardab, Agsu, Kurdamir and Ujar regions (Table).

Table.

Distribution of land in the Shirvan Plain by types of ownership

Name of the district	State-owned lands, ha	Municipal-owned lands, ha	Private-owned lands, ha	Total area, ha
Aghdash	42254,47	26078	33670,53	102003
Goychay	2141,19	39673	28467,26	70281,45
Kurdamir	44696,63	66415	49409,34	160520,97
Ujar	20757,52	40185,88	24438,12	85381,52
Aghsu	14777,16	53587,14	34042,7	102407
Zardab	19205	37947,93	27647,07	84800
Hajigabul	54350,69	1806,71	440,6	56598
Total area	198182,66	265693,66	198115,62	661991,94

The basis of the land fund owned by municipalities is formed by areas not cultivated in agriculture, or other lands withdrawn from agricultural use (roads, settlements, cemeteries, etc.), as well as rural pastures. used by municipalities is 295408.12 ha. The structure of the land cover owned by the municipalities in the Shirvan Plain zone is brought in accordance with the current state of the main types and subtypes of land in administrative regions, which is of exceptional importance in land use, or rather, in calculating the demand for land in terms of population growth in the future and when calculating agricultural output per capita. The composition of the soil cover in the study area includes 11 types and subtypes.

There are municipalities in the Shirvan Plain, on the territory of which lands unsuitable for agriculture and conditionally unsuitable for agriculture predominate. Such lands mainly include salt marshes, swamps, highly saline soils and areas covered with sediments from flood cones during floods on rivers. The reserve land fund of municipalities includes municipal lands that were previously used by legal entities and individuals for use or lease, the right to use which was later terminated in accordance with the law, as well as other lands allocated for reserve purposes. The category of lands of the reserve fund of the municipality includes the land fund allocated for the long-term development of municipalities, which includes lands intended for the long-term development and expansion of settlements. In general, the lands of the reserve fund of the municipality can be provided for general use, use and lease to individuals and legal entities, as well as the ownership of citizens of the republic and legal entities in accordance with the law. Common lands include soils under the streets and squares of cities, towns and other rural settlements, soils under forest shelterbelts, as well as lands under buildings and structures for general use of the local population, soils under rural pastures. Thus, it can be said that lands transferred to municipal ownership belong to different categories, and a change in the designated purpose of lands belonging to this category can be allowed in the manner prescribed by law. In general, based on our study, it was found that the municipal lands in the administrative regions of the Shirvan Plain cover more than 280 administrative-territorial units (Mammadov, 1998; 2002).

In our republic, especially in the Shirvan plain, there is a rather high level of geolandscape reserves, which has great prospects for the targeted development of municipalities in the future. In the future, an increase in the local population will create a constant demand for municipal lands for the expansion of residential areas on the municipal territory, for the construction of buildings and structures of national importance on public lands. According to our data, as of January 1, 2007, the land rate per person from the land fund owned by municipalities in the territory of the Shirvan Plain regions has changed from 0.43 to 0.86 ha. In the areas of the Shirvan Plain, this figure was 0.65 hectares. This, in turn, allows us to say that in the future, due to population growth, there will be cardinal changes in the legal regime of municipal land in the zone. Along with this, there will be a decrease in the areas allocated for the prospective development of settlements in the reserve land fund of municipalities. It is at this time that the deformation of the municipal reserve fund for short-term, long-term or permanent use of individuals and legal entities, as well as land plots less suitable and unsuitable for agriculture, therefore, this process should be taken into account. Thus, it is of great importance to study the structural distribution of the total land fund owned by the municipality at the level of districts and farms (Mammadov, 2003; Babayev, 2007).

In connection with the natural population growth in the areas of the Shirvan lowland, the construction of new settlements, the improvement of their socio-economic well-being and other similar demographic problems will also take place. Given the future growth of population, it can be said that with the expansion of settlements, land less suitable for agriculture and unsuitable for construction will be given over to development for the purpose of building apartments. At the same time, population growth in the future will lead to an increase in demand for agricultural products (Mammadov, 2015). Satisfying this requirement also places a certain responsibility on the municipalities. Therefore, in the near future, we took into account the importance of creating new settlements at the expense of the municipal lands of the Shirvan Plain regions and the possibility of allocating land plots for these purposes. In the future, the growth of the population of the regions of the Shirvan Plain creates the need to study and identify land plots for the construction of new residential buildings. Early determination of the average population growth rate in the regions leads to the determination of the demand for land.

The average population growth rate by region is calculated using the following mathematical formula (Mammadov, 2007):

$$v=(a\cdot 100):b \qquad (1)$$

here v is the average population growth rate for the regions; a - the average annual population growth of the regions, (persons); b - the number of subjects in the districts, (persons).

The number of entities that can receive a land share in the future is also calculated using the average population growth rates in the regions. The following formula is used here:

$$p=(v\cdot b):100 \qquad (2)$$

here p - is the number of entities that can receive a land share in the future, and formula (1) is used to find the values of v and b.

The number of entities that can receive a land share is calculated by multiplying the average land share rate. Many of the land in the area has been affected by natural processes such as erosion, salinization and alkalinity. The main reason for salinization and solonetzization of soils is an increase in the percentage of sodium cations in the soil. It is also very important to lay drainage on the site in order to prevent groundwater from escaping to the surface. Violation of the territory by natural and anthropogenic factors also leads to desertification of the territory, which can lead to the complete destruction of land (Abduyev, 1957). Therefore, there is a need for land reclamation activities in the areas. Security measures should be implemented to protect the territory from natural and anthropogenic impacts.

CONCLUSION

The following types of soils are common in the municipal property of the Shirvan Plain: dark gray-brown soils; ordinary gray-brown soils; light gray-brown soils; ordinary meadow-serozems; open grassy-grey lands; dark gray meadow soils; ordinary gray-meadow soil; open gray-meadow lands; marsh-meadow lands; subasar-meadow lands; salt marshes. The distribution of the lands of the Shirvan Plain according to the forms of ownership is given. It was revealed that most of the land owned by the municipality is located in the Agsu district, and the least in the Hajigabul district; non-saline lands are the most in Agsu, strongly saline soils - in Agdash, the least strongly saline soils are in Agsu. There are no saline soils in Agsu. Weakly solonetsous soils are the most in Zardab, and non-saline soils - in the Goychay region. Medium solonetsous soils are common in the Agsu and Ujar regions. The area of territories owned by the municipality and allocated for the prospective development of settlements may be increased in the future due to population growth.

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MONITORING LAND AREA CHANGES IN THE CASPIAN SEA COASTAL ZONE USING REMOTE SENSING DATA

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Since the Caspian Sea has no access to the ocean, its level changes are irregular and cover a wide range. These fluctuations affect the coastal zone and cause both quantitative and dynamic changes in the processes on the coast (abrasion, accumulation, etc.). Thus, it is directly interesting for the local economy of the state to monitor the changes in coastal characteristics over time in the coastal zone, to determine the quantitative indicators of the increase and decrease of land areas in the coastal zone. The lowering of the level of the Caspian Sea in recent years has a serious impact on the infrastructure of the coastal zone.

Thus, by using distance sensing data and satellite data, a comparative analysis of the years 2005 and 2021 was carried out in the research work, and the geographical position of the coastline and the morphometric indicators of the changes occurring in the area were determined in the coastal zone around the Ghizil-Agaj Bay of the Azerbaijan water area of the Caspian Sea. In the research work, using Landsat satellite indicators, using the Tasseled Cap and DSAS-Digital Shoreline Analysis System method, the high-risk areas were identified as a result of a comparative analysis, and the land areas increased and decreased. It was determined that during the years 2005-2021, the land area in the coastal zone increased by 250 km^2. The applied method allows us to evaluate the changes occurring in the coastal zone in a short time in a large area.

Keywords: *remote sensing, satellite images, coastal zone, land areas, DSAS.*

INTRODUCTION

The coastal zone is one of the most dynamic areas on Earth, with changes occurring at a wide range of time and spatial scales. Shoreline is defined as the line of contact between land and water body [1]. They are continuously modified by natural and human made process. This fact, makes systematic mapping of this type of regions a challenge. Coastal zones is of particular importance for the presence of availability of settlements and economic activities, most of which are related to tourism. Accurate demarcation and monitoring of shorelines necessary for understanding various coastal process. Shoreline delineation is difficult, time consuming and sometimes impossible for entire coastal system when using traditional grand survey in techniques. The coastline is not a straight line to all locations; it has many modulations and undulations because some geomorphological features are easily washed out by wave energy, like limestone. Shoreline changes resulting from natural and anthropogenic activities are interrelated. International Geographic Data Committee (IGDC) is recognized the shoreline as the one of the 27 most important features-to be mapped and monitored [2]. The shoreline change studies helps in the different application fields such as shoreline erosion monitoring, coastal zone management, flood prediction, and evaluation of water resources [3]. In this study, coastline demarcation is an important and challenging task as it forms the basis for further research such as coastline changes, forecasting and detection of vulnerabilities, etc. Understanding coastal dynamics requires a broader temporal and spatial scale approach that time-limited and localized research cannot provide. Over the past several decades, remote sensing and geographic information systems techniques have led to improvements in coastal geomorphological research. Currently, the development of remote sensing and GIS technologies has established itself as the most powerful and reliable tools for mapping coastline changes.

Tasseled Cap Transformation (TCT) and different Normalized Difference Water Index, Normalized Difference Vegetation Index have been used to demarcate the shorelines and vector change detection method has been employed to access the changes of coastal zone Caspian sea territory of Azerbaijan by using Sentinel 2A and Landsat 7 (ETM+) sensor data [5].

The main objectives of the study are to demarcate the shorelines of 2005 and 2021 from the different sensor satellite images, to identify the quantitative and qualitative shoreline changes for above mentioned periods. The study area is the coastal zone of the Caspian Sea in the territory of Azerbaijan around the Ghizil-Agaj Bay.

MATERIALS AND METHODS

In this study for to identify occur changes in the coastal zone for sixteen years was used ortho rectified and geodetic dataset of Landsat Enhanced Thematic Mapper plus (+ETM 2005) and Sentinel 2A (2021) data.

Based on accessible data bases, some pre-preprocessing methods were first involved for correction of atmospheric inaccuracy using dark object subtraction. Dark object subtraction (DOS) is perhaps the simplest and most widely used image based relative atmospheric correction approach for classification and change detection applications [4]. In the second stage, the process of geometric correction, which is known as orthorectification, was applied to the Landsat images. During this process, data is corrected according to the user's ground reference system. The Sentinel-2A product has radiometric and geometric corrections. An atmospheric correction operation was performed by applying a Sen2Cor processor to the satellite image in the SNAP software package provided by ESA (European Space Agency).

For extract of the shoreline, we used the Tasseled Cap Transformation method and NDVI (Normalized Difference Vegetation Index). Determining the Normalized Difference Vegetation Index (NDVI) in this technique uses a composite red band and Near Infrared (NIR) to determine the level of greenness and classification of vegetation areas. The next step uses Tasseled Cap to convert band channel into a new band set with clear interpretation for vegetation mapping, this transformation already proven fit for shoreline extraction [7]. Tasseled cap transformation (TCT) is a usually used remote-sensing technique and has been successfully used in various remote sensing-related applications. However, the TCT coefficient set is sensor-specific, and therefore, in this article, we developed the TCT coefficients specifically for Sentinel-2 multispectral instrument at-sensor reflectance data [7]. Tasseled Cap process are using composite bands of red, green, blue, NIR, short wave infrared-1 (SWIR-1) and short wave infrared-2 (SWIR-2) to find out the level of brightness, greenness and wetness of an object.

Brightness, a measurement value for the ground; greeness, a measured value for the vegetation; wetness, a measured value for interactions of soil and canopy moisture (Figure 1) [5]. After this analysis shoreline around the Ghizil-Agaj Bay was extracted and it was determined that in 2005 the coastline was 330 m long, and in 2021 it was 160 m long. (Figure 1).

Figure 1. Shoreline extraction results for 2005 to 2021

RESULTS AND DISCUSSION

In Caspian Sea, the minimum sea level for the past years was registered in 1977 by a ground station at -29 m. Since 1978, the sea level has risen, and in 1995 it was registered at -26.66 m and whereupon the sea level was almost stable with slight decrease. In 2005-2020, a 1.18-meter descent was observed in the Caspian Sea (Figure 3).

Figure 3. Sea level changes in the Caspian Sea (1837-2019)

The Digital Shoreline Analysis System (DSAS) is a GIS-based system established by the USGS. DSAS 5.0 has six statistical methods to measure variations. In this study, Net shore Movement (NSM) was used. NSM measuring net shoreline change according to distance rather than mean value. NSM relates to date and only two shorelines requires, i.e. total distance among the earliest and the latest of coastline in each transect [6]. Where, the NSM positive and negative value shows seaward and landward movement of the coastline respectively. Baseline, historical seashores and coastlines uncertainty are input data delivered in the model for during simulation phase. The spaces among transects alongside the baseline and transects length were demarcated based on the Coastline pattern. DSAS creates transects that are cast perpendicular to the baseline at a user definite spacing along the coast. The transect coastline intersections along this baseline are then used to compute the rate of change statistics.

The results of coastline analysis show that the NSM distance positive values follow the 0,8 m between 10850 m, negative values follow (-138.02 m) between (-0.26 m). The maximum accretion distance 10850 m, maximum erosion distance -138.02 m (Figure 4).

Figure 4. Assessment of shoreline change (2005-2021)

The rates of shoreline position variations measured by the NSM method during this period show that the coastline is principally subjected to accretion (Figure 5).

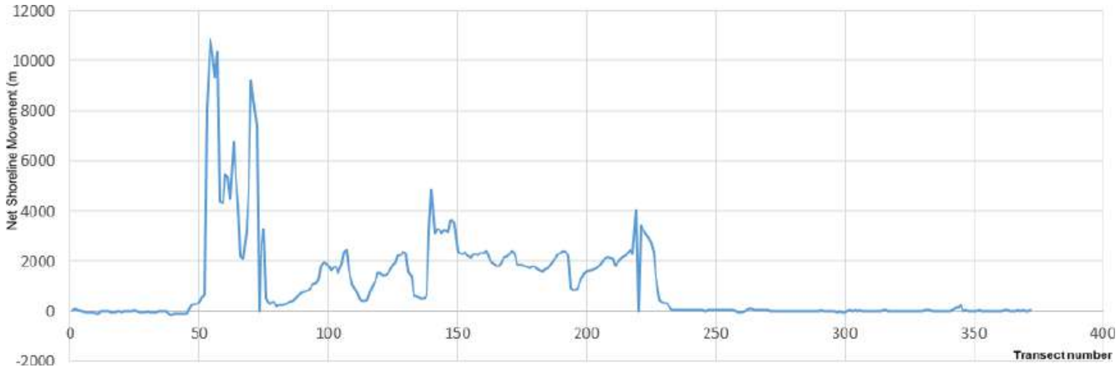

Figure 5. Net Shoreline Movement (NSM) Change Rate 2005 to 2021

CONCLUSION

According to the results, in period form, 2005 to 2021 the rates of shoreline position changes indicate that all transects are accretion and less erosion was observed. Study area shoreline is changing over time because of accretion and erosion process. However, the whole area of the coastline is almost gone through the accretion process whereas the erosion also occurred but not like the accretion through the entire period. From 2005-2021 most of the accretion took place having 250 sq. km of the net gain of the area. The varying pattern of landmass in diverse interval has presented in Figure 7.

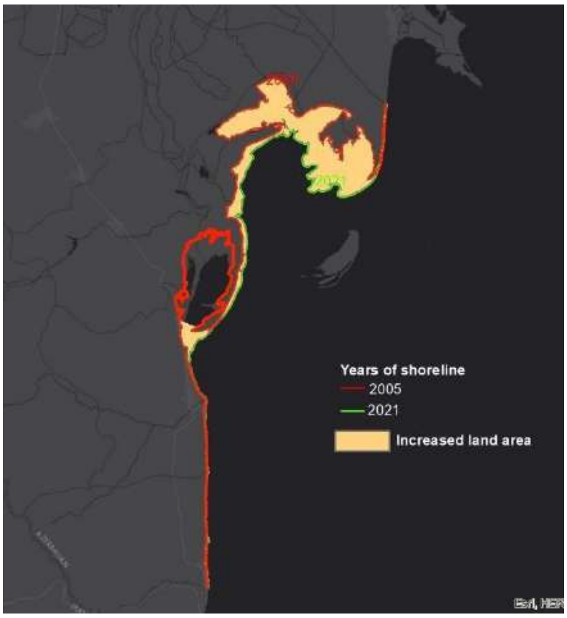

Figure 7. Fragments showing land gain areas

Acknowledgements: This research aimed to investigate the changes occurring in the coastal zone of the Caspian Sea, particularly in the area surrounding the Ghizil-Agaj Bay of the Azerbaijan water area. The irregular and wide-ranging fluctuations in the sea level have a significant impact on the coastal processes, leading to quantitative and dynamic changes such as abrasion and accumulation.

The results of this research have significant implications for the local economy, particularly in relation to the impact of sea level lowering on the infrastructure of the coastal zone. The findings can

inform decision-making processes and coastal management strategies aimed at mitigating the effects of these changes and ensuring the sustainable development of the region.

It is important to note that this study is part of an ongoing research effort, and further investigations are necessary to comprehensively understand the complex dynamics of the Caspian Sea coastal zone and its implications for the surrounding communities and ecosystems.

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ECOLOGİCAL ASSESSMENT OF FOREST AREAS WİTH A HİGH CONTENT OF AEROSOLS BASED ON SATELLİTE İMAGES OF LANDSAT TM / ETM + SENSORS (ON THE EXAMPLE OF LACHIN, GUBADLY AND ZANGILAN REGİONS)

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INTRODUCTİON

The notion of a composite satellite image made up of several images acquired on several dates is widely used. When Holben (8) studied vegetation dynamics, complex satellite images obtained on several dates were used to determine the maximum value of the normalized index of various vegetation types. (NDVI), in a number of tasks, this method was used to reduce cloud pollution, atmospheric attenuation, surface reflectance, and other tasks. Roy et al. (9) also took a similar approach and applied it to the MODIS vegetation index and Landsat-7ETM+ imagery, generating weekly, monthly, seasonal, and yearly integrated satellite images not only for this single NDVI but also using selected time intervals (on pixel), respectively, to form the sensor reflector composites. The presence of pollution in different parts of the time series and the widely varying amounts of missing data can create significant difficulties in analyzing long-term behavior. Kowalski and Roy (10) presented a worldwide statistical analysis of cloud formation and loss data in the Landsat archive..

Changes in the environment, including the atmospheric air, which is one of the main components of the environment, as a result of human activities in recent years, is currently considered one of the serious environmental problems. One of the many factors that pollute the atmosphere is aerosol pollution. The impact of aerosol pollution on the environment, including the human body, differs sharply from the impact of other polluting gases [1,2]. Given this point of view and taking into account that the assessment of aerosol pollution in large industrial centers plays an important role in various environmental issues, including atmospheric optics, the relevance of research conducted in this area becomes one of the important issues of the day. Based on space information, two types of atmospheric pollution are analyzed. One of them is gas particles with molecular effects (Rayleigh and Mie scattering), and the other is numerous solid aerosol particles. Natural aerosols are mainly produced by forest fires, grass fires, dust swirls, and volcanic eruptions. Anthropogenic aerosols are formed as a result of human activities, mainly in energy production processes.

MATERİAL AND METHODS

According to the literary data known to us, the Gekari River flows through the Lachin, Gubadli and Zangilan regions. Its source is the Lachin region, and the final point is the Zangilan region. Based on the studies, the aerosol forest cover index (AFRI1600), vegetation cover index (NDVI) and hydrological conditions were determined according to the data for 2000 and 2020 (2021) [1,2].

As another step, let's do an environmental assessment. So, let's determine the influence of the AFRI1600 index on the NDVI index and the hydrological state by field indicators [3,4].

As you know, the AFRI1600 index is conditionally divided into high, medium, weak and pure classes. Below are the gradations of the listed classes:

High -0.7÷-0.3; Average -0.3÷-0.1; Weak -0.1÷0.3; Pure 0.3÷0.68.

Based on these gradations, comparing 2000 and 2021, we identified declining and increasing areas, and the result is shown in Figure 1. If you pay attention to the image shown in Fig. 1, then the average decreasing class passed into a weak increasing class, that is, some parts of the medium aerosol areas in 2000 decreased in aerosol, and in 2021 weak aerosol areas. [5,6].

We will determine the environmental assessment for the decrease and increase in areas.

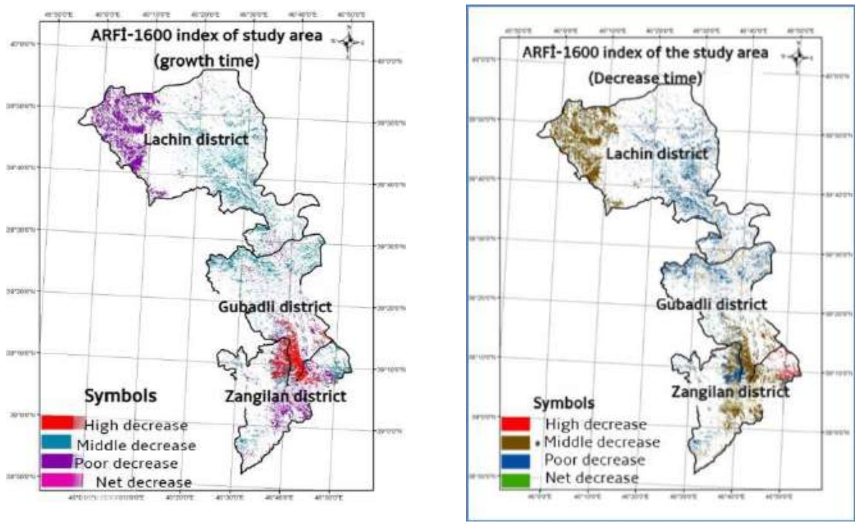

Figure 1. Areas with increasing and decreasing ARFI-1600 index in the study area

As we know, we have distinguished the increasing and decreasing areas. Let's examine the growing areas first.

Grade	For different years		Dynamics
	2000	2021	
Mountain views, sand, snow	6,1	11,42	5,32 ↑
Water	0,72	7,76	7,04 ↑
cut down area	388,4	3772,89	3384,49 ↑
Bushes and pasture	4292,88	3965,77	327,11 ↓
Bare and sparse trees and shrubs	1682,19	4,89	1677,3 ↓
Strong dense vegetation (shrubs)	1274,04	3,18	1270,86 ↓
Strong dense vegetation (forest)	119,46	0	119,46 ↓
Very strong dense vegetation (forest)	0,45	0	0,45 ↓

Based on the indicators shown in Table 1.1, let's make a histogram and show it in Figure1.2.

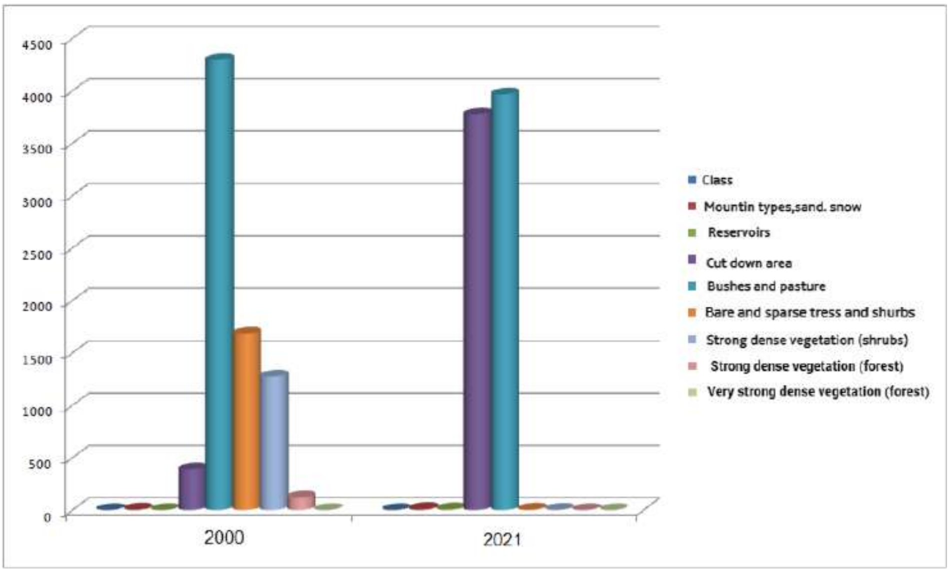

Figure 1.2. Histogram showing the NDVI index for 2000 and 2021 (growth in areas with high levels of aerosols) of the area indicators of the study area.

Based on the histogram presented in Figure 1.2, it can be said that in 2000, most of the area was shrubs and pastures, and in 2021, in addition to shrubs and pastures, the area of unforested areas increased. Bare and sparse trees and shrubs and strong dense vegetation (shrubs) have decreased compared to 2021.

Now let's look at the reduction of areas with high aerosol content.

Grade	For different years		Dynamics
	2000	2021	
Mountain views, sand, snow	26,05	8,11	17,94↓
Water	3,11	110,58	107,47 ↑
cut down area	1425,41	449,19	976,22 ↓
Bushes and pasture	506,16	1230,36	724,2 ↑
Bare and sparse trees and shrubs	7,57	55,26	47,69 ↑
Strong dense vegetation (shrubs)	4,09	82,85	78,76 ↑
Strong dense vegetation (forest)	0,27	37,74	37,47 ↑
Very strong dense vegetation (forest)	0	2,6	2,6 ↑

Let's display the field indicators presented in Table 1.3 in the form of a histogram in Figure 1.3

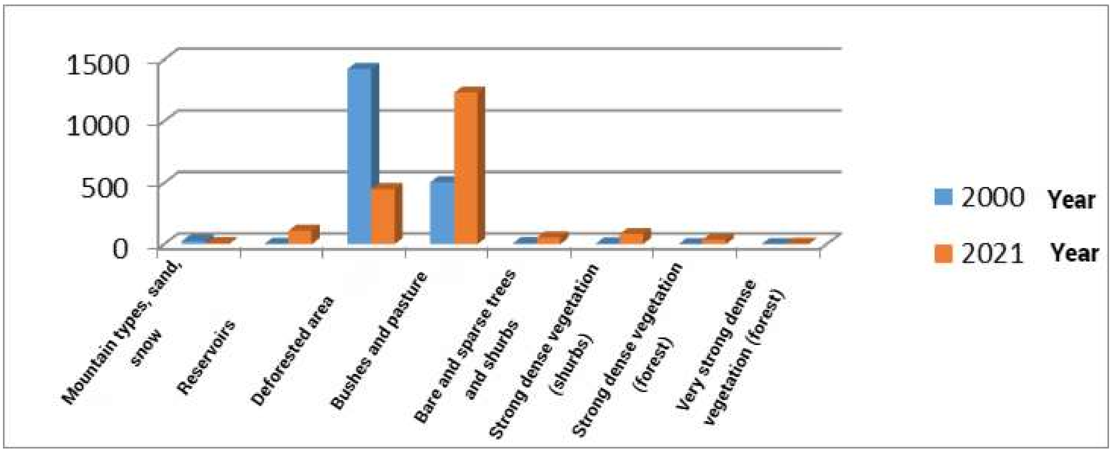

Figure 1.3. Histogram showing the field performance of the NDVI index (decrease in areas with high aerosol) of the study area in 2000 and 2021.

According to the inverted histogram, it can be said that the treeless area in 2000 changed to shrub and pasture in 2021; that is, the treeless area decreased while the shrub and pasture area increased. Summarizing tables 1.1 and 1.2, we will make table 1.4.

Table 1.4

Grade	İncrease	Decrease
Mountain views, sand, snow	5,32 ↑	17,94↓
Water	7,04 ↑	107,47 ↑
cut down area	3384,49 ↑	976,22 ↓
Bushes and pasture	327,11 ↓	724,2 ↑
Bare and sparse trees and shrubs	1677,3 ↓	47,69 ↑
Strong dense vegetation (shrubs)	1270,86 ↓	78,76 ↑
Strong dense vegetation (forest)	119,46 ↓	37,47 ↑
Very strong dense vegetation (forest)	0,45 ↓	2,6 ↑

Based on the figures in Table 1.4, an increase in areas with high aerosol means a decrease in the NDVI index, which reflects the forest cover, that is, a weakening of the forest cover.

Another object of study is the impact on the hydrological situation.

Table 1.4

Class (grid code)	**For different years**		**Dynamics**
	2000	2020	
1	1430,74	1556,91	126,17 ↑
2	391,01	338,61	52,4 ↓
3	152,75	130,87	21,88 ↓
4	76,64	67,44	9,2 ↓
5	41,52	34,87	6,65 ↓
6	31,55	27,67	3,88 ↓
7	5,58	5,11	0,47 ↓
8	1,9	2,1	0,2 ↑
9	0,07	0,02	0,05↓
10	0,1	0,03	0,07 ↓
General	**2131,86**	**2163,63**	**31,77↑**

We reflect the indicators presented in Table 1.4 in the form of a histogram in Figure1.5.

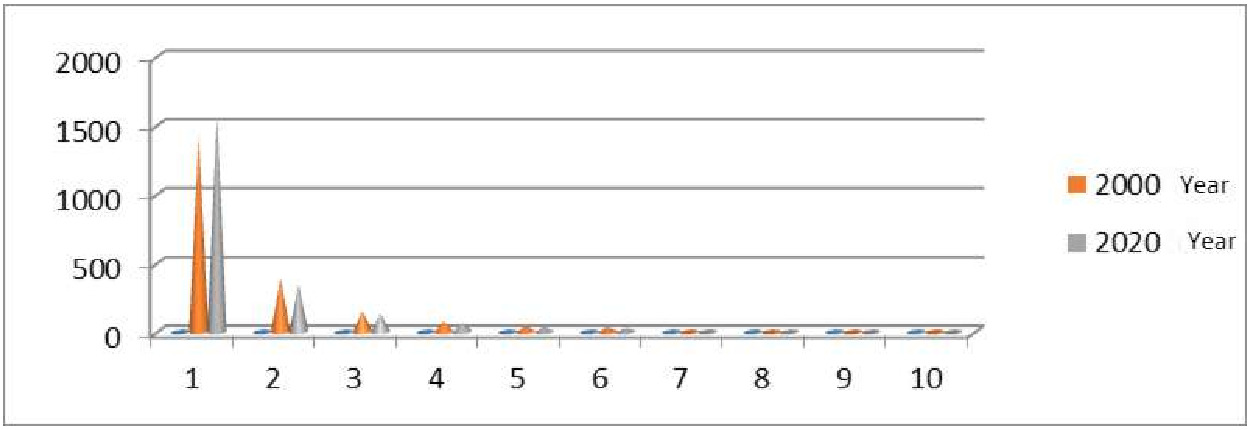

Figure 1.5: Histogram reflecting the hydrological state of the study area in 2000 and 2020 (with increasing areas with high aerosol) length in km

Based on the histogram shown in Fig. 1.5, we can say that when comparing 2000 and 2020, there was an increase in the river network of the 1st and 8th categories, while others decreased, but the total length increased by 31.77 km.

Let us now consider the effect of a decrease in areas with high aerosol on the hydrological situation.

Table 1.5

Class (grid code)	For different years		Dynamics
	2000	2020	
1	323,82	323,38	0,44 ↓
2	91,97	79,35	12,62 ↓
3	44,65	42,02	2,63 ↓
4	27,42	25,5	1,92 ↓
5	11,66	10,28	1,38 ↓
6	9,1	8,75	0,35 ↓
7	4,73	4,92	0,19 ↑
8	0,08	0,15	0,07 ↑
9	0,06	0,66	0,6↑
10	0,4	0,03	0,37 ↓
General	**513,89**	**495,04**	**18,86↓**

So, we will make a histogram based on the indicators indicated in Table 1.5 and present it in Figure 1.7.

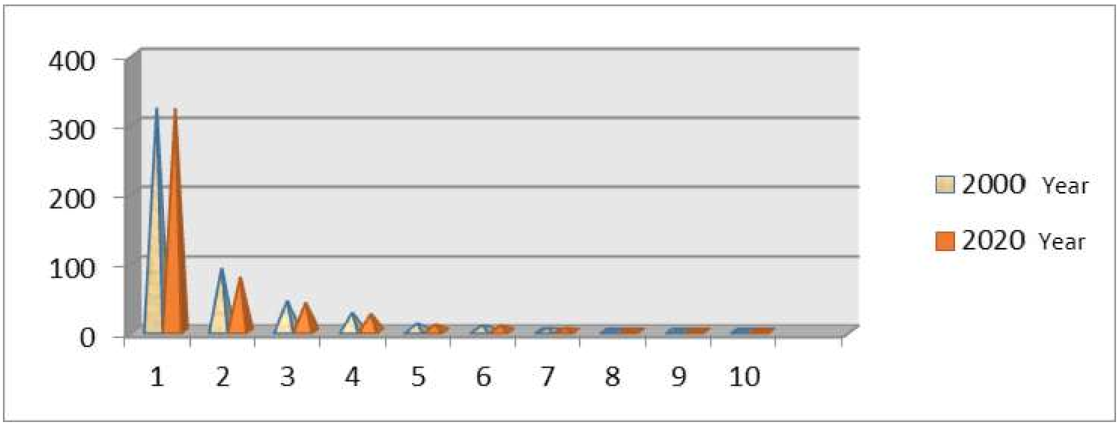

Figure 1.7: A histogram showing the hydrological condition of the studied area in 2000 and 2020 (to reduce the area with high aerosol) length in km

On the histogram presented in Figure 1.7, for classes 7, 8, and 9, growth in 2020 was observed, and a decrease in the rest of the classes, but a decrease in the length of the entire river network was observed. Summing up the obtained tables 1.4 and 1.5, we make table 1.6.

Table 1.6

Class (grid code)	For different years	Dynamics
1	126,17 ↑	0,44 ↓
2	52,4 ↓	12,62 ↓
3	21,88 ↓	2,63 ↓
4	9,2 ↓	1,92 ↓
5	6,65 ↓	1,38 ↓
6	3,88 ↓	0,35 ↓
7	0,47 ↓	0,19 ↑
8	0,2 ↑	0,07 ↑
9	0,05↓	0,6↑
10	0,07 ↓	0,37 ↓
General	**31,77↑**	**18,86↓**

RESULT

Summarizing the above, the following results are obtained: according to the indicators of 2000 and 2001, the area without forests decreased, while the areas of shrubs and pastures increased, the increase in areas with high aerosol content caused a decrease in the NDVI index. , which reflects the forest cover, i.e. the weakening of the forest cover. The high total length increases with increasing aerosol areas, and decreases with its decrease, and these results show that an increase in aerosol areas is required to expand the river network.

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SOIL ASSESSMENT AND AGROECOLOGICAL CONDITIONS OF THE ECONOMIC REGIONS OF AZERBAIJAN

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The presence in Azerbaijan of 9 out of 11 climatic zones of the world has led to the formation of more types of soils and various agro-ecological conditions. According to the vertical location of the land and the plasticity of the relief, mountain-meadow, mountain-meadow forest, mountain-snow, mountain-brown, mountain-yellow, mountain-brown, mountain-chestnut, chernozem, brown, chestnut, brown, gray, gray-meadow , alluvial-meadow, floodplain-meadow and swamp lands. On the territory of economic regions, there are 31 types of soils, 55 subtypes and their species diversity 1629. From the assessment of soil fertility, it is known that the most fertile are washed and carbonated mountain black (100 points), mountain chernozem (98 points), mountain meadow (89 points). points), pseudopodzolic-gley - yellow (94 points), mountain-forest meadow and typical mountain-forest - brown (87 points). When assessing the natural fertility of the soil, the stock of humus, total nitrogen and total phosphorus (t / ha), absorbed bases in the 0-20, 0-50 and 0-100 cm soil layer, which has a close and good correlation with the biological productivity of cultivated agricultural plants (c In accordance with the increase in these indicators, credit scores should be increased. There are also soil indicators (deterioration of the granulometric composition and the amount of salts), their excessive increase leads to a decrease in the fertility and productivity of cultivated agricultural plants. At this time, the increase in these indicators should be reduced in proportion to credit scores. The optimal level of soil reaction and carbonization determines fertility and productivity. Decreases and increases from the optimal indicator equally and negatively affect the decrease in fertility and the decrease in plant productivity. The agro-ecological conditions of the country and its individual economic regions have been studied, and for the first time an assessment of agro-ecological indicators in terms of soil fertility has been given. In addition, agro-ecological characteristics of economic regions, plastics, water bodies, flora and fauna, and cultivated crops are widely reported. According to the results of soil and agro-ecological conditions of Sheki-Zakatal (100) and Guba-Khachmaz (99) economic regions are more favorable for agricultural production. The soils and agro-ecological conditions of the Baku (46) and Absheron-Khizi (59) economic regions are extremely unfavorable for agricultural production.

Keywords*: economic region, soil, agro ecological, flora, fauna, agriculture, fertility*

INTRODUCTION

Despite the fact that Azerbaijan is considered one of the small-earth countries, the soil and vegetation cover of its territory is very variegated. According to some world researchers, 9 out of 11 climatic zones of the world are located here. Some climatologists and geographers believe that there are only 3 climatic zones in Azerbaijan. According to the vertical arrangement of climatic zones from the high-mountain zone to desert and semi-desert zones, all types and subtypes of soils are common. 31 soil types and 55 subtypes and 1629 varieties of them have been identified in Azerbaijan (Aliyev H.A., 1964; Volobuyev V.R., 1973; Kovalyov R.V., 1966; Salayev M.E., 1966; Hasanov Sh.H., 1978; Mammadov G.Sh., 2002, 2003; Babayev M.P., Hasanov V.H., Jafarova Ch.M., Huseynova S.M., 2011; Sharifov E.F., 1984).

MATERIAL AND METHODS

When assessing the natural fertility of the soil, the reserves of humus, total nitrogen, total phosphorus and potassium (t/ha), the amount of absorbed bases (cations $Ca^{\cdot\cdot}$, $Mg^{\cdot\cdot}$, $Na^{\cdot}$ and $H^{\cdot}$) amount in 100 g of absolutely dry soil in mg.eq in 0-20, 0-50 and 0-100 cm soil layer, which has a close and good correlation with the biological productivity of cultivated agricultural plants. These soil indicators play a key role in shaping the productivity of all agricultural and fodder crops cultivated in Azerbaijan on summer and winter pastures. In addition, when assessing the natural fertility of some soils, the amount of nitrogen, phosphorus and potassium, the level of soil reaction (pH), indicators of exchangeable and hydrolytic acidity are also used as criteria (Ahadov D.R., 2022).

RESULTS AND DISCUSSION

The territory of the country is divided into 14 economic regions. In the formation of economic regions, regional, soil-climatic, agroecological conditions, integration of infrastructures, local uniqueness, compatibility of agricultural production and other factors are taken into account. The direction of our research is the systematic assessment of soil cover and agroecological conditions by economic region. Chestnut soils (1.36 million ha), floodplain alluvial-meadow (1.11 million ha), brown (0.9 million ha) and gray-brown (0.85 million ha) soils predominate in all economic regions of the country. Mountain lands, which are located in the highlands, mountains and foothills of the territory of Azerbaijan, account for 31.3% of the total land fund (3.0 million hectares). Mountain soils were formed in the Higher and Lesser Caucasus and in Talysh. Mountain soils are mainly distributed in the East Zangazur, Garabagh, Ganja-Dashkasan, Shaki-Zagatala, Guba-Khachmaz and Lankaran-Astara economic regions (table 1).

The presence of large water basins in Azerbaijan created conditions for the formation and distribution of alluvial-meadow soils along these rivers. Around the rivers Araz, Kur, Arpachay, Samurchay, Gilgilchay, Katehchay, Mukhagchay, Goshgar, Gargar, Tartarchay, Hakari, Bargushad, Vilash and their tributaries, floodplain alluvial-meadow and meadow-forest (tugai) occupy large areas, and these lands are used in agriculture, which has more fertile conditions for growing different plants. Such lands were formed mainly in the territories of the Guba-Khazmaz, Shaki-Zagatala, Mountain Shirvan, Central Aran, Mil-Mughan and Garabagh economic regions (table 2).

Employees of the Department of Agroecology and Soil bonitet of the Institute of Soil Science and Agrochemistry under the leadership of Academician Garib Mammadov compiled an electronic map of soils based on GIS technologies, taking into account relief plasticity (2023). The assessment of the soils of Azerbaijan, including the soils of certain economic regions, shows that the highest quality soils are mountain leached and calcareous black soils (100 points), mountain-black typical (98 points), mountain-meadow soddy soils (89 points), pseudopodzolic-gley yellow (94 points), mountain-forest soddy and mountain-forest brown typical (87 points). The main quality scale of soils of the country was developed by Academician G.Sh.Mammadov (2003). High quality soils are 20.1% (1.73 million ha) of the total land fund (table). For the first time, based on the results of soil analyzes of recent years in office conditions, the main quality scale of soils in the economic regions of the country was compiled. Among the soils of the highest quality in certain economic regions and rated at 100 points on the main bonitet scale, leached and typical mountain black in Absheron-Khizi and Gazakh-Tovuz regions, mountain-meadow soddy soils in Guba-Khachmaz and Garabagh, mountain-black calcareous in Shaki-Zagatala and Mountain Shirvan, Central Aran and Mil-Mughan floodplain and carbonate meadow-forest (tugai) soils. In the indicated economic regions, the main agricultural crops are grown on these soils.

The indicators of the reaction of the soil environment were used in the assessment of mountain yellow soils, pseudopodzolic yellow, yellow soils, pseudopodzolic-gley yellow soils, mountain brown soils in the transitional stage to the yellow soils of the Lankaran-Astara economic region. The researchers found that some mountain soils, especially those located in the Alzian and Subalzian zones, the thickness of the soil layer and the degree of skeletal structure play an important role in the formation of the yield of agricultural plants, were taken by the researchers as criteria when evaluating some soils of the Garabagh, East Zangazur, Ganja-Dashkasan, Guba-Khachmaz and Shaki-Zagatala economic regions, especially soils located in high and mid-mountain regions plays an important role. Granulometric composition, degree of salinity, carbonate content, level of gleying (Eh), level of irrigation, cultivation, etc. were used as correction factors in assessing the open scale of soils, i.e., the smallest taxonomic unit of soil. A special role in the formation of the natural fertility of the soils of the Shirvan-Salyan, Mil-Mughan, Central Aran economic regions is played by the irrigation factor (Volobuyev V.R., 1973; Babayev M.P., 1998). These lands were formed mainly in the territories of the Guba-Khazmaz, Shaki-Zagatala, Mountain Shirvan, Central Aran, Mil-Mughan and Garabagh economic regions (table 2).

Table 1.

Areas and soil bonitet scores in Azerbaijan

№	Soil types and subtypes	Area, ha	Points
1	Mountain-meadow primitive and peaty (Haplic Leptosols skeletik)	204.565	<20
2	Mountain meadow sod (Humic Umbrisols)	267.070	89
3	Mountain black	18.156	98
4	Mountain meadow black	60412	90
5	Mountain black leached and typical (Vivic Chernozems typical)	66.962	100
6	Mountain black carbonate (Calcic Chernozems)	49.584	86
7	Mountain meadow-steppe	62.876	72
8	Mountain-forest meadow (Phacozems)	84.932	87
9	Mountain-forest dark brown carbonate and sod (Haplic Cambisols)	19.806	76
10	Mountain forest dark brown typical (Haplic Cambisols)	353.026	87
11	Mountain-forest dark brown residual carbonate and partially steppe (Livic Cambisols)	150.828	76
12	Mountain forest yellow soil (Luvisols, Lixisols)	21.505	68
13	Mountain forest yellow soil typical (Plithic Lixisols)	4.661	65
14	Mountain-forest pseudopodzolized yellow soil (Alic, Gleyic Lixisols)	29.482	79
15	Mountain forest brown typical	278.153	85
16	Mountain-forest brown carbonate and partly steppe (Calcic Kashtanozems)	241.436	69
17	Mountain forest brown leached (Livic Kashtanozems)	311.932	84
18	Mountain chestnut dark and ordinary	412.954	65
19	Mountain chestnut partly humus-sulfate (gaseous) and unripe	232.233	59
20	Mountain grey-brown mountain typical (Mollic Kashtanozems)	53.874	63
21	Mountain grey-brown light (Haplic kashtanozems)	82.074	45
22	Gray-brown dark and ordinary (Calcic Kashtanozems)	265.634	69
23	Meadow-brown typical and carbonate (Gleyic Kashtanozems)	69.168	85
24	Sulphurous and gray-brown, partially saline	343.314	62
25	Light chestnut partially salted	280.846	53
26	Chestnut dark and regular	389.523	80
27	Chestnut humus-sulfate	41.638	61
28	Pseudopodzolized yellow soils	28.570	78
29	Pseudopodzolized-gleyed yellow soils	25.631	94
30	Meadow-gray	547.470	79
31	Gray typical	108.377	66
32	Gray dark	95.321	82
33	Gray light and primitive	230.642	44
34	Meadow-gray high-humus	187.835	79
35	Meadow-gray medium and low humus	277.303	68
36	Meadow-forest leach and carbonate (tugai)	290.756	75
37	Meadow-chestnut and chestnut-meadow	96.697	56
38	Meadow-marsh and swampy	231.302	71
39	Floodplain alluvial-meadow	1.075.946	63
40	Salt marshes (alluvial, deluvial and stork)	25.137	<20
41	Typical salty	6.755	<20
42	Takyrs and takyr-like soils	11.843	<20
43	Bare rocks and superficial silos	338.629	<10
44	Sands	91.492	<10
45	River basin with river stones	55.756	<10
46	Rivers, lakes, reservoirs and swamps	533.371	<10
	Total:	**8.655.481**	**70**

Particular attention in assessing the properties of soil fertility should be given to three points. An increase in the indicators of some soil properties (reserves of humus, nitrogen, phosphorus, potassium, the thickness of the arable layer and the amount of absorbed bases) stimulates the growth of fertility and plant productivity. In accordance with the increase in these indicators, the bonus points should be increased. There are also such soil indicators (deterioration of the granulometric composition and the amount of salts); their excessive increase leads to a decrease in fertility and crop yields. At this time, the increase in these indicators leads to a decrease in the bonitet points proportionally. There are some soil indicators, which their optimal level (the reaction of the soil environment and carbonate content) determines the fertility of the soil and the productivity of agricultural and natural crops). Decreases and increases from the optimal indicator equally and negatively affect the decrease in fertility and plant productivity. Deviation from the optimal indicator leads to a decrease in the quality score. This approach was first used in assessing the soils of the humid subtropics of Azerbaijan (Ahadov D.R., 1979; Ahadov D.R., 2022).

The presence of large water basins in Azerbaijan created conditions for the formation and distribution of alluvial-meadow soils along these rivers (table 2). The basin of the Araz, Kur, Arpachay, Samurchay, Gilgilchay, Katechchay, Mukhachay, Goshgar, Gargar, Tartarchay, Hakari, Bargushad, Vilash rivers and their tributaries floodplain alluvial-meadow and meadow-forest (tugai) occupy large areas, and these lands are used in agriculture, has more fertile conditions for planting.

The ecological conditions of the territories of economic regions are diverse, as are the soils. There are 9 climate zones in total. The cold alpine and subalpine climatic zone of the East Zangazur, Guba-Khachmaz economic regions is changing to a hot and dry climate in dry deserts and semi-deserts of the Shirvan-Salyan, Central Aran and Mil-Mughan economic regions. If the average annual air temperature in the high-mountain zone is 10.7°C in Eastern Zangazur and 11.0°C in Guba-Khachmaz, then in Central Aran it is 14.9°C, and in Shirvan-Salyan, located on the plains and plains, 14.4°C. Soil surface temperature is 17.8°C in Shirvan-Shaki and 18°C in Mil-Mughan, while in Eastern Zangazur it drops to 12.3°C. The absolute average annual minimum air temperature is 8.6°C in Central Aran, 9.2°C in Shirvan-Salyan, the absolute average annual maximum temperature is 41.6°C in Central Aran. The lower limits of the maximum average annual temperature are observed in Eastern Zangazur (36.8°C). If in the humid subtropics the amount of precipitation is 800-1300 mm, then in the Middle Aran it is only 190-230 mm. The annual rainfall in the economic regions of Azerbaijan also varies dramatically. If this figure is 946 mm in Shaki Zagatala, 847 mm in Lankaran-Astara, 281 mm in Shirvan-Salyan and 247 mm in Baku. In general, the largest amount of precipitation in Azerbaijan falls on the territory of the Astara region (1300 mm), and the least amount of precipitation falls on the territory of the city of Baku (247 mm). Along with precipitation, we also encounter evaporation contrasts. So, if the annual absolute average annual evaporation is 760 mm in Guba-Khachmaz and 796 mm in Shaki-Zagatala, then this figure increases to 1140 mm in Baku and 1128 mm in Nakhchivan (table 2).

Of exceptional importance in the maturation and high yield of agricultural plants is the value of the effective air temperature (the sum of temperatures above 10°C), as well as the fact that the plots are planted several times a year. Central Aran (4606°C), Shirvan-Salyan (4559°C) and Baku (4461°C) economic regions with the lowest average annual air temperature are Eastern Zangazur (3615°C) and Gazakh-Tovuz (3615°C).

Basins of large and medium-sized rivers Kur, Araz, Valvalchay, Bargushad, Hakari, Tartarchay, Arpachay, Karachay, Vilash, Samur, Girdiman, Demiraparanchay, Katehchay, Mazimchay, Bolgarchay, Goshgarchay, Gargarchay, Khachinchay and their numerous tributaries passing through the territory of economic regions, played an important role in the formation of relief plasticity. Due to the soil and climatic conditions, the flora and fauna of Azerbaijan is distinguished by its such as brown bear, lynx, wolf, fox, jackal, gazelle, roe deer, wild boar, badger, mountain goat. In the formation of agroecological conditions, along with soil-climatic elements, an important role is also played by the wildlife of the area and naturally growing trees and shrubs, as well as perennial and annual grasses and fodder plants. The richest fauna of Azerbaijan is found in the East Zangazur, Garabagh, Ganja- Dashkasan, Guba-Khachmaz and Shaki-Zagatala economic regions.

Table 2

Assessment of agro ecological indicators of economic districts of Azerbaijan

Economic district	Ecological indicator	Average annual air temperature, in °C	Average annual absolute minimum air temperature in °C	Annual absolute minimum temperature of the air, in °C	Annual absolute maximum air temperature, °C years	Average annual land temperature, in °C	Annual amount of temperature above 5° C, in °C	Annual amount of temperature above 10 °C, in C	Average annual relative humidity of the air, in %	Annual amount of precipitation, in mm	Rainy; gwnlarin annual amount;	Annually available evaporation, in mm	Average annual wind speed, mm/sec.	Annual number of days w ith strong winds (>15 m/s	Number of snow-covered days per year	Annual number of hail days	The average credit score of the lands	Agricological price point	Correction coefficients: Look at the watering conditions	Correction coefficients: According to the condition of the flora	Correction coefficients: According to the condition of the fauna	Price score of economic district's economic viability
I.Baku	Indicators	14,4	-5	-13	40	17	5013	4461	70	247	74	1140	6,3	67	7	0,4	71	75	0,5	0,5	0,5	46
	Estimates score	81	54	71	96	79	99	97	99	29	73	50	0	12	20	67						
2. Absheron-Khizi	Indicators	12,4	-13,7	-18	41,3	16	4303	3880	75	351	-	941	5,4	57,7	26,3	0,09	76	84	0,6	0,6	0,6	59
	Estimates score	95	52	98	93	86	85	84	95	41	-	76	50	0	76	30						
3. Guba-Khachmaz	Indicators	11,0	-14	-22	39,4	14,4	12,4	-3380	-18	413	16	760	2,94	21,8	29,4	0,3	91	93	0,8	1,0	0,9	99
	Estimates score	85	48	80	98	97	85	84	94	54	85	100	12	40	85	100						
4. Sheki-Zagatala	Indicators	12,1	-11,8	-23,2	36,8	14	4222	3818	62,2	946	98,5	796	1,3	6,3	34,4	1,5	88	98	0,9	1,0	0,8	100
	Estimates score	93	72	75	96	100	86	83	87	82	97	76	54	83	100	20						
5. Gorno-Shirvan	Indicators	11,6	-10,8	-18	38	14,3	4095	3817	71,8	572	108	962	2,4	14	29,3	1,6	87	95	0,7	0,9	0,9	93
	Estimates score	83	83	98	99	98	81	83	99	62	93	73	100	26	85	18						
6. Central Aran	Indicators	14,9	-8,6	-20,1	41,8	17,1	5054	4606	70,3	418	84,8	1001	2,37	11,3	10	0,52	85	90	1,0	0,5	0,6	76
	Estimates score	85	93	90	91	78	100	100	99	49	84	68	99	21	92	37						
7.Shirvan-Salyan	Indicators	14,4	-9,2	-22,4	40,8	17,8	5045	4559	73	281	75	1014	3,54	20	7,8	0,24	63	84	1,0	0,6	0,5	65
	Estimates score	81	100	78	94	73	96	99	93	33	74	67	15	31	23	80						
8. Mil-Mugan	Indicators	14,0	-11	-22,7	40,8	18	4938	4473	73,8	303	72	954	2,75	16,7	11	0,33	90	89	0,8	0,6	0,5	69
	Estimates score	82	80	86	94	71	98	97	96	26	71	75	85		20	88						
9. Ganja-Dashkesan	Indicators	11.8	-12.7	-20.3	36.0	11.0	4267	3810	69	367	86	1000	2,95	20,5	30,3	2,15	95	88	0,8	0,9	0,7	89
	Estimates score	91	62	89	94	79	84	83	97	43	85	68	77	38	88	15						
10 . Gazakh-Tovuz	Indicators	11,3	-12,8	-24,2	38	14	4038	3615	71	476	101	849	2,18	21	25,6	2,22	100	94	0,8	0,8	0,7	92
	Estimates score	87	69	68	99	100	80	78	100	56	100	88	91	39	88	12						
11. Karabakh	Indicators	12,6	-10,5	-19,1	38,9	15,3	4384	3644	68,6	443	94,4	810	2,0	5,4	17,6	2,1	100	95	0,7	0,8	0,9	96
	Estimates score	97	86	96	91	81	87	79	97	52	93	93	87	100	51	14						
12. East Zangezur	Indicators	10,7	-13,2	20,8	36,8	12,2	3811	3351	65	521	91	835	2,6	8,2	40,4	1,9	95	93	0,6	0,8	1,0	92
	Estimates score	82	57	76	94	88	75	73	92	68	90	90	92	49	87	40						
13. Lenkoran-Astara	Indicators	13,0	-9,2	-18,3	38,5	15,3	4521	4007	76,7	847	115	841	2,4	11,5	23,3	0,72	83	100	0,8	0,7	0,8	88
	Estimates score	100	100	100	100	81	89	87	92	100	86	89	100	21	36	50						
14. Nakhichevan	Indicators	11,8	-16,9	-28,5	41,5	15,6	4410	4080	58,9	335	74	1128	2,2	7,0	40,6	2,1	74	81	0,7	0,6	0,7	65
	Estimates score	91	17	44	92	89	87	89	83	40	73	57	42	97	82	37						

In addition to wildlife, wild animals squirreland rabbit live in these areas. The birds on the territory of the economic region, there are eagles, falcons in the highland zone, as well as owls, thrushes, pheasants, partridges, goldfinches, golden duck, golden goose, white vulture, black grouse, sultan bird, etc. in the lower parts meets. In livestock breeding, Baku, Absheron-Khizi, Central Aran, Mil-Mughan, Shirvan-Salyan economic regions are very poor. Although the animal world in these parts is poor, it is rich in a variety of birds, mainly commercial ones. Among them are tern, partridge, pheasant, golden duck, and golden goose.

CONCLUSION

The territory of most economic regions of Azerbaijan has rich vegetation. Of particular note is the diversity of the flora of the Guba-Khachmaz, Shaki-Zagatala, Garabagh, Ganja-Dashkasan and Lankaran-Astara economic regions. In these areas, specimens of various relict trees and shrubs, as well as fruit and berry plants growing in natural conditions, are distributed over vast territories. In addition, important representatives of the flora are herbs and forage plants of various formations. Vegetation creates conditions for a healthy ecology and an abundance oxygen in the atmosphere. Forests are of great importance for the survival and development of people and other living beings, acting as the lungs of nature. In the forests there are pine, fir, birch, oak, poplar, linden, amazin, walnut, barberry, chestnut, apple tree, pear, cherry, blueberry, sycamore, hawthorn, alder, cypress, alder, willow, elm, mulberry, beech, blackthorn, blackberry, wild rose, azgil, persimmon, cherry plum, peanut, dogwood, sucker, etc. mulberry plants are common. In these forests, there is also an iron tree (especially in Lankaran-Astara), the names of which are listed in the Red Book. Among grasses and fodder plants in these economic regions, watercress, fodder, and sedge grow in large arrays. Unlike mountainous and foothill areas, dry subtropics are classified as deserts, semi-deserts, etc. In these forests, there is also an iron tree (especially in Lankaran-Astara), the names of which are listed in the Red Book. Among grasses and fodder plants in these economic regions, watercress, fodder, and sedge grow in large arrays. Unlike mountainous and foothill areas, dry subtropics belong to deserts, semi-desert climates.

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THE LAND BELONGS NOT ONLY TO US, BUT ALSO TO FUTURE GENERATIONS

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In recent years, the development of technical progress has reached such a high level that its various areas have an extreme impact on the stability of the biosphere. Maximum use of natural resources has led to global changes in climate. Pollution of land, water and air all over the world is now causing people to sound the alarm all over the planet. In particular, the development of the chemical industry is considered the most important culprit of the environmental crisis. The achievements of a number of sciences are also applied to production with the help of chemistry.

Keywords: *biocenoces of the soil, ecological problems, genetic engeneering, pollution of atmosphere, pollution of the soil, soil protection, soil erosion*

INTRODUCTION

We can include wars, urbanization, nuclear energy production , human habits etc. in this list. This makes it necessary to study the lands of our republic ecologically in a comprehensive and complex way. Soil has animate or inanimate properties and its most important property is its fertility. However, it is believed that a large percentage of the land in the world is very low-yielding land. It takes a lot of work and investment to make them productive. Creation of cities and villages, construction of roads, soil erosion by wind, water, detergents, household waste salinization, swamping etc.

That is why, every year, 5-7 million hectares of land become useless and are taken out of use.

The chemical composition of soil should be studied in comparison with its biocenosis.

Its primitive creatures - microorganisms should be studied in depth. In our republic, biological science must be studied the biocenosis of our soil, the interactions of the living world concentrated in it, the chemical substances in the soil: fertilizers, herbicides, pesticides, etc., in short, all its regularities in a complex way.

Qualified specialists in soil microbiology and their work in this field should be expanded on a large scale and soil monitoring should be done daily. This is important to see the quantitative and qualitative difference between yesterday's and today's microbiocenosis.

For many years, people have been cold-bloodedly using chemical substances without observing the agrochemical rules, without feeling responsibility.

Since the self-cleaning ability is limited, the natural resistance of our soil is broken, its biological activity decreases, and its fertility gradually decreases .

EXPERIMENTAL DETAILS

If we take into account that industrial household waste is also buried in the ground, the continuous decomposition-burning processes not only poison our soil, but also the harmful substances created by these processes poison our water and air. Every inch of our land, which we call black gold, is becoming unusable due to neglect. Every year, fruits, vegetables, and melon plants unique to our area have not kept their previous quantity and quality. If we look at the experience of developed countries, we shall see that "landless" countries like Japan and America try to get the maximum yield from every inch of cultivated land. In agriculturally advanced Europe, the achievements of biotechnology science, especially genetic engineering, are used instead of chemicals used against pests. In addition, preventing the soil from becoming unusable, it also helps to achieve high stable productivity to harvest several times a year, thanks to the genes added, to obtain a product with high resistance to various pests, for growing plants resistant to environmental conditions – cold, drought, salinity, It serves economic efficiency as it brings out resistance to diseases, herbicides and medicines.

It is true that along with the positive aspects of trans gene products, its negative manifestations also cause disputes among the world scientists. Because the effect of these products on living organisms, including human health, has not been fully studied yet. The reason is that the effect of genetically modified products on the body lasts for many years. This makes it difficult to examine such an effect.

In any case, if we take into account plants such as tomatoes , cucumbers, and watermelons , which are 2-3 times larger than their natural size , melons inflated with nitrogen fertilizer, I don't think that all this leads to damage to the muscles, kidneys, liver, and nervous system. It poisons both the soil and our body. Such chemicals also lead to the generation of mutations in the genetic apparatus of people and their transmission to subsequent generations .

Land protection is considered to be the protection of the state's economic power. The land belongs not only to the present, but also to future generations. Therefore, protecting it is the most important duty of each of us.

For many years, our land was crushed under the enemy's foot. Our territories under Armenian occupation were subjected to chemical and biological pollution as a result of their atrocities. The tools used in the mountains during the military operations in those areas, the burning of forests and agricultural fields, the discharge of sewage into these areas, and the planting of narcotic plants in the place of the forests are clear examples of Armenian vandalism. This has led to the change of fauna and flora of those areas. One of the ecological terrors carried out by Armenians is the fires carried out on the lands of Azerbaijan. Unique oak, beech, walnut, birch, walnut, oriental sycamore were cut down and transported to the territory of Armenia. According to the calculations, approximately 8-10 percent of the forest areas were destroyed.

The owners of the land are the nations who use it efficiently and with care. That's why our grandfathers said "there is no share in the land".

Thanks to the "Iron Fist" operation of our president Mr. Ilham Aliyev, who is a worthy follower of the policy founded by our great leader Haydar Aliyev, we were able to experience the pride of being the citizens of the victorious country. Construction works are being carried out on these lands, and the works for the restoration of the fauna and flora of our lands will bear fruit over time.

The measures implemented by our state in the environmental field are commendable. The foundation of these works was laid by Haydar Aliyev from the first years of our independence. It was on his initiative that the state of Azerbaijan joined the most prestigious international conventions on solving environmental problems, signed bilateral and multilateral agreements.

CONCLUSION

International cooperation in solving global problems of our state is continued by Mr. Ilham Aliyev at present, the successor of his political legacy. Various state programs designed for the protection of greenery, water bodies, and the atmosphere, as well as greening actions carried out every year, are a clear example of this.

The system of important measures implemented in the field of soil protection is as follows.

1. Implementation of the Republic and international regulations on land use.
2. Drawing up the land cadastre and establishing state control over land use.
3. In addition to the right to use the land given to farms as they wish, they should be responsible for the productivity of those lands.
4. Development and implementation of an effective system of measures against soil erosion, soil salinization and marshland conversion, land reclamation based on a long-term program.
5. Fertilization of soil is based on scientific evidence and meets modern environmental requirements.
6. Continuous improvement of agrotechnical care of the land, taking into account the characteristics of a specific zone and region in the process of land use.
7. Conducting a consistent and effective fight against physical, chemical, radioactive and biological pollution of the soil.

8. Protecting the vegetation which plays a role in the formation and protection of the soil, expanding their forest strips and their polycomposite principle.

Each of us is obliged to support the work of our state in our professional sphere. We must protect our fertile and reliable land, air and water. Because these blessings are not only ours, but also future generations.

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THE CURRENT STATUS OF UTILIZING SURFACE WATER RESOURCES IN THE KURA RIVER BASIN

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During modern times, the significant scientific importance lies in the pollution and problems caused by contaminants and pollutants in natural components, particularly water resources. In this context, the article explores the issues arising from the utilization of surface water resources in the Kura River basin, which serves as the main water artery in Azerbaijan, a country with limited water resources. The article also analyzes the current status of utilizing the Kura River basin for various purposes.

A comprehensive evaluation of Azerbaijan's surface water resources, particularly those in the Kura River basin, was conducted before assessing the surface water resources in terms of their exploitation for economic activities, including the assessment of the availability of water resources required for domestic and agricultural use. The analysis revealed that 68% of Azerbaijan's total water resources (31 thousand cubic kilometers) are transboundary, with a significant portion flowing through the Kura River basin. The location and significance of the Kura basin within the water balance were also determined.

The analysis indicates that 44 out of 63 districts in Azerbaijan, accounting for 69.8%, 55 out of 78 cities (70.8%), 147 out of 261 towns (56.3%), and 2899 out of 4248 rural settlements (68.2%) are located within the Kura River basin and are actively engaged in various activities. The Kura River basin also holds great economic importance for agricultural activities in Azerbaijan. Research conducted in 2017 revealed that 81.6% of the total cultivated area, 77.8% of irrigated and rain-fed crops, 97.6% of technical crops, and 95.9% of cotton cultivation areas in Azerbaijan fall within the Kura River basin. It is noteworthy that in the arid climate zone of the Kura basin, more than 99.8% of the total cultivated area is used for irrigation agriculture.

The analysis also highlighted the significant role of the Kura River basin in ensuring food security, with 77.8% of cultivated land for cereal and mixed farming, 55.6% for meat production, and 73.3% for water production being attributed to the basin. This emphasizes the strategic importance of the basin in terms of water resources and territorial considerations for the Republic. The analysis further underscores the need for the effective utilization of the basin's water resources, elimination of potential risks in the context of global climate change, and the development of a comprehensive utilization strategy in collaboration with the countries of the South Caucasus region, given its location in the downstream part of the Transcaucasian region.

Keywords*; surface water resource, basin, climatic changes, transit river, river flow, The South Caucasus region, hydrological observation, ecological flux, water scarcity, anthropogenic factors*

INTRODUCTİON

Azerbaijan's water reserves are limited compared to other countries in the South Caucasus, accounting for only 15% of the total water resources in the entire region. The total water reserves in the Caucasus amount to 310 billion cubic meters, and Azerbaijan has the lowest per capita water share among neighboring countries. This is primarily due to the different geographical distribution of water sources in Azerbaijan. The assessed water reserve of Azerbaijan is 30.9 billion cubic meters. According to the author, 33% of this reserve consists of domestic internal waters, while approximately 66-70% is formed by transboundary river flows. The contamination of the main water sources, the Aras and Kura rivers, by neighboring states further exacerbates the situation.

In recent years, the decrease in rainfall and the rise in average temperatures have led to a reduction in water reserves and increased aridity. All these factors affect the drinking water supply for the population and the irrigation water supply for the agricultural sector in the country. Therefore, researching the current state of utilizing surface water resources in the Kura River basin holds great importance.

RESEARCH

The Kura River is the largest transboundary river in the Caucasus. It flows through the territories of Turkey, Georgia, and the Republic of Azerbaijan, eventually emptying into the Caspian Sea. The Kura River receives numerous tributaries in all three republics as it flows from west to east and is extensively used for various purposes. As a result, the water resources of the Kura River undergo natural and anthropogenic transformations along its course. The source of the Kura River is located on the northeastern slope of the Kizil-Gedik Range in Turkey at an elevation of 2,740 meters above sea level. The river has a total length of 1,515 kilometers, and its basin covers an area of 86,000 square kilometers. Considering the Aras River basin, its basin area reaches 188,000 square kilometers (Imanov F.A., Alakbarov A.B.).

In total, five states are located within the Kura River basin, and the watershed area of the Kura River covers 188,000 square kilometers within their territories. Analysis of the materials shows that out of the total length of 1,515 kilometers extending from the territories of the Caucasian Republics, Turkey accounts for 11.5%, Georgia accounts for 34.5%, and Azerbaijan accounts for 54.1%. In terms of the watershed area, these figures correspond to 6.5% for Turkey, 40.4% for Georgia, and 44.1% for Azerbaijan. The analysis indicates that both in terms of the length of the river and the watershed area, Azerbaijan holds a significant position in this basin due to its specific gravitational coefficient and the importance of the watershed area (Table 1).

Table 1.

The length and catchment area of the Kura River in the Caucasus countries

№	The Caucasus Republics	The length of the Kura River (km)	The basin area of the Kura River (km^2)	The basin area of the Aras River, including its tributaries (km^2)
1	Republic of Turkey	174	5590	27548
2	Republic of Georgia	522	34740	34740
3	Republic of Azerbaijan	819	37960	56700
4	Republic of Armenia	-	7710	29800
5	Islamic Republic of Iran	-	-	39212
	Total	1515	86000	188800

The conducted analyses indicate that overall, 44 out of 63 districts in the Republic of Azerbaijan, or 69.8%, are located and operate within the Kura River basin. Similarly, 55 out of 78 cities, or 70.8%, 147 out of 261 towns, or 56.3%, and 2,899 out of 4,248 rural settlements, or 68.2%, are situated within the Kura basin and carry out their activities. As shown in the table, the following rivers belong to the Kura basin: Ganjachay, Kurekchay, Tartarchay, Aras, Ganix, Gabirri, Turyanchay, Goychay, Khramchay, Aghstafachay, Zayamchay, and Shemkirchay. Their lengths, watershed elevations, watershed areas, and average flow rates have been determined (1.8).

In terms of agricultural land use, the Kura River basin also holds great importance for the economy of the Republic of Azerbaijan. Research has shown that in 2017, 81.6% of the total cultivated area, 77.8% of irrigated and irrigated-crop cultivated area, 97.6% of the total technical crop cultivated area, and 95.9% of the cotton cultivated area belonged to the districts within the Kura basin. It should also be emphasized that in the arid climatic zone, more than 99.8% of the total cultivated area in the Kura basin is attributed to irrigated farming.

Table 2.

The morphometric and streamflow characteristics of the main branches of the Kura River located within the territory of the Republic of Azerbaijan

The name of the river	Republic, the location of the basin	The length of the river (km)	The catchment area (km^2)	The height of the catchment area (m)	The mean annual flow (m^3/s)
Ganix(Alazani)	Georgia Azerbaijan	413	12080	900	125
Gabirri(İori)	Georgia Azerbaijan	389	4840	810	15.9
Turyanchay	Azerbaijan	170	1840	819	17,9
Goychay	Azerbaijan	113	1770	538	14,4
Khrami	Georgia Armenia Azerbaijan	220	8340	1530	58,7
Aghstafachay	Ermənistan Azərbaycan	133	2586	1418	13,2
Zayamchay	Azerbaijan	90	942	850	5,84
Shemkirchay	Azerbaijan	95	1170	1634	9,25
Ganjachay	Azerbaijan	98	752	1119	5,12
Kurekchay	Azerbaijan	126	2080	508	7,57
Tartar	Azerbaijan	200	2650	1820	23,1
Aras	Turkey Iran	1072	102000	-	290

Note: Based on the information provided by F. Imanov and A.B. Alekberov.

In Azerbaijan, the productive livestock population, out of a total of 1.9 million, is distributed within the Kura River basin. This accounts for 71.02% of the total, including 967.47 thousand head of cattle and camels, which make up 74.3%, and 6.8 million sheep and goats, accounting for 78.23% of the total population. The high number of livestock indicates the significant importance of the Kura basin in the production of livestock products. Currently, within Azerbaijan, 165.6 thousand tons or 55.6% of the meat produced from slaughtered livestock, and 1.33 million tons or 73.3% of milk production, are derived from the Kura basin (5, 8, 14).

The analysis shows that the Kura basin plays a major role in ensuring the food security of the population of Azerbaijan. Specifically, 77.8% of the total cultivated area of cereal and cereal-legume crops, 55.6% of meat production, and 73.3% of milk production are attributed to the Kura basin. This further demonstrates the strategic importance of the basin for the country in terms of water resources and territory. These analysis indicators also highlight the necessity for the implementation of comprehensive strategies to make effective use of the water resources in the region, especially in the Zagatala Region of Azerbaijan, and to address the risks posed by Global Climate Change.

The main transboundary rivers that contribute to the surface flow in the region include Kura, Aras, Samur, Ganix, and others, with a total of 21 rivers. This allows for the assessment of the total volume of transboundary flow in the region.

The analysis indicates that in the Azerbaijan region, only 31% of the river flows in the 50% average water supply year are formed within the borders of the country. Correspondingly, this percentage decreases to 28.9% in the 75% moderate water supply year and further decreases to 27.7% in the 95% high-water supply year. The decrease of 3.4% in the river flow during relatively dry years confirms the complete dependence of the population, irrigated agriculture, and other economic sectors of the agricultural complex located in the arid climatic zone on the transboundary flow.

According to the information provided by the Complex Development and Placement of Productive Forces in Azerbaijan up to 2020, it is observed that in the republic's territory, during the 50% average water supply year, 31% of surface water is formed, and during the 75% moderate water supply year, it is 28.9%, while in the full drought year with 95% water supply, it amounts to 27.7%. As for transboundary rivers, during the full drought period, it reaches 72.3% (Table 3).

Table 3.

Surface water resources of Azerbaijan

Water resources of the rivers	***Average annual water flow (50% supply)***		***Relatively low-flow year (75% supply)***		***Completely dry year (95% supply)***	
	mln. m³	***As a percentage of the total***	***mln. m³***	***As a percentage of the total***	***mln. m³***	***As a percentage of the total***
Transit	21359	69	18963	71.1	17010	72.3
The formation in the area	9605	31	7720	28.9	6510	27.7
Total	***30964***	***100***	***26683***	***100***	***23520***	***100***

It should be noted that only 10% of the water reserves in the South Caucasus region belong to Azerbaijan, and Azerbaijan falls significantly behind other countries in the South Caucasus in terms of water resources per square kilometer of territory and per capita. For example, in Azerbaijan, there is 107 cubic meters per square kilometer of territory and 1.5 thousand cubic meters per capita, while in Georgia, these figures are 763 and 11.3 thousand cubic meters, and in Armenia, they are 222 and 3.2 thousand cubic meters, respectively (11, 12, 15).

All these indicators, when evaluated in terms of their impact on resources in the context of global climate change, allow us to predict the future challenges that the agricultural complex of the region may face. Analyses conducted by the Ministry of Ecology and Natural Resources of the Republic of Azerbaijan for the periods of 1961-1990, 1991-2000, and 2001-2015 confirm that the average temperature in the region has increased by 0.52°C compared to previous years, and there has been a 9.8% decrease in the average annual precipitation.

There is also a significant reduction in the area of mountain glaciers. Glaciers in Azerbaijan mainly form in the Greater Caucasus Mountains in the Baş Suayrıc and Yan Silsilə regions, at elevations above 3600-4000 meters. Over the past 70 years, the area of glaciers on mountain peaks has significantly decreased. Currently, glaciers cover an area of approximately 6.6 km^2, with a water reserve of 0.08 km^3. Glaciers are present in various locations, such as 3.6 km^2 in Bazarduzu peak, 1 km^2 in Bazaryurd, 0.5 km^2 in Tufandagh, and 1.1 km^2 in Shahdagh. In the Lesser Caucasus, there is only one glacier with an area of 0.15 km^2 in Gapicig Mountain. Considering the important role of glaciers in feeding rivers and regulating annual water reserves in the region, it is possible to anticipate the emergence of real water scarcity risks. Changes in the relief, climate, soil-vegetation, and geological conditions in Azerbaijan, as well as their interrelationships, have led to significant changes in the development of river networks. All the rivers in our country belong to the Caspian Sea basin, which is one of the largest closed basins in the world, and they are mainly grouped into three categories

- Rivers belonging to the Kura River basin (flowing from the left and right banks);
- Rivers belonging to the Aras River basin (flowing from the left bank);
- Rivers flowing into the Caspian Sea.

It should be noted that only 10% of the water reserves in the South Caucasus region belong to Azerbaijan, and Azerbaijan lags behind other South Caucasian countries in terms of water reserves per square kilometer and per capita. For example, while Azerbaijan has 107 cubic meters per square kilometer and 15,000 cubic meters per capita of water reserves, Georgia has 763 cubic meters per square kilometer and 11,300 cubic meters per capita, and Armenia has 222 cubic meters per square kilometer and 3,200 cubic meters per capita. These indicators, when evaluated in terms of their impact on resources under the conditions of global climate change, allow us to predict the potential challenges that the agricultural complex of the region may face in the future. Analysis conducted by the Ministry of Ecology and Natural Resources of the Republic of Azerbaijan for the periods of 1961-1990, 1991-2000, and 2001-2015 confirms that there has been an increase in average temperature by 0.52°C and a decrease in annual rainfall by 9.8% compared to previous years. There is also a significant decline in the area of mountain glaciers. In the territory of Azerbaijan, glaciers are mainly formed in the Greater Caucasus Mountains in the Upper Karabakh and in areas with elevations above 3,600-4,000 meters. In the past 70 years, the area covered by mountain glaciers has significantly decreased. Currently, the total area covered by glaciers is approximately 6.6 square kilometers, with a water reserve of 0.08 cubic kilometers. Glaciers cover 3.6 square kilometers on the Bazarduzu summit, 1 square kilometer on the Bazaryurd, 0.5 square kilometers on the Tufandag, and 1.1 square kilometers on the Shahdagh. In the Lesser Caucasus, there is only one glacier with an area of 0.15 square kilometers on the Gapicig Mountain. Considering the important role of glaciers in the feeding of rivers and the regulation of annual water reserves, it is possible to predict the emergence of a real water shortage threat. Changes in the relief, climate, soil-plant, and geological conditions of Azerbaijan, as well as their interrelationships, lead to significant changes in the development of river networks. All the rivers in Azerbaijan, which are part of one of the largest river basins in the world, the Caspian Sea basin, can be divided into three groups based on their geographical location: (1) rivers of north-eastern Azerbaijan, (2) rivers of the Absheron-Gobustan area, and (3) rivers of the Lankaran area. The rivers flowing from the northern and eastern slopes of the Lesser Caucasus Mountains join the Kura River, while the rivers flowing from the southern slopes of the Lesser Caucasus Mountains and the Nakhchivan Autonomous Republic flow into the Aras River. The rivers that originate from the Greater Caucasus Range and the Lankaran Mountains flow into the Caspian Sea. Out of a total of 8,359 rivers in the country, the majority, 7,861 rivers or 61.5%, belong to the Kura-Aras basin. The average annual water shortage in the country ranges from 4.5 to 5.0 cubic kilometers. Currently, the average annual water shortage is 3.7 cubic kilometers, and during low-water years, it reaches 4.75 cubic kilometers. Taking into account the mandatory water use from rivers for ecological, energy, and other purposes, the water shortage is estimated to be around 6.5-7.0 cubic kilometers. Alongside water scarcity, pollution and deterioration of water quality, particularly of transboundary rivers, in neighboring Armenia and Georgia, are significant factors exacerbating social and ecological tensions in the country. Azerbaijan has a long history of irrigation agriculture. Although irrigated lands account for one-third (1,424,000 hectares) of the country's fertile land areas, they provide about 90% of the agricultural products. More than one-third of irrigated lands (559,000 hectares), including 350,000 hectares with electric pumping stations, 68,000 hectares with diesel pump stations, and 141,000 hectares with subartesian wells, are irrigated through mechanical means. The development of irrigation agriculture in Azerbaijan began in the first half of the 20th century. If in 1913, a total of 5.5 million hectares of land were irrigated, through subsequent land reclamation activities, this figure reached 14.24 million hectares in 2017, of which 125,800 hectares are currently under occupation. Based on calculations considering climate changes, it is projected that the average flow of rivers in the region will decrease by approximately 23% during the period of 2021-2050 and by approximately 29% during the period of 2070-2100. In such conditions, it becomes evident that the total volume of Azerbaijan's surface water reserves, with 50% reliability, will range from 21,984 million cubic meters to 23,842 million cubic meters, which is lower than the current indicators of a complete dry year. Therefore, the inclusion of Azerbaijan in the list of regions that will potentially face water scarcity in the near future in the classifications conducted by the United Nations should be considered as a result of a vital analysis. The evaluation of Azerbaijan's surface water reserves has been done by different authors in various years (Table 4).

Table 4
Quantitative Indicators of Azerbaijan's Surface Water Reserves Calculated by Various Authors

Authors	Years	Total surface water resources (km^3)	Water resources, the formation in the area
S.H.Rustamov and R.M.Gashgay	1978	32,3	10,3
S.H.Rustamov and R.M.Gashgay	1989	30,9	10,3
State Hydrological Institute	1967	30,6	8,71
State Hydrological Institute	1977	30,6	8,00
The South Caucasian ETHMİ	1988	28.1	7,81
H.Y.Fatullayev	2002	30,3	10,3
F.A.İmanov and A.B.Alakbarov	2017	30,9	10,3

Therefore, S.H. Rustamov and R.M. Gashqay's data from 1978 and 1989, water reserves amounted to 30.9 km^3. According to H.Y. Fatullayev's data from 2002 and 1996, water reserves were estimated at 30.6 km^3. Past data from the Transcaucasian Scientific Research Hydrometeorological Institute (ETHMI) in 1988, based on information from 1975, indicated water reserves of 28.1 km^3. It should be noted that the results obtained by S.H. Rustamov and R.M. Gashqay are almost identical to the findings of H.Y. Fatullayev. However, the evaluation conducted by the Transcaucasian Scientific Research Hydrometeorological Institute suggests that water reserves are lower, ranging from 2.5 to 2.8 km^3. It is important to mention that the same evaluation methodology was used in all of these studies, but different results were obtained due to the exclusion of hydrological observations in certain areas of Azerbaijan from the assessment of water reserves. In those areas, researchers utilize the following methods to evaluate water reserves:

- Evaluation based on annual flow maps.
- Evaluation based on the downward extrapolation of the annual flow module from the average elevation of the basin.
- Evaluation based on the downward extrapolation of the relationship between annual atmospheric precipitation and annual flow.

It should be noted that these types of extrapolation relationships can only be used for specific elevation intervals. However, the downward extrapolation of these relationships results in a sharp increase in calculation errors. Therefore, different authors obtain different results when evaluating water reserves. It is also important to know that rivers in Azerbaijan primarily form in mountainous areas. The lower reaches of river basins are transit and utilization zones, which are selected based on the dryness of the climate. In these areas, the flow is intermittent, hydrological observations are not conducted, and most of the received precipitation is used for infiltration, evaporation, and other purposes.

According to S.H. Rustamov and R.M. Gashqay, water reserves formed within the territory of the Republic of Azerbaijan amount to 10.3 km^3, whereas according to the Transcaucasian Scientific Research Hydrometeorological Institute, it is 7.81 km^3, resulting in a difference of 2.49 km^3 or a lower estimation. In general, the water reserves formed within the territory of the Republic of Azerbaijan were evaluated twice: in 1967 and 1977 by the State Hydrology Institute, yielding respective parameters of 8.71 km^3 and 8.0 km^3.

Azerbaijan is among the countries facing water scarcity conflicts. Analysis has determined that Azerbaijan will be among the first 50 countries to face severe water problems by 2050 (Bilalov, 2020). The main causes of water scarcity and decrease in the largest river of Azerbaijan, the Kura River, which is the main source of water supply in the country, are drought, decrease in water flow, and inadequate planning. The reasons for drought and water decrease in the river are climate changes and anthropogenic factors. Currently, the process of water decrease in the lower reaches of the Kura River is rapidly ongoing, and due to being a downstream country, Azerbaijan is more vulnerable to changes compared to Georgia and Turkey.

CONCLUSİON

The conducted research reveals that water resources in Azerbaijan, both historically and currently, are unevenly distributed. Approximately 68-70% of water reserves in Azerbaijan are in transit, and the incoming waters are ecologically harmful. This hinders the efficient use of water, including the inability to supply untreated water from the Kura Basin to industries and the population.

1. Analysis shows that in the Azerbaijani region, only 31% of river flow occurs within the country's borders during the average water supply year, which decreases to 28.9% during the moderate water supply year (75% supply) and further decreases to 27.7% during the high water supply year (95% supply). The 3.4% decrease in river flow during dry years indicates the complete dependence of the population, irrigation agriculture, and other economic sectors on the transboundary flow of water in the arid climate zone.

2. From an ecological perspective, the purification and use of water are crucial issues in modern times. Therefore, due to the depletion of water resources, its integrated and efficient management becomes highly important.

3. The sustainable management of water resources is included in international agreements such as the United Nations' 2030 Sustainable Development Goals, the Sendai Framework for Disaster Risk Reduction, and the Paris Agreement. The World Economic Forum has included the water crisis in the top three global risks for three consecutive years. Efforts are being made to prevent water pollution, conduct transboundary diagnostic analyses to address transboundary pollution, and implement various projects at national, regional, and global levels.

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REMOTE SENSING STUDY OF WIND ENERGY POTENTIAL IN AGSU DISTRICT

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The study begins by assessing the geographical and meteorological conditions that contribute to the region's wind resources. Agsu benefits from its location in a hilly terrain, which accelerates wind speeds due to channeling effects. The prevailing winds, influenced by regional climate patterns, are favorable for wind energy production. Historical wind data and simulations are analyzed to estimate the average wind speed and direction, which are crucial factors in determining the viability of wind projects.

Natural resources is the main self-supplying way which is being studied in paper. Ecological clean and independent clean energy stock is wind one. Furthermore, the abstract presents an overview of the existing infrastructure and policies related to renewable energy in Azerbaijan. The country has demonstrated a commitment to diversifying its energy mix and reducing reliance on fossil fuels. The government has implemented supportive regulations, such as feed-in tariffs and incentives, to attract investment in renewable energy projects, including wind power. The potential benefits of wind energy development in Agsu are discussed, including environmental advantages such as reduced greenhouse gas emissions and enhanced energy security. The economic benefits, such as job creation and increased local investment, are also highlighted.

Finally, the abstract addresses the challenges and considerations associated with harnessing the wind potential in Agsu. These include the need for appropriate site selection, potential impacts on local ecosystems, and the integration of wind power into the existing grid infrastructure. Technological advancements, such as improved turbine efficiency and storage systems, are identified as key factors in optimizing wind energy generation.

This potential is firstly studied by applying remote sensing way. In any coordinate of the district wind energy potential has been determined by measuring the potential applying radar technique which give possibility to reveal 2 D view. At several heights including 10,50,100,150,200 m^s the measurements have been realized. The achievable power generation for m^2 in the district was calculated. Daily, hourly and monthly wind energy potential data were graphed and schemed in the paper. Energy, environmental, economical advantages of wind energy for Agsu district was investigated by analyzing radar spectral measurements after remote sensing process. Agsu region in Azerbaijan offers substantial wind potential that can contribute to the country's renewable energy goals. With the supportive policy framework and growing interest in wind power, further exploration and development of this resource can lead to a sustainable and clean energy future for Azerbaijan.

Keywords: *wind potential, spectral radar analysis, ecological clean energy, ecological safety*

INTRODUCTION

Agsu is one of Azerbaijan cities situated near 100 km northwest distance of the capital Baki located in Absheron peninsula. The region is well known because of the richest windy climate, athus there is a great deal of high wind potential for develoiping wind power generation in the region. The main purpose of this scientific paper is to estimate the wind potential of Agsu district, and to determine the feasibility of wind energy potential as the green and renewable energy source in the territory.

The research object's one of the picturesque places on the Great Caucasus mountain. The district possesses 1020,1 km² (102010 ha) *(Data for Agsu, 2023)* total are locating in 40°34′10″ N 48°24′00″ E coordinates *(Data for Agsu, 2023), (Wind for Agsu, 2023)* determined from aerospace point of view. Indeed the rich natural resources in the territory makes Agsu have great advantages for ecotourism chance. At present tourism sector is being developed here day by day continuously. Summer and winter tourism might be successfully and independently developed because its relief, woodland stock, green lines, complete nature and renewable energy stock and etc. Agrarian sector has been expanded here since in the middle of the former century as well as cattle farming, bird farming, field plantations (onion, potatoes, cabbages, sunflowers, corn, wheat, barley, rice an so on). Forest industry is acting beside building furniture sectors. Additionally the district has many interesting historical places which directly attract tourists and guests, visitors coming to the region. But all the tourism sector *(Mammadova[b,e], 2022)* have been developed. The joint ecotourism section could be organized easily in Agsu because of a plenty of energy resources. Thus, without energy none of industry sector, life in settlements, districts, villages can exist. If the region is able to provide the necessary energy demand, so this district could have independently built its infrastructure including all sectors of the industry fields. The relief, geographical and natural location of the district cause renewable energy potentials' formation *(Agsu Wind Rose, 2023)* which has never studied before in order to built independent, clean energy sector for the region. In the development of the regions. In Azerbaijan energy dependence is to be solved in time to form normal infrastructure. The current research is important and demandable for the present day *(Mammadova[d], 2022)*. As the world continues to face the challenge of meeting energy demands while reducing carbon emissions, renewable energy sources such as wind power have gained increasing attention. Agsu, Azerbaijan, with its windy climate, presents an opportunity for the development of a wind energy station. The purpose of this study is to assess the feasibility of a wind energy station in Agsu, including its technical, environmental, and economic aspects.

The purpose of the research presented in the article is to determine the wind energy potential of the Agsu region located in Azerbaijan using remote sensing techniques. In this work, we used a radar remote sensing technique to measure the speed and direction of the wind at different heights. The data obtained from remote sensing measurements have been analyzed to evaluate the wind energy potential of the region. The results show that the Agsu region has significant wind energy potential, with average wind speeds ranging from 6 m/s to 8 m/s at a height of 100 meters above ground level. Remote sensing techniques demonstrate their potential for evaluating wind energy reserves in areas where surface measurements are limited. Wind energy has the potential to provide significant benefits to the energy complex of many countries worldwide, including Azerbaijan. However, the lack of reliable information on wind energy potential slows down the development of wind energy in Azerbaijan. In this research, we aim to fill this gap by evaluating the wind energy potential of the Agsu region using a combination of numerical modeling and surface meteorological measurements.

MATERIAL AND METHOD

As the investigation measurement method aerospace or remote sensing was used in the writing of the paper. The method is realized by several windsats or wind remote sensing systems. The method is more effective to study wind potential possibilities and energy generations in all kind of relief. Traditional measurements *(Mammadova[a],2022) (Mammadova[c], 2023)* ways are not practical useful. Because development of many stations in several heights are not real indeed. It stands in past times all deficiencies were calculated on the base of traditional methods. But, today remote sensing method deleted all the deficiencies in order to get full information about the potential. Such kind of measurements are being realized along the year by satellites of different aerospace agencies of the world. Actively this research was carried out following the results of NASA's Analytical Center *(Mammadova[d], 2022)*. Wind data from nearby weather stations was collected and analyzed using To evaluate the wind resource potential of the region, the Windographer program has been used. Data has been analyzed for a period of five years to take into account seasonal variations in wind speed. Based on the analysis, a wind resource map has been created for the region. The potential for wind energy production in the region has been evaluated using the wind reserve map and the available land area. A techno-economic analysis has been conducted to determine the operational capability of the wind energy station in Agsu. The analysis covers the installation and utilization costs of wind turbines as well as the revenue generated from the sale of produced electricity. The analysis also considers the potential environmental impacts of the wind energy station.

EXPERIMENTAL PART

To estimate the wind resource potential of Agsu, we collected wind data from two weather stations located in nearby cities. The wind data was collected at a height of 80 meters above ground level and covered a period of five years. The information was analyzed using the Windographer program, an industry-standard software for evaluating wind resources. The first step of the analysis was to check the quality of the data. Any data point that was deemed unreliable due to the malfunction of the equipment or other issues was removed. We also removed any data points collected during low wind speeds or high turbulence periods because these conditions can affect the accuracy of the analysis. After checking the quality of the data, we used the Windographer program to calculate the speed distribution of the wind for each meteorological station. We also calculated the Weibull parameters for each location, which are statistical parameters that describe the wind speed distribution. The Weibull parameters were used to evaluate the average wind speed and wind speed distribution in the Agsu region. Remote sensing measurements were realized by different wind statelets of NASA throughout the year. After the process, all data were analyzed in the Analytical Center.

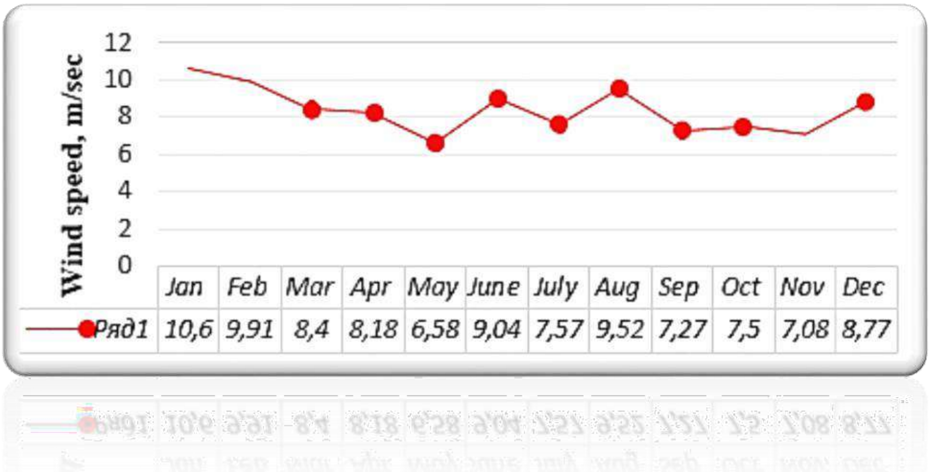

Figure 1. Annual Wind Speed at 10 m for 2022 in Agsu District

As if seen in Figure 1 annual wind energy potential is enough to built wind energy plants to develop the green energy sector in the region. Annual radar tracking on the territory gives us the opportunity to say that January and June's month have rich wind potential because of the high speed. Relief is the important factor in this term. This energy field can influence ecotourism sector at the same time. To determine the direction and heights of the actual wind flow, several approaches were tested at 10 and 50 meters. Wind energy data is provided below.

Based on the wind resource map created from the analysis of wind data, we evaluated the wind energy potential of Ağsu. We used the standard formula to estimate the power output of wind turbines based on wind speed, rotor diameter, and hub height. We assumed a typical rotor diameter of 100 meters and a hub height of 80 meters. We also examined the available land area for the wind energy station and estimated the number of wind turbines that could be installed in the region.

To determine the operational capacity of the Ağsu wind energy station, we conducted a techno-economic analysis. The costs of installing and operating wind turbines were determined based on national tariff rates accepted by the government in the local electricity market. The real value of wind energy was compared to the value of other forms of energy to evaluate their worth. National Tariff Council of Azerbaijan calculated the wind energy projects' total cost according to the current state, including capital, operating, and maintenance costs. The potential power generated can be sold as electrical energy to other regions. We conducted an environmental impact assessment to determine the potential environmental impacts of the wind energy station. We considered the impact on wildlife, including birds and bats, as well as the impact on the visual landscape. Wind energy is an increasingly important source of renewable energy, as it provides a clean and sustainable source of electricity.

Accurate measurement and assessment of wind energy potential are critical for the development of wind energy projects. Assessing wind resources typically involves time-consuming and costly site-based meteorological measurements. Remote sensing methods have emerged as an alternative approach for evaluating wind resources that provide a cost-effective and efficient solution for wind reserve assessment. The paper concludes with a discussion of the limitations and future prospects of the remote sensing study. It addresses potential challenges related to data availability, accuracy, and the need for ground validation. Additionally, it highlights the importance of ongoing monitoring and the integration of remote sensing techniques into the decision-making processes for wind energy projects. Overall, this paper demonstrates the significance of remote sensing in assessing wind potential and facilitating informed decision-making for wind energy development. The findings contribute valuable insights into the wind resources in the Agsu region of Azerbaijan, supporting efforts to promote sustainable energy generation and reduce dependency on fossil fuels. Furthermore, the paper discusses the implications of the wind potential in Agsu for wind energy development. It explores the capacity for electricity generation from wind power and provides insights into the potential contribution to the local energy demand. The economic and environmental benefits of harnessing the wind potential in Agsu are also discussed. the methodology section describes the remote sensing techniques employed in the study. The authors utilize data from various sources, including satellite-based remote sensing platforms and ground-based measurements. The remote sensing data are processed and analyzed to derive relevant wind parameters, such as wind speed, wind direction, and wind shear, which are crucial for assessing the wind energy potential.

In this work, we used remote sensing technology based on radar technology to measure wind speed and direction at various heights above ground level. Distance-based measurements using remote sensing were analyzed to evaluate the wind energy potential of the Agsu region. Experimental installation for remote sensing measurements included the Doppler wind RADAR system. The RADAR system uses laser light to measure the speed and direction of wind at various heights above ground level. The RADAR system was installed on a mast at a height of 100 meters above ground level. The RADAR system operated continuously for six months to collect wind data. The collected wind data was analyzed to evaluate the wind energy potential of the Agsu region.The results of this study demonstrate the potential of remote sensing methods for wind energy resource assessment in regions where ground-based measurements are limited. The use of remote sensing techniques, such as the Doppler wind RADAR system used in this study, provides a wind energy cost-effective solution.

Table 1.

Maximum Wind Speed and Direction Data at 10, 50 m above Earth for 2022

Wind Speed. m/sec												
H	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
10	10,6	9,91	8,4	8,18	6,58	9,04	7,57	9,52	7,27	7,5	7,08	8,77
50	13,53	12,29	10,99	11,6	8,56	11,25	9,8	12,04	9,52	9,53	9,03	11,38
Wind Direction, degree (^{0})												
10	216,62	233,25	137,31	167,75	140,62	127,69	139,06	117,19	120,62	107,81	203,25	259,19
50	204,12	244,12	104,31	146,44	127,5	119,81	132,94	110,94	111,38	102,81	178,81	353,06

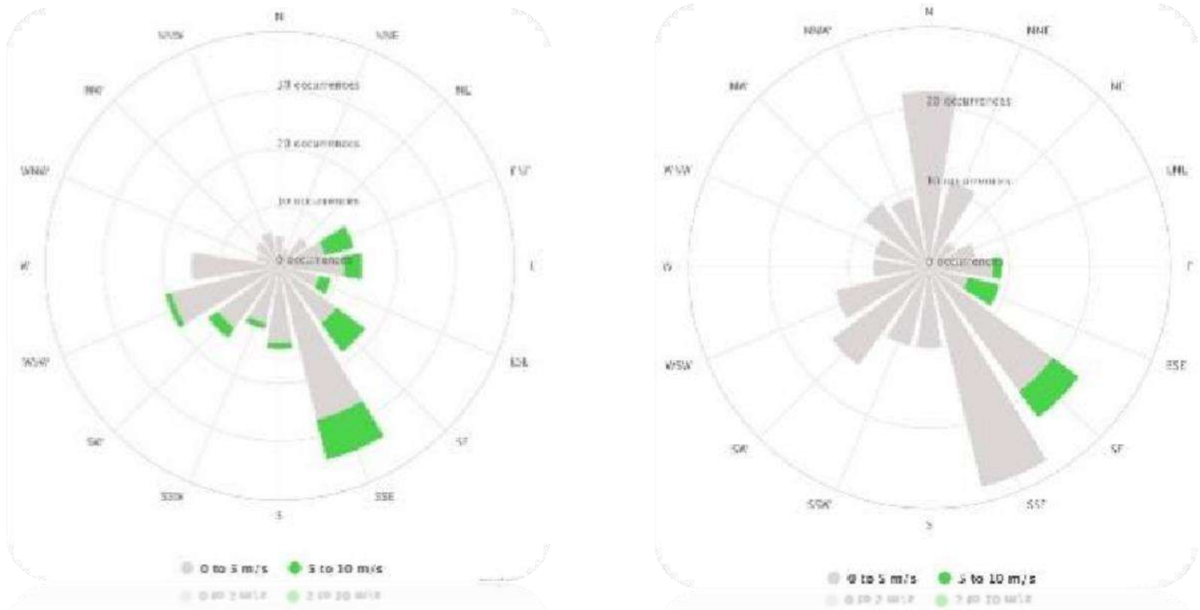

Figure 2. Wind Rose at 10 and 50 m above Earth

RESULTS

In order to assess the wind resource potential of Agsu, we conducted a wind resource assessment using historical wind data from nearby weather stations. The data was analyzed using industry-standard software tools, and a wind resource map was generated for the region. Based on the results of the analysis, we found that the average wind speed in the region was approximately 6.5 m/s at a height of 80 meters above ground level, which is considered to be a good wind resource for wind power generation.

Wind energy stocks has to be studied fully before the green energy stations built. Resource capabilities, property, distribution, relief plastics are to be taken into consideration. Because the above mentioned parameters should be followed if one of them is lack in this case usage of renewable energy stocks is impossible. Sometimes the energy potential, property kinds let the power stations to be built. But region’s relief make problems from economical, building, location point of view, specially on the mountainous regions. Thus relief plastics’ has great role in wind energy stations’ development. Besides, while studying any renewable energy kinds including solar and wind ones relief plastics is certainly to be taken into account by remote sensing, too. The process is going on automatically. On any surface such as water, field, stone, rock and other measurements directly are realized as a rule, even in the power generations’ calculations. In the investigation wind energy potential has been taken mainly. The region possesses mountain-valley winds which are blowing from valleys to the top of the mountains. Such kind of wind is called fyon, too, in the scientific literature. Geographical location, height index and characteristic wind kinds makes the situation for wind energy stock. So, district’s total wind potential and energy one was studied generally and the following results were obtained:

- 5,3 m/sec annual minimum wind speed at 10 m above earth;
- 8,4 m/sec annual maximum wind speed at 10 m above earth;
- 165° annual wind direction at 10 above earth;
- 162° annual wind direction at 50 above earth;
- 86 W/m² power generation of 2,85 m/sec wind speed at 10 m;
- 124 W/m² power generation of 3.69 m/s wind speed at 50 m;

Using the wind resource map, we estimated the wind power potential of Agsu. Based on the available land area and the wind resource, we found that the potential for wind power generation in the region is approximately 150 MW. This is a significant amount of power, and could provide a substantial portion of the energy needs of the region.

The ground-based measurements were taken using a meteorological tower equipped with anemometers and wind vanes at heights of 10, 30, and 50 meters above ground level.

The results of this study indicate that the development of a wind energy station in Agsu is a viable option for meeting the energy demands of the region. The estimated potential for wind power generation in the region is significant, and the techno-economic analysis indicates that the project is financially feasible. The development of a wind energy station in Agsu would also contribute to the reduction of greenhouse gas emissions, as wind power is a clean and renewable source of energy. The results of the remote sensing measurements show that the Agsu region has significant wind energy potential. The average wind speed at a height of 100 meters above ground level ranged from 6 m/s to 8 m/s. The wind direction was predominantly from the northwest, with a frequency of occurrence of 25%. The wind speed data obtained from the remote sensing measurements were used to estimate the wind power potential of the Agsu region. Based on the wind speed data, we estimated the power output of a wind turbine using a standard power curve. We assumed a typical rotor diameter of 100 meters and a hub height of 80 meters. We also considered the available land area for the wind energy station and estimated the number of wind turbines that could be installed in the region.

WIND POWER FEASIBILITY

In order to determine the feasibility of wind power in Agsu, we conducted a techno-economic analysis of a hypothetical wind power project. The analysis included the costs of installing and operating wind turbines, as well as the revenue generated by selling the electricity produced. Based on the analysis, we found that a wind power project in Agsu would be economically viable, with a payback period of approximately 7 years. The results of our study show that the Agsu region has a significant wind energy potential, with an average wind speed of 6.5 m/s at a height of 50 meters above ground level. The wind direction in the region is predominantly from the northwest, with a frequency of occurrence of 29%. The WRF model results were validated against the ground-based measurements, and a good agreement was found between the two datasets. We used the wind speed data obtained from our study to estimate the potential power output of a wind energy station in the Agsu region. Assuming a typical rotor diameter of 100 meters and a hub height of 80 meters, we estimate that a wind energy station in the Agsu region could generate approximately 40 MW of power. Our findings provide useful information for policymakers and developers interested in promoting wind energy in Azerbaijan.

CONCLUSION

After having realizing the investigation in Agsu district territory by applying remote sensing method (including only radar technique) the total wind potential has been determined. The measurement result shows that beginning 50 m height this potential can be effectively utilized. Thus, wind energy potential application is able to escape from ecological problems and atmospheric wastes including woodland cut, soil erosion and et c. In conclusion, the wind potential of Agsu is significant, with an estimated potential of 150 MW. A wind power project in the region would be economically viable and could provide a substantial amount of energy to the region. As such, we recommend further exploration and development of wind power in Agsu as a sustainable energy source for the region.

The results of this feasibility study indicate that the development of a wind energy station in Agsu is technically, environmentally, and economically viable. The estimated potential for wind power generation in the region is significant, and the techno-economic analysis indicates that the project is financially feasible. The development of a wind energy station in Agsu would also contribute to the reduction of greenhouse gas emissions, making it a sustainable solution for meeting the energy demands of the region. Our study demonstrates the significant wind energy potential of the Agsu region in Azerbaijan. The results of our study can be used to inform policymakers and developers interested in promoting wind energy in Azerbaijan. Our findings suggest that the development of a wind energy station in the Agsu region could generate a significant amount of power and contribute to the country's energy mix. Further studies are needed to assess the feasibility of wind energy development in the region, including land availability and environmental impact assessments.

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METHODOLOGY OF PREPARATİON OF SOİL-GEOLOGİCAL MAPS

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The article reflects the methodology for compiling soil-geological maps. Soil-geological maps are divided into 4 types: analytical, synthetic, general and particular. Taking into account the purpose of the maps, the requirements for design and the complexity of the soil and geological conditions of the area, the level of their accuracy and scale are determined. The scale of soil-geological maps was small, medium, large, and mostly large.

Keywords: *soil-geological maps, scale, horizontals, heights, design, geological conditions*

INTRODUCTION

Soil-geological planning is carried out at the stage of studying soil-geological conditions. Soil-geological maps are a description on paper based on the appropriate scale (with accuracy) of the factors that are considered important to take into account the soil-geological conditions of the researched area during the design, construction, operation and implementation of various engineering measures. The level of accuracy of this image depends on the scale and purpose of the drawn map, and the level of accuracy of the conducted soil-geological planning. They reflect the geological conditions of the area, geodynamic processes, conditions created in connection with man-made activities in accordance with the purpose of soil-geological maps [5].

RESEARCH METHODOLOGY

The methodology developed under the guidance of academician Garib Mammadov was used in the preparation of soil-geological maps (Guidelines for the preparation of interactive electron soil maps and maps of ecological assessment of soils at a scale of 1:100000) [3].

THE DISCUSSION OF THE RESULTS

There are 4 types of soil-geological maps: analytical, synthetic, general and specific.

Analytical maps reflect such conditions and soils by distinguishing them, which concentrate one or more characteristic indicators or signs of the soils or massif. Examples of such maps are permeability map, uniform load carrying capacity map.

Synthetic maps reflect a general assessment of soil-geological conditions. These maps can be drawn up as a single sheet for areas with simple conditions, or as a series of sheets for complex conditions.

General maps are drawn up to justify the planning of the territory without taking into account specific construction measures.

Special maps are designed to solve certain types of technical issues related to various fields of construction. They are designed to reflect the development (spread) of certain geological processes and events.

The purpose of the maps, the requirements of the design and the complexity of the soil-geological conditions of the area determine their level of accuracy and scale. The scale of soil-geological maps is usually small, medium, large and substantially large.

Little-scale maps are 1:500000 and smaller in scale and are designed for the purpose of planning large provinces, industrial centers and large cities, selecting more favorable locations, and so on. General-purpose soil-geological maps are prepared on a little scale (1:500000 and smaller) to study the geological conditions of the area, to determine regional regularities, and to obtain overview information [4,6].

Medium-scale maps have a scale of 1:200000 to 1:100000 and are designed for the design of cities, industrial enterprises, engineering facilities and communication routes (canals, roads, communication lines, power lines and water pipelines), regulatory measures in the courses of large rivers, and other purposes is being These maps are considered the basis for the preparation of the program of carrying out accurate soil-geological research and the study of the general soil-geological regularity.

Large-scale maps have a scale of 1:50,000 to 1:25,000, and are used for the justification of project tasks during the construction plan of road junctions, cities and various hydrotechnical facilities, selection of the structure of hydrotechnical facilities, construction sites of industrial facilities, roads, engineering communications, etc. is compiled for distribution and selection.

Basic large-scale maps have a scale of 1:10000 and larger, and they are used to justify the exact project of the location of various facilities or their parts on the plan, specific objects of cities, hydrotechnical facilities, transport communications, industrial facilities, etc. during the preparation of the detailed plan, it is drawn up for the purpose of justifying the project tasks and the technical project.

In general, there are 3 types of soil-geological maps (soil-geological conditions map, soil-geological zoning map, special soil-geological map).

Soil-geological condition map or general-purpose soil-geological map is drawn up for a general assessment of the natural conditions of the area where the construction is planned. The soil-geological zoning map is drawn up for general and special purposes. The soil-geological condition map and the soil-geological zoning map can be drawn up separately or together on one sheet. The soil-geological zoning map is drawn up based on the principles of zoning proposed by I.V.Popov [7].

A special soil-geological map is drawn up according to the nature of the soil-geological conditions of the construction and facility. They differ according to the information they reflect. Such maps are prepared according to the requirements of several objects of the same type. An assessment of the soil-geological conditions of the area and an approximate forecast of the soil-geological processes are given on them.

For regions with complex soil-geological conditions, it is also important to draw up auxiliary maps characterizing various elements of those conditions. When it is important for the relevant construction to take into account the elements that create the characteristics of the soil-geological conditions of the area (landslide, karst, geomorphological and hydrogeological elements, etc.), it is considered appropriate to draw up maps that reflect those characteristics.

Special soil-geological maps can be drawn at any scale. They are supplemented with sections, tables, explanatory texts reflecting the factors and events used to evaluate the soil-geological conditions of the area. Each soil-geological map consists of material reflecting special conventional signs, soil-geological sections and explanatory text.

Soil-geological maps are compiled on the basis of topographic maps with various materials added. Geological, hydrological, hydrogeological, and soil condition materials are transferred on the topographic map of the researched area by means of horizontal lines. That is, the horizontals that determine the height of the studied area on the map, communication lines, hydrographic network, main residential areas, soil age, lithological composition, bedding conditions, physical and mechanical property indicators, I rock complexes from the surface down, geodynamic processes, their area development limits, climate, etc. should be covered. Drilling works carried out in the research area should be marked on the overview map. Here, the tectonics, seismicity, hydrogeological conditions of the area, properties of rock complexes, geodynamic processes should attract special attention.

The following should be reflected in the soil-geological maps: the level of development of the genetic complexes of the formations and the petrographic rock types that make up them (composition and well-defined); underground water depth, aggressiveness and aggressiveness, wetness character; the level of development and damage of the territory of modern exogenous-geological processes; genetic relief types, indicating the predominant direction of new (early) tectonic movements; the main variation direction of one of the soil classification indicators; thickness characteristics of upper and lower stratigraphic-genetic rock complexes (types).

When drawing up maps, corresponding maps of the same scale are used. In the preparation of soil-geological maps, in addition to the maps, profiles, columns, explanatory materials and various materials that are not reflected in the map and help to understand it, clarify it, and obtain more favorable material are added [1,2].

Describing soil properties during the preparation of soil-geological maps was proposed by N.V.Kolomensky, G.K.Bondarik, M.I.Goralchuk, Y.N.Yerusalimskaya and others.

These maps should reflect the direction of development of modern exogenous-geological processes, their genetic affiliation, their intensity and the degree of damage to the territories. The development of these processes is related to the nature of the relief of the area, prevailing neotectonic movements, the genesis, composition, condition and properties of stratigraphic-genetic rock complexes, hydrogeological conditions taking into account the landscape-climate zoning and the presence of perennial stagnation.

In order to assess modern geological processes, soil-geological maps with a scale of 1:25000 should show the volume and dimensions of certain affected areas, the type and intensity of the influencing geological processes.

During regional soil-geological studies, it is preferred to specify the characteristics of both the area and its relevant areas. This allows to typify the area, that is, to determine the basic, significant and general value of their engineering geological conditions.

Each specific area or its corresponding parts is characterized by typical characteristics and certain quality of soil-geological conditions. These maps are illustrated with soil-geological columns, sections, schemes, etc.

Soil-geological cross-sections are drawn up based on the results of visual, field and laboratory studies conducted to determine the composition, condition and properties of soils. Soil-geological sections are considered an important addition to maps. These are vertical sections of the earth's crust drawn up in accordance with the requirements of the design and construction of engineering facilities at a certain point in the area. Geological factors are described and characterized according to the design and construction requirements of the facility designed on that section.

When compiling the columns, the stratigraphic distribution, age index and thickness of the sediments in the area up to the Quaternary period are shown on the left side of the column. On the right side of the column, the stratigraphic-genetic complex or lithological-petrographic type, the formations to which they belong, the dominant petrographic composition of the rock complex and the limit value of its thickness are indicated. On this map, separated and indicated units of soil-geological stratification are mainly depicted to geologically correlate stratigraphic divisions.

CONCLUSIONS

Soil-geological maps are divided into 4 types: analytical, synthetic, general and special types. The purpose of the maps, the requirement of the design and the complexity of the soil - geological conditions of the area are determined by their level of accuracy and scale. Soil-geological maps are divided into small, medium, large and basically large scales. Also, soil - geological maps are divided into 3 types: soil-geological conditions map, soil-geological zoning map and special soil-geological map.

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ECOLOGICAL STUDIES OF GOBUSTAN SOIL COVER STRUCTURES

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One of the five physical-geographical regions of Azerbaijan is the Greater Caucasus Region, which rises to 4466 metres above the level of the Caspian Sea. Gobustan-Absheron district is part of the Greater Caucasus Region. Absheron peninsula, foothills and narrow coastal plains in the southeast dip of the Greater Caucasus, the whole Gobustan and arid-denudation foothills of the Sumgaitchay basin and its tributaries are included here. To the south the district borders the Shirvan plain. Absolute altitudes in the region range from 28 to over 800-1,000 meters. Its maximum width is 80km from north to south and it is over 120km long. One of the most important features of the geological structure of the area is widespread mud volcanism. Much of the area is arid-denudated lowlands. The most widespread landforms are anticlinal and monoclinal ridges and crests, synclinal and denudation-tectonic depressions. Computer technologies have been applied, which allowed to automatically identify convexity and concavity soils and to represent them on a plane volumetrically.

Their separate types were defined: tree-concentric type of SSC (Gobustan-Absheron trough), bulbous-gathering type of SSC, tree-shaped type of SSC of volcanic origin.

Key words: *Structure of the soil cover, Gobustan, mud volcanoes, relief.*

INTRODUCTION

Gobustan district is located in the eastern part of Shamakhi, 101 km from Baku. The relief is abrasive-rocky, and the soil cover is diverse here. In the eastern part of Gobustan, grey-brown saline soils are common, in the northwest - grey-brown ones. The vegetation cover of Gobustan is also diverse, 470 of the 4,000 plant species of Azerbaijan can be found here. Most of them are bloomers.

The territory of Gobustan is a mountainous area with a complex relief, represented by valleys, ravines, and cliffs. It is characterised by relatively ancient elevated and intensively dissected relief. The present relief has been changed by later erosion and denudation processes. The depth of surface dissection reaches 200-300 m. There are numerous mud volcanoes in the region [1].

Based on geography, the mountain slopes are divided into three areas: plateaus, hills, and plains. A mountain plateau covers the north-western part of Gobustan. Clay karst has developed in the mountains near Ajidara River. As a result, the karst terrain is prevalent here. Winds, precipitations, and mud volcanoes have played a vital role in the formation of Gobustan relief. From a geological point of view, Gobustan is rich in oil and gas. Their natural features are mud volcanoes. Jayirli, Shorsulu, Kolany, Sheikhsarli, and other mud volcanoes are located on the territory of the region. There are reserves of various building materials in the area (limestone, sand, gravel, volcanic ash, gypsum, and slates).

Southwest Absheron is characterised by inverted low-mountain relief. The outer edges of the synclinal plateaus (Baku, etc.) with a ledge 150-180 m high abruptly (sometimes stepwise) break off and pass to flat basins, valleys, and ravines. Mud volcanoes are widely developed on the eroded clusters of anticlines.

RESEARCH METHODOLOGY

To determine the structures of the Gobustan soil cover, the method of relief plasticity was applied [2]. Their separate types were defined: tree-like concentric type (Gobustan-Absheron trough), bulbous-collecting type, tree-like type of volcanic origin.

For the first time, computer technology was applied, which made it possible to automatically distinguish soil convexities, concavities and depict them on the plane "volumetrically". We have divided the soil structures of Absheron into several types by their shape and by the orientation of flows with respect to the highest (repellers) and lowest (attractors) points of the topographic surface. In the concept of plasticity, structure is the ordered assembly of soil ranges under the influence of some unifying force, in particular the hydrographic network. Using the results of both personal research and archive-fund materials each structure received its own characteristic [3].

1) Tree-concentric type (Gobustan-Absheron trough). It is highly dissected and intricate, and it is distinguished by diverse soil composition. There are common grey-brown, slightly solonetzic soils of strongly dissected slopes, light grey-brown slightly solonetzic, grey-brown highly gypsiferous, grey-brown incompletely developed soils on modern eluvial-diluvial deposits of slopes. Loams with rare inclusions of weathered rock fragments are present; heavy bundles of limestones from the daytime surface (20-50 m), underlain by a clay stratum with subjugated proplastics of sands, sandstones, shell limestones.

2) The bulbous-collecting type is located in the western part of Absheron in the Cheildag area. It has an elliptical shape, the streams of which are directed to the centre of the bulb. The soils are mainly ordinary grey-brown, light grey-brown with varying degrees of salinization and solonetzic; grey-brown underdeveloped. It is possible that there was once a lake basin here. This can be judged by the shape of the stream direction [4]. Rocks: pliocene-akchagyl clay with layers of sands, sandstones, marl sediments and emissions of mud volcanoes. 3) The tree-like type of volcanic origin occupies part of the territory of the Alyat range, part of Gobustan, mountain Turagai. The structure is fragmented and disturbed by numerous mud volcanoes. It is a tectonically disturbed structure. There are grey-brown alkaline-saline soils, grey-brown undeveloped soils, as well as salt marshes, undeveloped takyr-type soils, outcrops of dense rocks, and technogenic lands.

The rocks are modern remnants of mud volcanoes. Breccia Hill is non-layered clays with angular fragments of rocks with highly developed gully-beam erosion [5]. The soils common here are represented by differences of grey-brown irrigated soils, grey-brown saline-irrigated, grey-brown underdeveloped irrigated, grey-brown alkaline-saline irrigated. For a systematic analysis of the formation of the structure of the soil cover (SSC) on Absheron, in order to assess the quality of the SSC, which determines its natural fertility, it is first of all necessary to consider and analyse the natural and climatic factors that determine the SSC. A prominent place in soil research is occupied by ecological-genetic analysis, which means "an in-depth analysis of the relationships between soils and environmental factors, namely vegetation, soil-forming rocks, climate, relief, taking into account the established types of natural relationships and quantitative relationships in the plant-environment system" [4, 6].

Soil structure is formed as a result of long and active soil-forming processes occurring in various conditions. With the development of the soil, its structure evolves and changes. The biological causes of structure destruction are associated with the mineralization processes of soil humus – the main adhesive substance during its formation. Also, with a decrease in calcium saturation, the soil structure deteriorates, colloidal substances become unstable, easily disintegrate and, under the influence of precipitation and irrigation, are washed deep into the ground, forming a very dense illuvial horizon at a shallow depth. Restoration and preservation of the structure in conditions of agricultural use of soils is carried out by agro-technical methods.

CONCLUSION

1. The scientific basis for studying the structures of the soil cover, taking into account the relief and geological-geomorphological structure, based on modern computer technologies, has been developed.

2. The method of relief plasticity on the territory of Gobustan identified three types of soil cover structures: (a) Tree-concentric type (Gobustan-Absheron trough); b) a bulbous-forming type of SSC in the west of Absheron; and c) a tree-like type of SSC of volcanic origin.

3. The intrinsic qualities of these structures have been determined: their soil content, their physical, chemical and biological properties. The interrelation has been shown.

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THE AIM OF OPTIMIZING ENVIRONMENTAL PROTECTION MEASURES IN THE MOUNTAIN MEADOW BELT OF THE GREATER CAUCASUS

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This paper presents some results of various studies conducted in the highlands of the Azerbaijani part of the Main Caucasus and Lateral Ridges of the Greater Caucasus using materials from field surveys and interpretation of satellite images. The results of these works, together with the analysis of studies by other researchers, made it possible to characterize the peculiarities of the development of the natural conditions of highlands, to identify the most degraded areas of mountain landscapes and to determine the most optimal ways of protecting the natural environment.
Keywords: *landscapes, zone, images, complex, slope, cover*

INTRODUCTION

The natural conditions of the Greater Caucasus and the processes occurring here, in their distribution, are subject to altitudinal zonality, which, as many researchers note [Abduev, 2010; Alizade and Tarihazer, 2010, 2015; Budagov, (Eds.), 2009], is a consequence of the latest tectonic movements and different landscape complexes and exogenous processes occurring in them. In the further re-formation of landscapes, endogenous and exogenous processes (landslides, landslides, debris, etc.) played a large role. In order to avoid possible future catastrophic consequences associated with dynamic processes, careful study of the territory is necessary.

MATERIALS AND RESEARCH METHODS

Summarizing the results of some studies conducted in the field of assessing the natural conditions of the Greater Caucasus to develop various economic sectors and effective environmental protection, we selected the optimal way to assess the degree of degradation of mountain landscapes under the influence of geodynamic processes using the combined use of aerospace materials, visual observations and laboratory processing samples taken.

The tasks assigned meant a certain order of research. Thus, when collecting and systematizing the existing geological, geomorphological, landscape, hydrometeorological and soil-plant materials about the natural conditions of the high mountains of the Greater Caucasus, a huge amount of research material on exogenous geodynamic processes carried out in different years was processed.

The generalization of the results of the influence of degradation processes on the state of soil and vegetation on the basis of field and cameral surveys, including laboratory analyzes of samples taken in characteristic key sites, and visual interpretations of aerial photographs made it possible to determine the degree of degradation of high mountain landscapes on the southern slope of the Main Caucasus Range and North the eastern slope of the Greater Caucasus, to draw up maps of the territory.

RESULTS AND ITS DISCUSSION

Erosion processes occurring with great intensity within a given territory and the morphosculptures created by them – relief forms are the result of dependence both on modern physical and geographical conditions and on morphostructural features of the relief as a whole.

As many researchers [Abduev, 2011] note, exogenous relief formation is not only due to general climate features, but also due to altitude zonation, since hydroclimatic processes are controlled by the hypsometric position of the territory. This can be visually analyzed by the compiled map of the distribution of absolute heights.

Within the mountain-forest zone there are large areas of non-forest areas, which, subject to continued intensive anthropogenic impact, can become an arena for the development of adverse geodynamic processes leading to the complete degradation of mountain ranges.

Within the territory, especially on the southern slope of the Greater Caucasus Mountain Range in the process of relief formation, a significant role belongs to the gravitational processes - landslides, talus, placers and landslides.

The landslide-flow Chereke is one of the most active landslides that have arisen within the subalpine zone (Figure 1.). It arose in 1997 on the right bank of the Gudialchay, which flows down from the northeast slope of the Main Caucasian Range on one of the spurs of the Lateral Range. Its length reaches 3 km, and the width varies between 25-150 meters. Observations carried out in 1998 showed that the growth of the landslide exceeded 15–20 meters and that the greatest damage occurred in the initial part. The landslide material covered this year's materials with a fresh layer of 0.5–2.0 m in 1997.

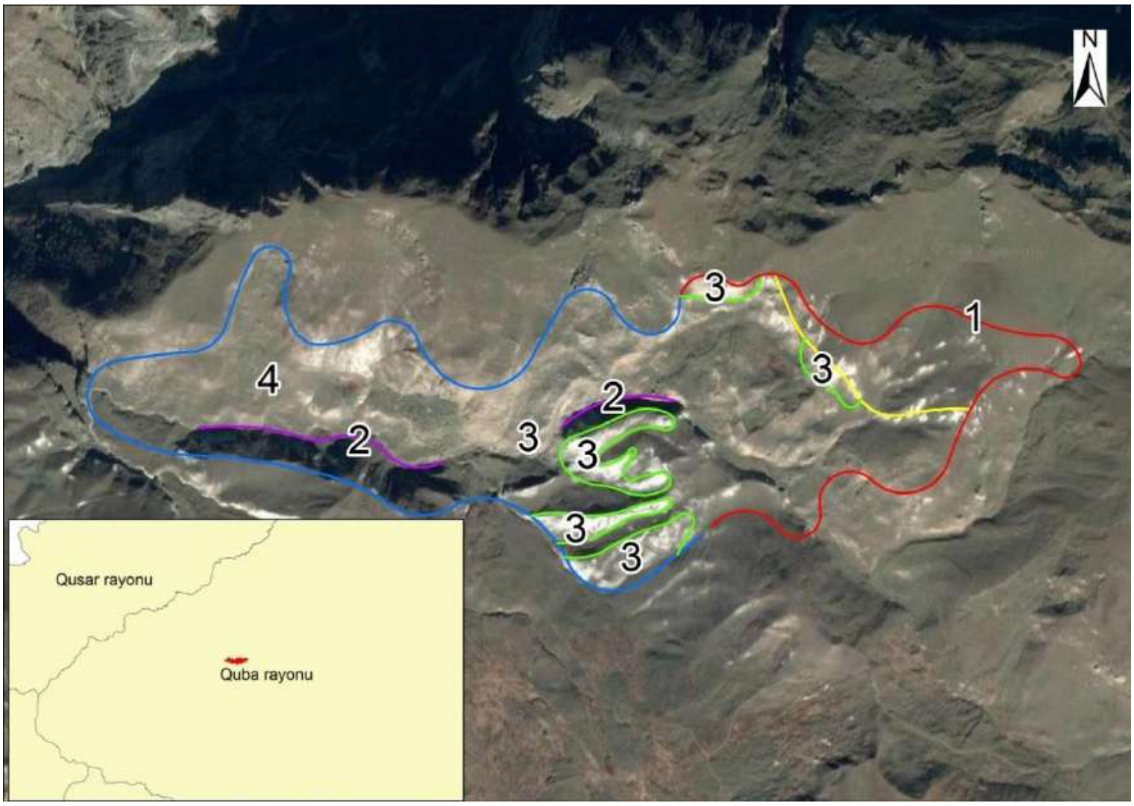

Fig.1. Satellite image of the Chereke flow landslide (Guba administrative region), submitted by Google (USA) and recorded on October 18, 2013, with a resolution of 1 m, in which the steep slopes are reflected by shading, and fresh landslide materials: 1-breaking edge; 2-steep slopes of landslide masses; 3-fresh landslide materials; 4-body landslide overgrown with vegetation.

The obtained hydrological data show that the large quantities of the sediment discharge module differ in many rivers of the northeastern and southern slopes of the Greater Caucasus (Gusarchay, Gudialchay, Velvelichaychay, Talachay, Kurmukhchay, Kishchay, Dashagilchay, Turianchay, Geokchay, etc.). Many factors of high intensity of flushing from the surface of the southern slope of the Main Caucasus Range are natural factors contributing to the development of denudation processes. Features of the nature of denudation and erosion processes in the Azerbaijan part of the Greater Caucasus are of great importance in modern conditions of development of the economic structure of the region, the creation of an extensive tourism and transport infrastructure [Agaev, (Eds.) 2013].

An analysis of existing literature materials and field-based soil-erosion, landscape research conducted in different years suggests that this uneven modulus of sediment flow is due to the intensive development of erosion in the Greater Caucasus region [Abduev, 2014; Mamedov, 2009].

The weak protection of the surface by woody vegetation as a result of intensive anthropogenic impact is indicated by the fact that in some parts of the basins the rivers Kurmukhchay, Shinchay and Kishchay mountain-meadow, high-grass subalpine vegetation is lowered to altitudes of 1600-1700 m.

An example of this is the territory of a large mountain meadow array “Khanyaylag”, located on the same spur of the southern slope of the Main Caucasus Range. This site is located near the town of Sheki, which is of cultural and historical importance and is an important center of domestic and foreign tourism.

At the same time, the compilation of cartographic materials based on the interpretation of aerospace photographic materials and statistical data, which reflect geodynamic processes, climatic fluctuations that adversely affect the mountain landscapes of the Greater Caucasus, and the soil that is sensitive to anthropogenic impact, acquires great importance. In general, works aimed at assessing the natural environment provide factual material reflecting the state of the environment of the Greater Caucasus under the influence of anthropogenic factors, which serve as the basis for choosing the most optimal solutions for environmental planning [Mamedov, 2016].

CONCLUSIONS AND RECOMMENDATIONS

When identifying the factors influencing the onset and development of degradation processes, the main morphoclimatic factors of exogenous relief formation were identified, the most important of which are heavy rainfall, leading to intensive flushing of the destroyed soil cover of the mountain meadow zone.

According to the results of the survey, it was revealed that an important factor in the development of geodynamic processes in the high mountains of the Greater Caucasus is the composition of the underlying rocks, which are sufficiently malleable to erosion and denudation processes, especially in the conditions of heavy rainfall typical of mountain areas.

At the same time, it should be emphasized that the implementation of studies to assess the degree of degradation using materials of aerial and space photography at this stage without conducting field surveys is extremely difficult and this problem is not fully resolved at this stage.

It should be noted that the creation of one national park or nature reserve implies carrying out anti-erosion - forest reclamation, agrotechnical, organizational measures, carrying out roads, paths, organizing the work of various park services and providing services to tourists. These works require the involvement of local labor resources, which, in turn, is an important tool in solving the problem of employment of residents of high mountain settlements (Table 1).

Table 1.

Scheme of anti-erosion measures in the mountain meadow belt of the Greater Caucasus

The degree of erodedness	Measures
Non-eroded	A) regulation of cattle grazing, use of a pen system
	B) the use of conservation regime, the monitoring of the status of biological diversity and chemical composition of soil and plant groups
Slightly eroded	A) the creation of protective dams in steep areas (150-200), preventing surface runoff and the formation of furrows, the use of park mode
	B) work to improve the surface (grass seeding, cleaning scree and placer materials, preventing runoff and the formation of furrows)
Medium-eroded	A) grasslands on the northeastern slope of the Greater Caucasus, fertilization, the creation of protective dams, the temporary cessation of grazing, reclamation of ravines, the cessation of their development
	B) the creation of protective dams on the southern slope of the Greater Caucasus, preventing the development of ravines and their amelioration, termination of cattle grazing
Strongly eroded	A) stopping livestock grazing, creating hydraulic structures to limit surface runoff, preventing the development of ravines and their amelioration
	B) grass seeding on slightly inclined plots, mainly, on the northern slopes, less exposed to the effects of heavy rainfall

The southern slope of the Main Caucasus Range, including its high-mountainous part, represented by mountain meadow and rock-nival landscape belts, is attractive for tourist routes due to the presence of both natural and historical monuments. Such mainly walking paths can enable tourists to observe the diversity of natural conditions and the effects of natural elements, which are an integral part of these natural complexes.

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STUDY OF SOIL FERTILITY OF THE PLAIN AREA OF ORDUBAD ADMINISTRATIVE DISTRICT

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Ordubad administrative district borders Armenia to the Northeast, The Islamic Republic of Iran to the South, and Julfa administrative district to the West. The main reason for the small number of fertile and agricultural lands in the territory of the administrative region is that, most of the region consists of high and steep mountains, and at the same time, as a result of seasonal water erosion, the soil cover of the Ordubad sloping plain is covered with stones of different sizes. Thus, in general, 6.4% of the fertile lands included in the territory of the Nakhchivan Autonomous Republic belong to the mentioned administrative region. The productivity of ephemerals in the plots is in the middle and end of May, and the productivity of wormwood and soronotus coincides with the end of September and mid-October. In the plain area of the administrative district - alluvial-flooding soils on the river banks, light chesnut-brown, chestnut-brown soils from the rivers banks to the mountains, alluvial-flooding, marshy-meadow on the banks of the Araz River, and in the center of the sloping plain there are large stony areas, stony-pebble brown, gray-brown soils. As a result of the analysis of the samples taken from the soil sections placed in the research area, it was determined that the amount of humus in the upper accumulative layer of alluvial-flooding soils is 1.34%, the amount of total nitrogen is 0.09%, the amount of active phosphorus (P_2O_5) is 13.17 kg/hectares, exchange the amount of potassium (K_2O) was -223 mg/kg, pH indicator - 8.6. Accordingly, in gray-brown soils, the amount of humus in the top layer of the profile was 2.09%, the amount of total nitrogen was 0.1%, P_2O_5 - 3.44 kg/hectares, K_2O - 494 mg/kg, the reaction of the soil solution was 8.18, the amount of humus in the chesnut-brown soils is 1.39%, the amount of nitrogen is 0.04%, P_2O_5 is 74.43 kg/hectares, K_2O is 132 mg/kg, and the acidity of the environment (pH) is 8.03. Based on the stock materials of the soil cover of the study area and the results of personal field-soil and laboratory studies, the modern fertility characteristics were estimated.

Key words: *Alluvial-flooding, Chestnut-brown soils, Fertility indicators, Gray-brown soils, Ordubad administrative district.*

INTRODUCTION

The current global transformation of the Earth's surface and the widespread degradation of ecological factors have led to a significant and urgent threat of ecological disasters. In this regard, there is a need for comprehensive work to assess the ecological condition and balance of the region, as well as to protect the biosphere from negative ecological factors, focusing on the evaluation of soil cover.

Ensuring soil fertility and achieving sustainable agricultural production are global challenges in our era. Increasing agricultural productivity and improving soil fertility primarily rely on advancements in agricultural technologies, selection, land reclamation, irrigation, the use of fertilizers, proper soil management, and planned utilization, which have yielded significant results. However, in terms of energy enrichment components, such as the conversion of photosynthetic materials - the products of humus and other organic substances, new approaches need to be developed to ensure the high productivity of soils and their sustainable fertility [1,2,3].

MATERIAL AND METHODS

The research object is considered to be Ordubad region, located in the far eastern part of the Nakhchivan Autonomous Republic, at geographical coordinates of 38° 54' E and 46° 02' N, with an altitude of h = 1895 m above sea level, covering a total area of 972 km2. It is bordered by the Julfa region in the west, the Zangezur mountains and Armenia in the north and east, and Iran through the Araz River in the south.

The physical and chemical properties of soil samples have been determined by the Ministry of Agriculture of the Republic of Azerbaijan, specifically the Absheron Regional Agrochemistry Laboratory, using the following accepted methods:

1. The granulometric composition of soils was determined according to N.A. Kacinskiy.
2. The environmental reaction (pH) was measured using the apparatus PH-GOCT26423-85.
3. The humus content was determined using the Walkley-Black method.
4. For the determination of total nitrogen, the C.E. Keldahl method was employed.
5. Phosphorus content was analyzed using the Olsen method, and for phosphorus soluble in water, the B.P. Matchygin method was used.
6. Exchangeable potassium was determined using the ammonium acetate method.

RESULTS AND DISCUSSION

One of the most important factors that limit the development of irrigation agriculture in Azerbaijan, including the Nakhchivan Autonomous Republic (NAR), as well as in all irrigated districts of the country, is the degradation of lands due to erosion, denudation, and extensive erosion processes in mountainous and hilly areas, which result in the loss of topsoil and require the implementation of appropriate agrotechnical and land reclamation measures for soil conservation and fertility restoration. Therefore, the study of soil fertility is crucial in this regard[3]. The Nakhchivan Autonomous Republic consists of 8 administrative districts: Ordubad, Julfa, Shahbuz, Babek, Nakhchivan, Kangarli, Sharur, and Sadarak. The dominant features of Nakhchivan's relief are rocky outcrops and steep slopes, which often occupy a significant area devoid of soil cover, consisting of crystalline formations. Particularly, the southern and eastern exposures of steep slopes experience increased denudation with the increase in slope gradient. The lower zone, stretching parallel to the Araz River valley and its left tributaries, with a width of 15-30 km, is divided into the lower accumulative semi-zone and the upper semi-zone. Here, there are river valleys and narrow interfluves. The high mountainous part has a continuous chain of Zangezur and Dereleyez ranges, which are composed of numerous volcanic peaks with elevations exceeding 3000 meters. In the middle and lower mountain belt and mountain-refuge belt, as well as in some areas of intermontane plains, there are deluvial-proluvial deposits [5].

The lower part of Nakhchivan, covered with the sediments of the Araz River and its left tributaries, is characterized by diverse alluvial plains with complex micro-relief consisting of nearby ridges, peaks, depressions, elevations, remnants, and other elements. This area is marked by the development of river terraces, floodplains, deltas, and other landforms [5]. From a geomorphological perspective, A.L. Reinqard [6] distinguishes three geomorphological zones in the Nakhchivan area: the Paleozoic-Triassic range adjacent to the Middle Araz Plain, the high mountainous zone of the Kapichay system with elements of glacial structures, and the Nakhchivan basin of the Araz River. S.S. Kuznetsov [7] identifies three regions: the northern-eastern part of high-level peneplains, mid-level peneplains beneath the Mesozoic and Paleozoic eras (reaching approximately 2500-3000 m from the left bank of the Araz), and mid-level peneplains in the Neogene lithoplastic. B.A. Antonov [8] distinguishes the following geomorphological regions: 1. High mountains of the continental development; 2. Middle mountain range occupying more than half of the autonomous territory; 3. Low mountain and hill terrain with continental development; 4. Fluvio-alluvial-proluvial plains; 5. Alluvial-proluvial plains; 6. Alluvial-proluvial piedmont plains of the central part of the Sederek plain; 7. Alluvial-proluvial piedmont Upper Third plains; 8. Plains consisting of clayey-loamy and loamy alluvium, and valleys of terraced Aran rivers; 9. Channel plains of the left tributaries of the Araz River. According to the materials of the Geological Institute of the Academy of Sciences of Azerbaijan in Nakhchivan, the Zangezur-Mehri-Ordubad intrusions (Lower Miocene-Upper Eocene) are widely represented along the southern-western slope of the Zangezur Range with a distribution width of 2-12 km along the riverbed, shifting to contact-metamorphic rocks in the west [6]. In the middle course of the Arpachay River, there are Upper and Middle Devonian rocks in the mountainous zone. The western margin of the Dereleyez Range is characterized by significant areas of carbonate rocks of the Triassic system. The Nakhchivan Basin is considered part of the Middle Miocene's development of the Caspian-Black Sea basin, where colorful sandy-clayey sediments are observed along with salt and gypsum deposits in the Upper Middle Sarmatian [9]. In the northern-western part of the Nakhchivan Autonomous Republic, relics from the ancient Devonian period and widespread sand and sandstone deposits of the Paleozoic era can be found [10].

The Nakhchivan Autonomous Republic has a continental climate with hot summers and harsh winters, which can be divided into five types [11]:

Semi-arid and arid desert climate with hot summers: This climate type covers the Araz Plain and partially the low mountainous regions (600-1100 m). The average annual temperature ranges from 10-14°C, average annual precipitation is up to 300 mm, and potential evaporation is around 1200-1400 mm. The hottest month (July) has an average temperature of 29°C, while the coldest month (January) has an average temperature of -3 to -6°C. Snow cover lasts for about 20-40 days throughout the year.

Semi-arid and arid desert climate with dry winters: This climate type encompasses the upper part of the lowland zone and the lower part of the middle mountain zone (1100-1600 m). The average annual temperature ranges from 8-10°C, average annual precipitation is around 300-350 mm, and potential evaporation is approximately 800-1100 mm. The hottest month (July) has an average temperature of 21-26°C, while the coldest month (January) has an average temperature of -4 to -6°C.

Semi-arid and arid desert climate with dry summers: This climate type covers the upper part of the middle mountain zone and the lower part of the high mountain zone (1600-2600 m). The average annual temperature ranges from 6-10°C, with the hottest month (July) having an average temperature of 16-20°C and the coldest month (January) is having an average temperature of -6 to -10°C. The average annual precipitation varies between 400-800 mm. In the warmer half of the year, rainfall ranges from 300-400 mm, while in the colder half; it ranges from 200-400 mm.

Semi-arid and cool climate with dry summers: This climate type is found only in the central zone of the high mountain range in the Zangezur Range at an elevation of 2600-3200 m. The average annual precipitation is 600-700 mm, and the average annual temperature ranges from 1-3°C. The hottest month (August) has an average temperature of 8-12°C, while the coldest month (January) has an average temperature of -10 to -13°C.

Climate of alpine tundra: This climate type covers the high mountain peaks above 3200 m. It is characterized by cold winters and summers, less precipitation, and relative humidity compared to the previous type. The average annual temperature ranges from -3 to 8°C. The hottest month has an average temperature of 2-8°C, while the coldest month has an average temperature of -13 to -16°C.

The western part of the Nakhchivan region is generally drier. In the mountainous areas, the hydrographic network is well developed, while the soil cover is subject to erosion and leaching. The main rivers in the region include the Araz, Chanakhchy, Arpachay, Nakhchivanchay, Alinjachay, Karaderi, Gilanchay, Duglunchay, Venendchay, Aylis, Ordubadchay, Kazanchay, Ketemchay, and Kilitchay.

The annual flow of the rivers in the Autonomous Republic of Nakhchivan exceeds 1 billion cubic meters, with the Arpachay River accounting for nearly 600 million cubic meters. The main portion of the water flows during the spring (April-June), and the peak water demand period (July-August) represents 7-17% of the annual flow [12].

The fundamental beginnings of soil research in the Nakhchivan Autonomous Republic are associated with the name of S.A. Zakharov. Subsequent studies on the genesis, geography, physical, chemical, and physicochemical characteristics of soils were continued by H.A. Aliyev and A.K., resulting in the preparation of a soil map that completed Azerbaijan's soil map.

In their book "Soils of the Nakhchivan ASSR," the authors note that the soils formed under various physical-geographic conditions in the autonomous republic differ sharply from each other and carry their own distinctive features. Taking into account ecological factors and analytical results, the authors propose the following soil types [6]:

Soils of mountainous areas: 1. Mountain grass-cereal and Initial grass-cereal; 2. Rocky Mountain cereal-desert; 3. Mountain cereal-forest; 4. Flooding alluvial; 5. Mountain brown; 6. Underdeveloped mountain brown; 7. Mountain brown emerged from under the forest; 8. Urbanized mountain brown; 9. Mountain gray-brown; 10. Carbonate mountain-black; 11. Mountain sierozem.

Soils of plain areas: 13. Sierozem; Open sierozem; 14. Anciently transported open sierozem; 15. Transported open sierozem; 16. Gray-chernozem; 17. Gray soil; 18. Anciently transported gray soil; 19. Alluvial gray soil; 20. Initial gray soil; 21. Transported cereal-soil; 22. Shorans.

According to the Soil Science and Agrochemistry Institute of the Ministry of Education and Science of the Republic of Azerbaijan, in the 1:200,000 scale Soil Map of Azerbaijan (Baku, 2022) organized by economic regions, the following soil types are distinguished in the Ordubad administrative district: 1. Mountain cereal; 2. Mountain cereal-steppe; 3. Urbanized mountain-black; 4. Mountain brown; 5. Mountain gray-brown; 6. Transported mountain gray-brown; 7. Transported soil; 8. Transported alluvial-cereal; 9. Shorans.

The productive soils within the territory of the Nakhchivan Autonomous Republic account for 6.4% of the mentioned administrative district. The productivity of ephemerals occurs in May, mid-May, and the end of May, while the productivity of grass and sorghum coincides with the end of September and mid-October. In the plain areas of the administrative district, alluvial-flooding, open-sierozem, sierozem, alluvial-f on the banks of the Aras River, swamp-cereal, and stony areas, stony-chalky soils are widespread.

Segment №1: Located on the left bank of Düylünçay, Aza village (N 38°55175, E 148°376) is characterized by weakly developed alluvial-cement soils with flooding flat areas and brought-in sediments. The soil consists of carbonate-rich, loamy-silty alluvial-proluvial deposits. The area is used for cultivating vegetables, pumpkins, fodder, and fruit-bearing plants. The climate is characterized by cold winters and hot summers, with an overall annual precipitation of 250-300 mm. The average annual temperature ranges from 13.5 to 14.6°C. The moisture coefficient is less than 0.3, and the total evaporation is 122-128 kkal/sm^2. Samples taken from the eastern part of Anaqut mountain indicate the presence of fine-grained soils. The content of <0.01 fraction ranges from 64.12% to 71.52%. The humus content is 2.91%, and the total nitrogen is 0.02%. The soil reaction is neutral, with a pH of 8.14. The content of P_2O_5 (phosphorus pentoxide) is 16.60 kg/ha, and K_2O (potassium oxide) is 631 mg/kg.

Segment №2: Located near the Ordubad district in the valley of a river (N 38°5667, E 055°96.26), Segment №2 is characterized by weakly developed alluvial-cement soils. These soils have a fine-grained loamy-silty composition, with the physical clay content ranging from 61.56% to 68.77%. The soil reaction is neutral, with a pH of 8.18 in the water suspension. The humus content is 2.21%, which is considered satisfactory according to R.H. Mammadov's [13] classification. The total nitrogen content is 0.16%. The content of P_2O_5 is 15.46 kg/ha, and K_2O is 523 mg/kg.

Segment №3: Segment №3 is located on the right bank of Ordubadchay in Ashagi Endemic village. The soils in this area are weakly developed alluvial-cement soils, with a fine-grained clayey composition. The content of <0.01 mm fraction ranges from 24.61% to 28.22%. The humus content is 2.04%, and the total nitrogen content is 0.13%. The soil reaction is neutral, with a pH of 8.27. The content of P_2O_5 is 5.0 kg/ha, and the exchangeable K_2O is 274 mg/kg.

Section №4 is located in the village of Biləv on the right bank of the Gilan River (N 39°03.623 E 045°49.683). It consists of moderately developed mountain-steppe soils formed at an altitude of 2800 meters above sea level. The soil is formed by the weathering and eluvial deposits of the surrounding rocks. The vegetation in this area is dominated by subalpine steppe grasses and is used for grazing and hay production.

The climate in this region is characterized by cold winters and warm summers. The average annual precipitation ranges from 550 to 600 mm, and the average temperature varies between 4.2 and 5.1 °C. The moisture regime is mesic (K=1), and the active temperatures range from >10°C to 120-150 days. The grass layer is relatively thin, with a thickness of 8-12 cm, and the root system is mainly distributed within the depth of 10-30 cm. The humus layer is light brownish-gray, with a thickness of 13-18 cm and a content of 1.39%, indicating a low humus content. The total nitrogen content is 0.04%.

According to the granulometric composition, these soils are moderately clayey, with a physical clay content ranging from 32.44% to 43.12%. The soil reaction is alkaline, with a pH of 8.03. The exchangeable bases in the soil amount to 30-40 mmol/100 g. In terms of nutrient content, the soil contains 74.43 kg/ha of P_2O_5 and 132 mg/kg of K_2O.

Section №5 is located in the village of Dəstə in the Ordubad district (N 38°53.643 E 045°53.769). The developed brown soils in this section are distributed in depressions at an altitude of 800-1000 meters above sea level. These soils are formed by deluvial-alluvial loamy silts, carbonate, and saline alluvial loams. They are suitable for technical, dense, and vegetable crops. The climate in this area is characterized by cold winters and hot summers, with an average annual precipitation of 250-300 mm and an average temperature of 13.5-14.6 °C. The moisture regime is xeric, with a moisture coefficient of less than 0.3. The active temperatures in the area are above 10°C and range from 3900 to 4600°, with a duration of 300-330 days.

The mineral soil horizon is 35-40 cm thick, and the plow layer is 25-30 cm thick. The humus layer is light brownish-gray, with a thickness of 40-45 cm and a content of 1.34%, indicating a low humus content. The total nitrogen content is 0.09%. According to the granulometric composition, these brown soils are moderately clayey, with a physical clay content (<0.01 mm) ranging from 24.31% to 28.63%. The soil reaction is alkaline, with a pH of 8.6. The nutrient content in the soil is 13.17 kg/ha of P_2O_5 and 223 mg/kg of exchangeable K_2O.

Section №6 is located on the western slope of Anaqut Mountain, and it is characterized by carbonate-rich, reddish-brown mountain-steppe soils (N 38°58.726 E 045°57.089). These soils are moderately clayey according to their granulometric composition, with a physical clay content ranging from 23.77% to 16.89%. The soil reaction is slightly acidic, with a pH of 7.64, close to neutral. The humus content is moderate, at 2.88%, and the total nitrogen content is 0.14%. The nutrient content in the soil is 33.21 kg/ha of P_2O_5 and 546 mg/kg of K_2O.

Section №7 is also located on Anaqut Mountain, but on the eastern slope (N 38°58.710 E 045°53.769). The soil type in this section is moderately developed mountain-steppe brown soils. They are formed at an altitude of 2800-3100 meters above sea level on clayey, eluvial-deluvial deposits. The vegetation in this area mainly consists of dense and xerophytic plant formations, primarily used for grazing. The average annual precipitation is 550-600 mm, with an average temperature of 7.3-8.5 °C, and the moisture coefficient ranges from 0.7 to 1.1. The active temperatures occur above 10°C and range from 1000 to 3000 degree-days. The grass layer is 11-14 cm thick, and the main root system extends to a depth of 20-40 cm. The humus layer is dark brownish-gray, with a thickness of 20-40 cm and a content of 2.91%. The nitrogen content in the humus is 0.02%. The soil reaction is close to neutral, with a pH of 7.6. According to the granulometric composition, the soils are clayey. The physical clay content ranges from 52.65% to 57.88%. The nutrient content in the soil is 16.60 kg/ha of P_2O_5 and 631 mg/kg of exchangeable K_2O.

CONCLUSION

Based on the conducted research, it can be concluded that 6.4% of the productive soils within the territory of the Nakhchivan Autonomous Republic belong to the mentioned Ordubad administrative district. The productivity of ephemerals in the soil areas coincides with the months of May and June, while the productivity of clover and alfalfa coincides with the end of September and mid-October. In the flat areas of the administrative district, along the riverbanks, there are alluvial-flooding soils, open-meadow soils from the rivers towards the mountains, and Araz River banks have alluvial-flooding, marshy-loamy soils. In the center of the plain, there are large areas of stony soils, stony-loamy soils, and scattered brown soils, which can be effectively utilized and improved in fertility through modern agricultural techniques and tools.

SUMMARY

The presented article focuses on the main soil types formed in the Ordubad district, which serves as the research object in the Nakhchivan Autonomous Republic. The morphological analysis of the genetic layers of soil profiles has been conducted, and the diagnostic features of the obtained

soil samples have been analyzed through physical, chemical, and physicochemical analyses. In addition to the climatic indicators of the area, the precise geographical coordinates of the sampling sections and their geographical location have been provided.

Keywords: Ordubad district, soil type, diagnostic features, soil profile, physical and chemical characteristics of soil, food substances.

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STUDY OF THE WATER-PHUSICAL CHARACTERS IN THE IRRIGATED SOILS OF MUGHAN PLAIN (COTTON, GRAIN PLANT)

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The comprehensive data about change of some üater-phusical characrers under different plants in the anciently irrigated meadow –grey soils have been given in the article. It was determined that pH index was 7.6-8.0 in the soils of the fields where the cotton was planted;but it was 8.1-8.5 in the areas with the barley; it was 7.8-8.5 in the field with wheat.

An average value of salt was 0.250-0.769% at 0-100cm of layer in the area with the cotton plant,but it was o.56-1.13% in the area with barley and 0.235-0.852% in the field with wheat.

The water minerlization which is used for plants irrigation was 0.84-0.98g/l; this indicator was 3.69-5.92-7.14g/l in drains and 3.24-2.78g/l in the water reservoir during the research.The fact that minerality of water used for irrigation is less than 1.0g/l indicates that it is suitable for watering plants.

A quantity of physical clay in the soils of the experimental areas was studied and their change by 32.28-63.80% along the profile shows the soils are light loamy and clayey. The soils are salinized to a weak, moderate, strong degree and they are weakly solonetzificated.

Key words: *irrigated soils, physical clay, salinized soils,pH, water mineralization.*

INTRODUCTION

The researches were performed on the amount of salts, bulky mass, special weight, humidity, water-absorption, porosity, groundwaters, their location levels and minerality change and so on in the soils of the same zone in order to learn these issues in the Mughan plain. From this point of view the scientists – V.R.Volobuyev, A.K.Behbudov, Kh.F. Jafarov, M.P.Babayev, A.Muradov, Y.G. Sultanov, G.Z.Azizov, M.G.Mustafayev and others'researches were comparative analized. The performed researches indicate that the same soils expose to salinization process when the soils used under various plants aren't utilized correctly, a need of plants for water wasn't taken into account during the irrigation, irrigation rates are applied more than required and agromeliorative measures are not taken. This leads to aggravation of water-physical characters of the soils and at least it causes decrease of productivity of agricultural plants[1].

The researches indicate that one of the main reasons of the same soil salinization is presence of groundwater with high mineral content which is very close to the surface of the soil. As the salt concentration in the soil increases, the development of both underground and above-ground organs of the plant weakens, the productivity decreases. Generally. It is recommended to provide appropriate showing water to achieve a reduction of salt according to the amount of plants.

RESEARCH OBJECT AND METHOD

The researches were performed in the anciently irrigated meadow-grey soils under various plants in the Mughan plain. The soils were salinized to ma different degree and weakly salonetzificated.Irrigation of plants was performed using irrigation canals taken from the Kur river.

During the research the soil cuts were put in the characteristic places, the soil samples were taken from genetic layers according to the method. The researches were fulfilled according to the widely used method in the republic: full and short water weight analyses, pH –saturated bases – Arinuskina[2],determination of physical clay-Kachinsky, salinization degrees for salt quantity and salt types were fixed according to the gradation offered by V.R.Volobuyev [3].

ANALYSIS AND DISCUSSIONS

It was determined based on the researches that correct use of the soils under tillage, providing water according to the plant's needs during the irrigation, application of fertilizers with norms in time led to both a decrease in the amount of salts and an increase in ptoductivity.(15-20%). In places where reverse of these processes is observed, the decrease in an amount of salts is very rare. As it is known the soils of the Mughan plain are used under the cotton plant. A need of the cotton plant for nutrients is higher than the other plants and it is necessary to meet the plant's demand for nutrients in time[3].A state of the soils used under the cotton plant was studied, the soil cuts were put(in 3 sections)in the same zone and essential analyses were fulfilled. So, some indicators of the soils in the experimental area qranulometric composition, hygroscopic humidity, absorbed bases and concise water weight analyses were defined. So, the ontained results indicate that an amount of the little particles is 19.80-63.80%(less than 0.01mm).

The soilforming and floor rocks of the experimental area consist of alluvial-prolluvial sediments. The soils are moderate and heavy loamy in granulometric composition. Microrelyef consist of micro-depressionsç they are cultivated soils. During the research development and productivity of the cotton plant on phases have been studied depending on soil saltness. The phonological observations have been performed in the vegetation period, and the number of the boll and its growth was determined.

It was known that the places where a quantity of the salts is little, exit and development of the plant is good, but the places where an amount of the salts is much, its reverse is observed.[4,5,6] .As a result of the of the water sample taken from the zone, but HCO_3 ion was 0.010- 0.030% during the research. Cl ion was 0.020-0.105%. The salt quantity in these samples (for dry residue)was 0.25-0.715%. The consequences show that an amount of the salt rises towards the low layers.

CO_3ion wasn't observed in the water samples taken from irrigation canal with concrete clad which was used for irrigation in the experimental area, a quantity of HCO_3ion was 0.034g/l in 2020, Cl ion was 0.060g/l, the these indicators relatively reduce in 2021, and was accordingly 0.031 g/l and 0.054g/l. CO_3,$HCO_3$and Cl-ions were less in the content of the drainage waters compared to 2020. So, their amount was 0.03g/l,0.549g/l and 1.034g/lin 2020, but they were 0.024g/l, 0.534g/l and 0.934g/l 2021. Mineralization of irrigation and drainage waters was less compared to 2020. So, mineralization of irrigation water was 0.715g/l and minerality of the drainage water was 4.858g/l in 2020, but in 2021 these indicators were 0.618 g/l and 4.522g/l.

The researches indicate that pH index was 7.6-8.0 in the areas with cotton plant, but it was 8.1-8.5 in the barley areas, the index was 7.8-8.5 in the field with wheat. An average value of the salt quantity was 0.250-0.769% at 0-100cm of layer in the cotton field, but it was 0.56-1.13% in the barley area and the index was 0.235-0.852% in the wheat field.

The soils weren't salinized, they were salinized to weak moderate and strong degree. As it is seen that very little changes were observed either in the amount of salts in the soils along the profile or in the mineralization of the waters.In some places the salt amount had increased, if only a little.Because it was impossible to perform additional agromeliorative measures in the same areas[7].

The available classifications were used for definition of salt types in the research soils. The same classifications found their large application and at present they are used both in the republic and in the countries of CIS. The abovementioned classifications were used for definition of salt types in the research soils. The same classifications fount their large application and at present they are used both in the republic and in the countries of CIS. The abovementioned classifications were used for definition of the salt types in the research soils. []. It was determined that a quantity of Cl ion made up 18.93-23.01 % of the amount of salts, the salt type was sulphate –chlorine for indicators(for 2-1 gradation) of Cl /SO_4-ratio in all the samples.

CONCLUSIONS

1/The researches show that pH index in the experimental area was 7.6-8.0(in Javad village)in the cotton fields, it was 8.1-8.5 (Yastigobu village) in the barley areas, but in the wheat field the index was 7.8-8.5(Minbashi village). An average value of the salt quantity at 0-100cm of layer in the cotton field was 0.250-0.769%(in Javad village),but it was 0.56-1.13% in the barley area of the Yastigobu vollage and the index was 0.235-0.852% in the wheat field of the Minbashi village.

2. The consequences of the analyses show that minerality of irrigation water was 0.84-0.98g/l; the water mineralization in the drains was 3.69-5.92-7.14 g/l and 3.24-2.72 g/l in the water collector. The groundwater was observed in one place of the area of the Minbashi village and its minerality was 3.69g/l. The less water mineralization in 1.0g/l for irrigation in the experimental area indicates that

they are suitable for irrigation of plants. Physical clay was 32.28-63.80% in the soils of the experimental areas, the soils are light loamy and light clayey. SAB is 21.75-36.65 mg-eq, Ca from SAB is 56.37-68.52%; Mg -24.88-36.69%; and Na -5.49-6.85%. The soils are weakly solonetzificated.

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ECOGEOGRAPHICAL CHARACTERIZATION OF LIBERATED ALONG ARAZ TERRITORIES THROUGH GIS TECHNOLOGIES

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During the period of occupation of the territories of along Araz, agricultural land areas were not used for years, were not planted and cultivated, agricultural objects were destroyed, and thousands of hectares of arable land became unusable. Producing competitive agricultural products and forming a processing sector based on the principles of sustainable development in the liberated territories is considered one of the important issues ahead. All this makes it important to study the modern natural-soil-ecological conditions of the liberated along Araz territories. The territory of Zangilan, Jabrayil and Fuzuli districts included in the along Araz strip was taken as the research object, the total area is 3,142 km^2. Based on the purpose of the research, we collected and analyzed the literature and fund materials about the natural-ecological conditions and land cover of the along Araz territories liberated from occupation. At the next stage, using satellite data, 5 maps of the research area - height, inclination, isoline, salience and polar maps - were drawn up based on GIS technologies. According to the altitude map of the area, the altitude of the along Araz strip varies from 76 m to 2240 m above sea level. According to the prepared inclination map, 78.9% of the total area has an inclination indicator of less than 9 degrees. Steep slopes are a minority relative to the total area. 35% (108145 hectares) of the total area of the territories of the liberated-from-occupation along Araz strip has a slope of 0-2.56º, 13.4% (41206 hectares) has a slope of 9.1-17.9º, 6% (17531.7 hectares) is located at 17-30º inclination, and 1.7% (5304.6) is located at 29-65º inclination. The compiled polar map allows to obtain detailed information about the dip of slope, which affects all areas of people's economic activity in the study area.

Keywords: *along Araz, GIS technologies, relief, height, inclination and polar map, isolines*

INTRODUCTION

Historically, agriculture has been one of the most important areas for the economy of the along Araz regions, and played an important role in the overall development, improvement of the social welfare of the population, and the creation of new jobs. The results achieved in the agricultural sector of the region before the occupation, cotton and grape processing plants, modern animal husbandry complexes, water reservoirs, collector - drainage networks, care and attention paid to the land, were brought to a sad state during the occupation. A large number of agricultural objects existing in the fertile lands of the along Araz region were destroyed. As a result of Armenia's aggression, thousands of hectares of arable land have become unusable. As a result of deliberate fires in the areas, the upper, fertile layer of the soil and the living world were destroyed. Long-term non-planting and cultivation of the land has led to its deterioration, which does not guarantee a high yield from those lands in the future. The destruction of hydrotechnical facilities, collector-drainage networks, canals, and water basins as a result of the occupation is measured by a large amount of damage to agriculture, and if our lands were not under occupation, today the agricultural sector would be developed more rapidly and could become the most advanced sector of our economy. Of course, it is unacceptable that the agricultural lands under occupation are not used, cultivated or damaged for years, and it cannot be denied that it was possible to take thousands of tons of grain, cotton, potatoes, grapes, tobacco, and vegetables from those areas. Degradation of land and destruction of national genetic resources, product and food stores, destruction of agricultural machinery and equipment parks, failure of seed production and supply system, loss of agricultural specialists or forced removal from agricultural activities and other cases, without a doubt, the rural areas of the region had a serious negative impact on the economy. From this point of view, it is clear that the study of the modern ecogeographical conditions of the liberated along Araz territories is of great relevance.

MATERIAL AND METHODS

The territory of Zangilan, Jabrayil and Fuzuli districts included in the along Araz strip was taken as the research object, the total area is 3,142 km^2. Based on the purpose of the research, the following methods were used: 1 - characterization based on the collection, statistical analysis and analysis of literature and fund materials about the state of the research area before the occupation; 2 - drawing up digital maps of the research object using GIS technologies through remote sensing, using the ArcGIS program. Using GIS, it is possible to quickly and efficiently transform a cartographic image, create derivative maps and transform it to obtain new information from them. ArcGIS maps are very useful because they can be used to perform specific tasks. Digital maps created by using GIS and remote sensing data enable more accurate ecogeographical calculations and at the same time become an important tool in the integrated management of resources, all of which have great scientific and practical importance.

RESULTS AND DİSCUSSİON

The along Araz foothill plain is located in the south-eastern corner of the Lesser Caucasus. The southern border of the zone is bordered by the Islamic Republic of Iran through the Araz River, Armenia and Gubadli district to the west and northwest, the mountainous part of Karabakh to the north and northeast, and Beylagan district to the east. According to the relief features, the along Araz foothill plain can be characterized in most cases as mountainous areas and areas consisting of weak and sometimes barely perceptible fragmented small uplifts. Having a small undulating area, its shores consist of numerous small, dry creeks. The foothills of Megri, Bargushad, Teydag, Dagtumas, Chatandag, Tajar and other mountain ranges are located on the edges of the territory. Most of them are located in the east and southeast direction. The total elevation in the studied areas ranges from 80m (east) to 2269m (west) above sea level. Many rivers of the Lesser Caucasus, such as Okchuchay, Basitchay, Hakari, Chaxmag, Guru Chay, Kondalan Chay, Chepekan, Shopart, Chaylax, Guzgunlu, etc. rivers flow. A few plains stand out in the soft and hilly terrain: Yazi plain, Kayan, Haram plain, etc.

The valley part of the zone along Araz is characterized by a terraced relief with separate depressional micro-depression channels.

The geomorphological structure of the along Araz foothill plain is related to its geological structure. The along Araz foothill plain is divided into three large parts according to its geomorphological characteristics.

1. Arid denudation fragmented mountains;
2. Accumulative denudation plateaus and plains;
3. Accumulative plains.

This geomorphological division corresponds to the mid-mountainous, low-mountainous, and foothill plains in the valley of the Araz river from the orographic point of view.

1. Arid denudation fragmented mountains. Arid denudation mountains include middle, low mountains, as well as interalgae depressions formed at the end of the lower quaternary. Within these geomorphological divisions, Antonov (1959) distinguishes several unique regions. Hakara region forms the basin of the upper reaches of the Hakarichay on the southeastern slopes of Mikhtoken mountain.

The Tartar regions of the mentioned region differ from the flat elevations in the river valleys in that they are much smoothed and watery. In the south-eastern part of the district, the Hakari river suite is involved in the formation of the relief. In the area, the Hakara suite between the mouth of the Pranis river and the Gochazsu river forms the upper part of the Pirjan depression and is characterized by a smoothed relief. Unlike other regions, the Hakara suite in the described area covers the valley of the Hara river and is located in its tributaries. As in Tartar and Hakara regions, lava flows of the fourth period cover the terrace of the valley of the Gorchu river passing near the village of Kurdhaci. Lachin-Zangilan region covers part of the Hakari and Araz river basins. Cretaceous sediments, especially hard limestones, are widespread in the region. Volcanic-proluvial Hakari suite with shale-clastic sediments is widespread in the area. In the mountainous part, sediments are mainly related to the river valley.

The valleys of the rivers have deep cuts and large slopes: the terraces have remained in separate parts, the slopes of the valleys in the lower parts are sometimes very steep, which is explained by the revival of modern erosion processes as a result of uplift. Zangilan-Gubadli half-district is separated. This sub-region occupies the south-eastern part of Azerbaijan, occupies the west of the valley of the Bazar river, and is characterized by a sharply divided relief. There is a large depression (Katlovan) in the Okchuchay valley.

2. Accumulative denudation plateaus and plains. It includes Jabrayil-Martuni and Hakari-Bazarchay districts. They cover the foothills and sloping plains of the along Araz zone. Jabrayil-Martuni region occupies the foothills of the southeastern corner of the Lesser Caucasus, and is mainly covered with Jurassic, volcanic, Cretaceous and sedimentary rocks, and in the eastern part with Quaternary sediments. The described region can be divided into two half-regions: western and eastern. The terrain of the western half-region consists of divided valleys and watersheds of small rivers, covering the foothills. The arid conditions of modern relief formation mostly occupy Fuzuli and Jabrayil foothills, which can be considered a denudation area. Its rivers are characterized by wide terraced valleys and the presence of deluvial deposits on the slopes around them. The eastern half-region is characterized by fragmented hills, occupying the foothills in the northeast of the city of Fuzuli. Small rivers also consist of wide terraced valleys. The Hakari-Bazarchay river district is located in the middle and lower reaches of the Hakari and Bazarchay rivers and forms the sloping plain of the Araz river valley. Two sub-districts are separated here: Heryusin and Hakari.

Heryusin sub-district is located between the middle streams of Hakari and Bazarchay, and occupies the Karabakh tuff-lava or Herysin plateau. The Karabakh plateau forms a noticeable slope, gradually descending to the southeast, creating a monoclinal shape. The surface of the Heki plain is a fragmented flat hill, Okchuchay, Bazarchay and expands along the valley of Hakari rivers. Some places of the plain are formed by badlands along the slope of the river.

3. Accumulation plains. Accumulation plains occupy the narrow part of the river valleys, are composed of gravel, calcareous sand, volcanic sand and tend to the flat slope of the Araz river. The surface of the plain appears to represent the fifth terrace of the Araz river and its height is 110-120 meters. The first (1.5-2 m) and second (5-6 m) terraces on the slope of the valley consist of developed and layered clay and small stones. The third and fourth terraces occupy the surface of the along Araz plain, entering the fifth terrace. The plain is divided by the valleys of the Kondalanchay, Guruchay, and Gozlu rivers, and is also significantly divided by numerous dry valleys, and this division expands towards the Araz valley.

The density of rivers in the Karabakh volcanic plateau is the lowest. It is related to the Pliocene-Quaternary lavas of the area, broken by small rivers and containing atmospheric sediments. The largest river of the Lesser Caucasus, which is part of our research area, is the Hakari River. The Hakari and Tartar rivers have the same watershed, and their tributaries take their origin from the Karabakh volcanic plateau.

The territories of the regions included in the along Araz strip are geomorphologically mountainous, foothills and along Araz plains, and have complex relief conditions. The geological structure of the research area is very complex, starting from the sediments of the Jurassic period and reaching the sediments of the Quaternary period, all rocks are spread in the area. According to its geological structure, the territory is divided into two parts: The first part belongs to the mountainous and foothills, which is part of the Lesser Caucasus mountain system and is mainly covered with sedimentary rocks of the third period and their erosion products. They come to the surface in river valleys and steep slopes. The second part is the along Araz plain covered with Quaternary sediments. In the southwestern part of the mountainous area, intrusive rocks of volcanic origin are spread, which are mainly composed of porphyrite, basalt, granodiorite and diorite. All these rocks belong to the Lower Jurassic period. Intrusive rocks are most often found in the upper and middle streams of Khachinchay, Chandara, Okchuchay, Hakari and Kondalan river basins. Middle Jurassic volcanic rocks are spread in the area between Okchuchay and Araz rivers. The porphyritic rocks here are the same as the rocks in the Karabakh mountains. Intrusive rocks found near Razdara village in Zangilan district mainly consist of granodiorite. The composition is dominated by feldspar. Shenomal and

Senen-age limestones, sands and shales are widely distributed in the southern and northern parts of Zangilan region.

Most geologists consider the Lesser Caucasus Mountains as a geosynclinal region in their works. The foothill plain along Araz represents Upper Karabakh, which is close to it in terms of its geological structure, and the currently very fragmented middle mountainous country. As the south slope erosion is poor in soil cover in some places, the denudation potential is more intensive in these areas than on the north slopes.

In many cases, the Jabrayil sloping plain is similar to the Karabakh-Mil sloping plain. The Karabakh-Mil sloping plain borders the foothills of the Lesser Caucasus and descends to the valley of the Kura River. The Jabrayil sloping plain borders the Lesser Caucasus from the south and southeast (with the mountains of Karabakh and Zangezur) and descends to the river in the lower reaches of the Araz river.

In the upper Miocene, the Jabrayil sloping plain is actually composed of silts, clays, large sands and volcanic ash from Absheron continental sediments. These sediments covered irregularly spreading Mesozoic, Halogenous and Miocene sediments covered from the west and north and themselves spread monclinally over large areas. Hypsometric heights vary from 700-800 meters on the border with the foothills to 150-200 meters in the valley of the Araz river. The Jabrayil sloping plain with strong divisions leads to the valleys of Okchuchay, Hakari, Incechay, Gozluchay, Cherakenchay, Guruchay, and Kondalanchay. Other than Okchuchay and Hakari rivers, they form dry valleys in summer and are used for irrigation before reaching Araz. Upper Cretaceous sediments of the Cenomenian layer are widely distributed in the along Araz foothills. Cretaceous sediments in Upper Karabakh, the most Cenomenian outcrops in the Araz valley are noticeable in the vicinity of Jabrayil city. The characteristic features of the lithological composition of the sediments on the high terrace of the Hakari River are the significant predominance of ultra-basic rocks in their composition.

The description of the geological structure of the along Araz foothill plain showed that the dominant rocks here are composed of Quaternary sediments, as well as Jurassic and Cretaceous volcanic rocks. According to the data of Salayev (1958), the granodiorite eluvium in Gubadli region is characterized by the formation of rock fragments with rougher mechanical composition, weakly weathered, quartz sand. The relief of the along Araz sloping plain, formed on the cones of rivers, is relatively simple and consists of alluvial, eluvial and proluvial sediments. Among the geomorphological characteristics of the area, the erosion process played a major role in the formation of relief forms. Shirinov (1960) showed that the volcanic materials in the plains decrease compared to the mountainous part, and river stones increase instead. In general, the entire along Araz plain is composed of Quaternary sediments, which include sand, clay, clayey sand and river stones.

Araz along plain is covered with weathering materials. Clay shales, river stones, sand, tuff and conglomerates are most common here. In the ancient terraces of the rivers, the thickness of the river stones was very high, and it is clearly visible in the sections.

The research area geomorphologically consists of mountainous, foothills and along Araz plains, and has complex relief conditions. The territory of Zangilan region is geomorphologically mountainous and has complex relief conditions. It is divided into three parts according to its orographic structure.

1. Eastern foothills of Negriguney mountains;
2. South-eastern foothills of Barghusad mountains;
3. Araz coastal plains.

Megriguney mountains are the highest areas in the region, stretching from the south to the north and northeast. The highest point of Megriguney mountain is Bartaz (2269m), Shukurataz (2005m) and Kyzildash (1699m). Its average height is 1600-1800 m above sea level. All these mountains descend sharply from west to east. The southeastern foothills of Bargushad mountains cover the northern and northeastern part of the region. The relief here is simple compared to the relief of the Megriguney mountains. The highest point of this mountain in the region is Susendaghdr (1304 m). Susendag is very steep and steep in the direction of Okchuchay, and is composed of bare rocks. In the north-east direction, the inclination is relatively low and it is covered with forest.

The plain along Araz has a hilly terrain. The plain is quite wide in the north-eastern part of the district and narrows in the south and south-west parts, being replaced by the Megriguney mountains. From the above, it can be concluded that the eastern foothills of the Megriguney mountains are sharply divided and erosion processes are proceeding rapidly. All types of erosion occur in these areas. This leads to the deterioration of the environment and the ecosystem in general, and nutrients are washed away from the cultivated area. It was more exposed to erosion processes due to the lack of attention to agrotechnical rules while planting in the areas along Araz.

According to the researches of Antonov (1959), the geomorphological structure of the area can be divided into 4 zones:

1. Medium mountainous zone;
2. Low mountain and foothill zone;
3. Deluvial foothill plain;
4. Along Araz (Araz coast) sloping plain.

The middle mountainous zone covers the western part of the research area. It is sharply divided in the southern part and weakly divided in the north. The southern part of the mountain is not composed of limestone. It was less exposed to the erosion process since the western part is covered with forest. The valley of Bartazchay is covered with river stones and sand, and its slopes are very steep. Mount Asgulum, located in the central part of the middle mountainous zone, is distinguished by the presence of karst caves. Due to the fact that the southern foothills of the Asgulum mountains are poorly covered with vegetation, the erosion process has developed violently, and in many places the parent rocks have come to the surface. Asgulum mountain falls steeply in the direction of Okchuchay.

In the middle mountainous zone, the northern, that is, relatively poorly divided part covers the eastern foothills of the Bargushad Mountains. One of the biggest branches of Bargushad mountain is Pilasar mountain, which is a watershed and is located on the border of Azerbaijan and Armenia. The mountainous and foothill zone includes the low parts of the Megriguney and Bargusad mountains. In the southern part of this zone, eroded areas and exposed rocks are found. Here, stony and skeletal soils are more common. River rocks are mainly composed of granodiarid and porphyrites that make up the intrusive rocks. Limestones are also found here.

The delluvial foothill plain was formed as a result of accumulation, and materials eroded from the mountainous part were collected here. The relief of the Araz along sloping plain, formed on the cones of rivers, is relatively simple and consists of alluvial, eluvial and proluvial sediments. In the geomorphological characteristics of the area, the erosion process played a major role in the formation of relief forms. Shirinov (1960) showed that the volcanic materials in the plains decrease compared to the mountainous part, and river stones increase instead. In general, the plain throughout Araz is composed of Quaternary sediments, among which sand, clay, clayey sand and river stones can be represented.

Based on the literature and fund materials, after analyzing the collected data related to the relief, geology and geomorphology of the research area, we conducted research in the area based on satellite data. At this time, we have drawn height, slope, isoline, relief and polar maps of the research area based on GIS technologies. Initially, we downloaded the SRTM (Shuttle Radar Topography Mission) DEM (Digital Elevation Model) image from online resources through the Global Mapper program, and created an elevation map of the area through the ArcGIS software (Figure 1).

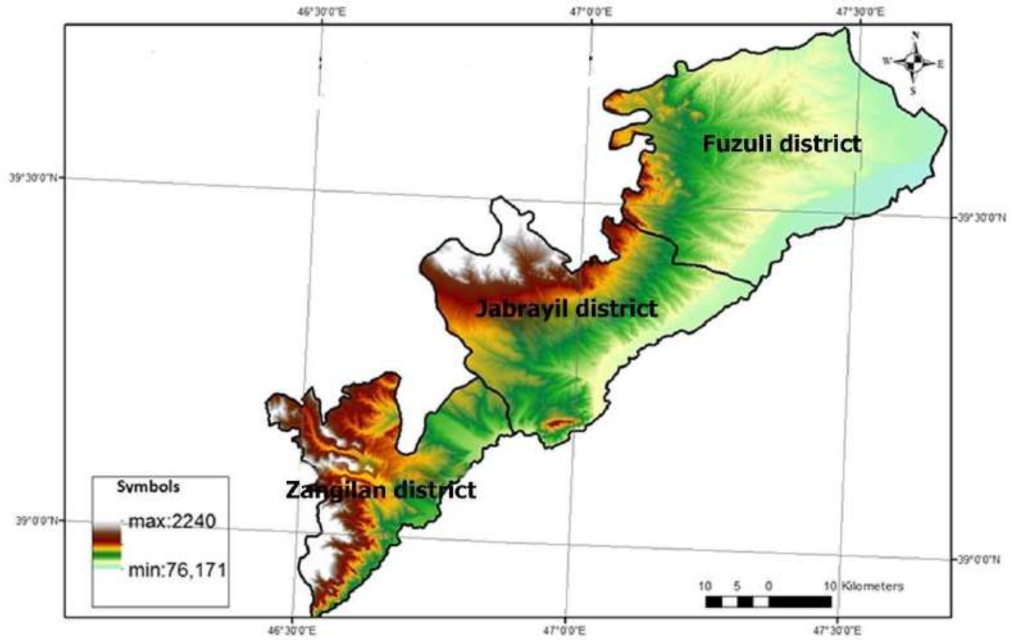

Figure 1. Height map of the research area

According to the description shown in Figure 1, the altitude of the Araz along strip varies from 76 m to 2240 m above sea level. When comparing the study area by regions, the most plains belong to Fuzuli region, and the altitude varies in the minimum interval. As the next processing step, we prepared the inclination map of the research area based on DEM. For this, the Slope tool in the ArcGIS program was used, the slopes of the area were determined, and the slope maps, in turn, can be used by researchers to identify and evaluate the most vulnerable areas in many cases, for example, in floods (Figure 2).

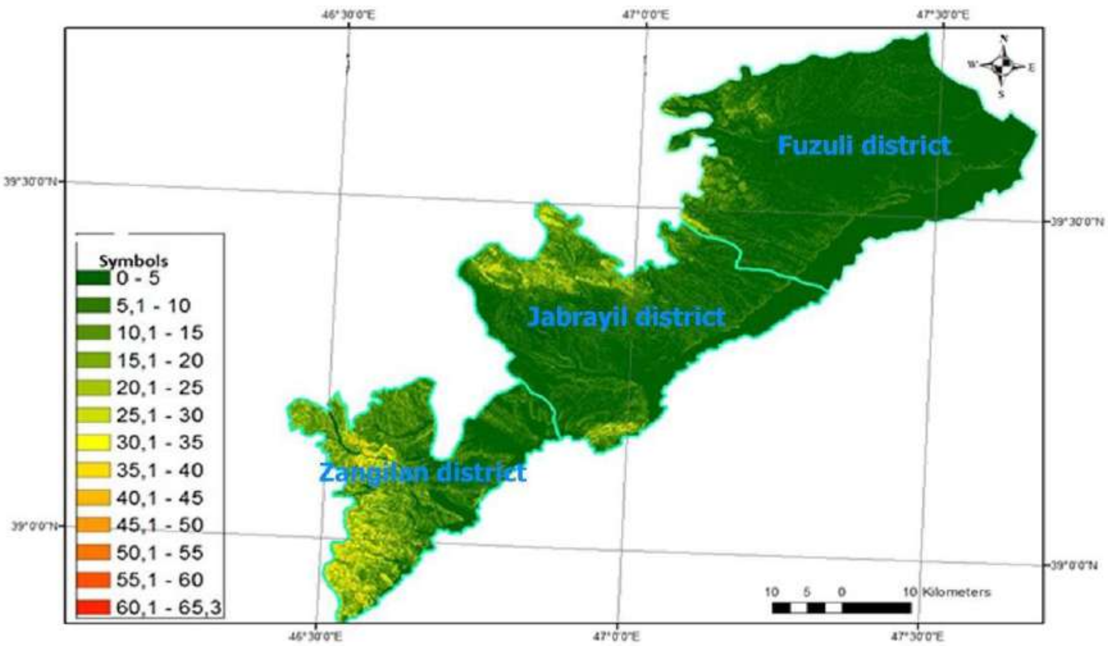

Figure 2. Propensity map of the research area

According to the image shown in Figure 2, the inclination in the study area increases from 0 degrees to 65.3 degrees, and if we pay attention to the image, it is clearly observed that the inclination of the area is high in Zangilan district and low in Fuzuli district.

Table.

Indicators of inclination of the longitudinal along Araz strip

FID	Shape *	GRIDCODE	(degree)inclination	area	percentage
0	Polygon	1	0-2,56	108145,4ha	35%
1	Polygon	2	2,56-5,64	91773,3ha	29,7%
2	Polygon	3	5,64 - 9,22	43756,2ha	14,2%
3	Polygon	4	9,22 - 13,23	24584,5ha	8%
4	Polygon	5	13,23 - 17,94	16621,5ha	5,4%
5	Polygon	6	17,94 - 23,06	11262,8ha	3,6%
6	Polygon	7	23,06 - 28,95	7268,9ha	2,4%
7	Polygon	8	28,95 - 36,64	4079,4ha	1,3%
8	Polygon	9	36,64 - 65,34	1225,2ha	0,4%

9 degrees are divided according to the map of inclination in the research area. As can be seen from the table, the inclination index of 78.9% of the total area is less than 9 degrees. High-sloping slopes are a minority relative to the total area. 35% (108145 ha) of the total area of the territories of the freed-from-occupation along Araz strip are at 0-2.56º inclination, 13.4% (41206 ha) at 9.1-17.9º inclination, 6% (17531 .7 ha) is located at 17-30º inclination, and 1.7% (5304.6) is located at 29-65º inclination.

In the next stage, an isoline map of the research area was drawn up by us. Here, an isoline map of the area was prepared by inserting the DEM image as the initial data using the Contour tool (Figure 3). Through the isoline we can, for example, analyze the distance between isolines, visualize flat and steep areas. The interval between isolines is 200 m.

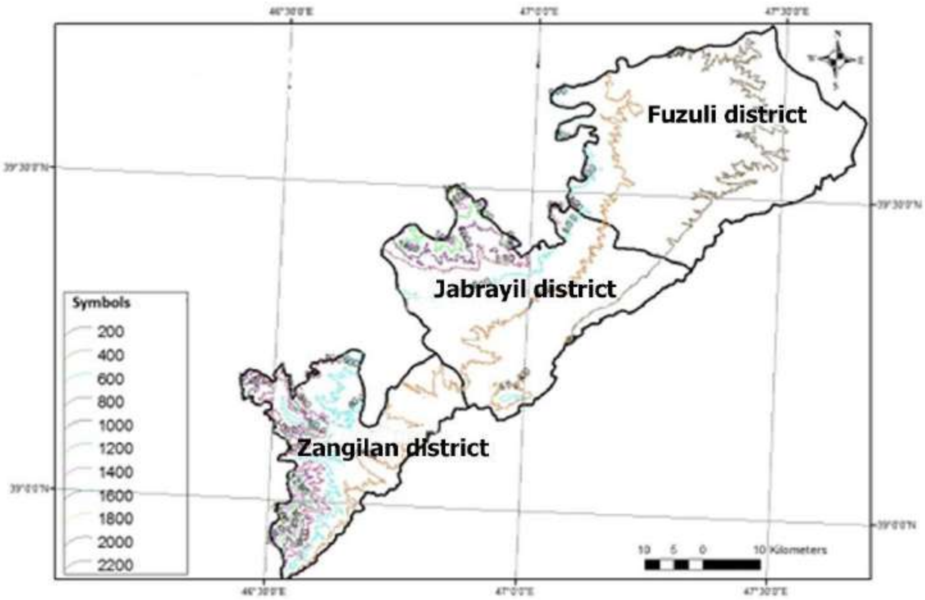

Figure 3. Isoline map of the research area

Next, the salience of the research area was studied. For this, a DEM image was obtained as initial data using the Hillshade tool. The result we obtained is shown in figure 4. The relief map provides complete visual information about the relief of the area by providing a 3D view of the relief of the research area. It is a technique where a lighting effect is added to the map based on the elevation change within the landscape. It simulates the effects of the sun (lighting, shading) on hills and valleys, providing a clearer representation of topography. Shadow and light are shades of gray associated with integers from 0 to 254 (increasing from black to white).

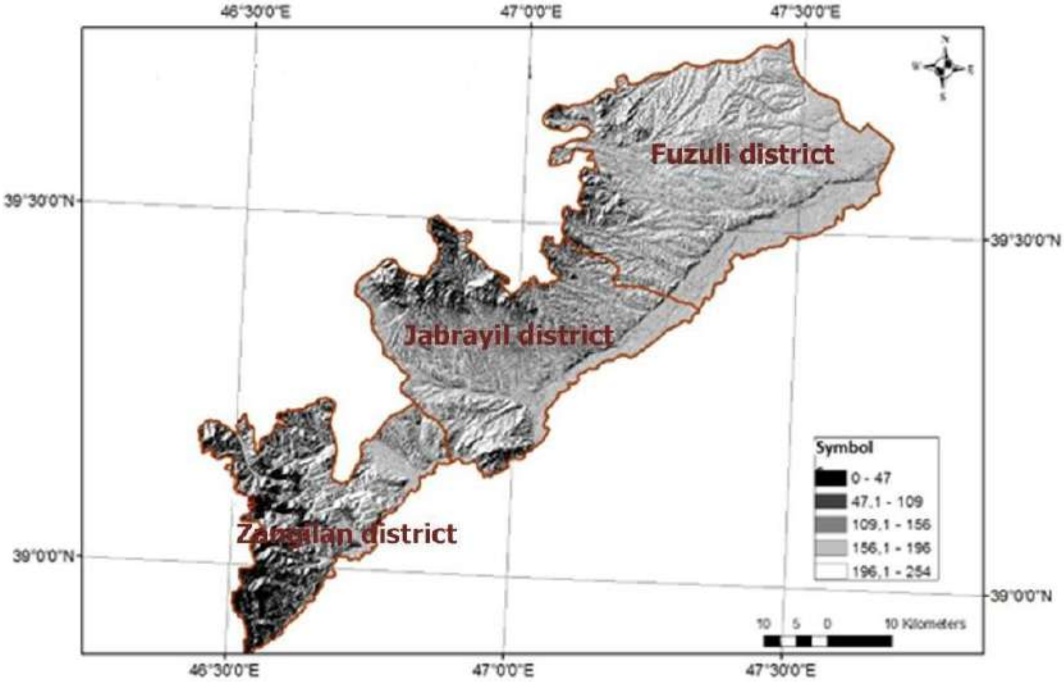

Figure 4. Relief map of the research area

The Aspect tool was used in the drawing of the polar map of the research area, through which the DEM image was recorded as initial information, the result we obtained is reflected in Figure 5. The polar map of the study area provides detailed information about the slope exposure. Slope exposure is one of the main factors involved in the change of macro and microclimatic conditions, mainly the interaction of heat and humidity. The steepness of the slopes is considered to be more effective in macro slopes, less effective in meso slopes, and weak in micro slopes. Different types of air masses within the geocomplex have different effects on slopes with different exposures. The visibility of the area affects all areas of people's economic activity. Therefore, in addition to the scientific-theoretical importance of the slope, the observation has great practical importance.

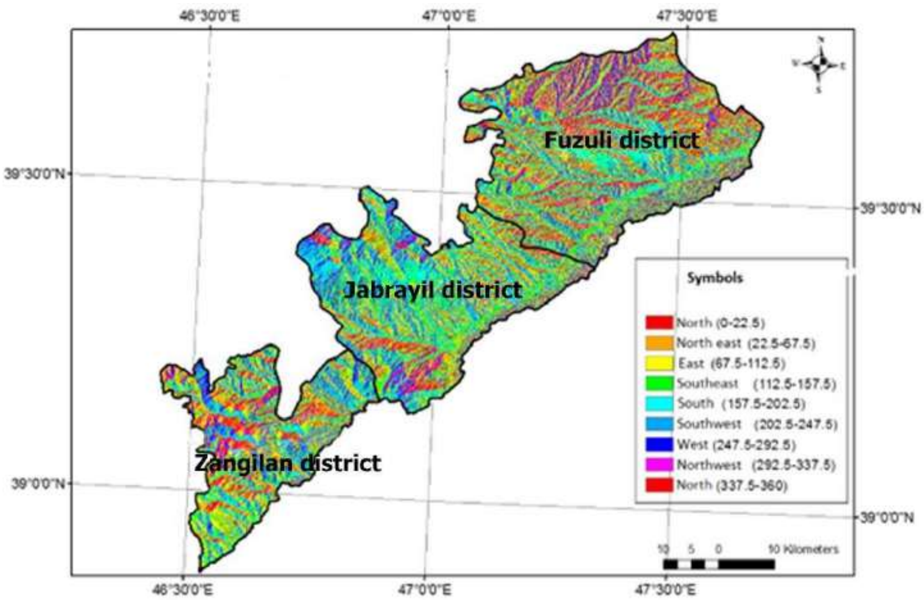

Figure 5. Polar map of the research area

CONCLUSION

Literature and fund materials about the natural-ecological conditions and land cover of the liberated along Araz territories were collected and characterized on the basis of statistical analysis and analysis. At the next stage of the research, 5 digital maps - height, inclination, isoline, convexity and polar maps were compiled using the GIS technologies of the area using satellite data. According to the altitude map of the area, the altitude of the along Araz strip varies from 76 m to 2240 m above sea level.

78.9% of the total area has an inclination indicator of less than 9 degrees according to the prepared inclination map. High-sloping slopes are a minority relative to the total area. 35% (108145 ha) of the total area of the territories of the freed-from-occupation Araz along strip has a slope of 0-2.56º, 13.4% (41206 ha) has a slope of 9.1-17.9º, 6% (17531.7 ha) is located at 17-30º inclination, and 1.7% (5304.6) is located at 29-65º inclination. The prepared polar map allows to obtain detailed information about the slopes of the research area.

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LAND ADMINISTRATION FOR SUSTAINABLE DEVELOPMENT

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The land administration system (LAS) provides the country with the infrastructure to implement the land policy and land management strategy. In modern administration, land contains land resources, buildings and also water environment. The land administration paradigm can be used by any organization, especially national governments, to design, conceptualize, and monitor their LAS. In order to achieve sustainable development of land administration, cadastral work, land registration and mapping should be based. These processes require a strategically integrated approach to implement or facilitate the four main functions of land management – land entrepreneurship, land valuation, land use and land use development. The land governance paradigm encourages developed countries to achieve highly organized governance, while encouraging developing countries to improve governance, often creating effective land markets, to reduce food and land insecurity. Regardless of whether countries use private property as the basis of their land rights, land security and land governance are the most important imperatives for the new role of land administration in supporting sustainable development. Regardless of whether the country is an economically developed country, it is important to improve and improve the existing systems. Thus, the Article deals with developing the ability of land administration to manage change. Jalilabad cadastral district has been selected as the research area.

Keywords: Land management systems, Land policy, Capital, Cadastre, Spatial information infrastructure.

INTRODUCTION

The Land Administration System (LAS) provides the infrastructure for implementing a land policy and management strategy for sustainable development. This includes the structure of organizations, legal structures, processes, standards, land information, management and systems of disagreements, technology that provides designation, land market, evaluation, control of use, increasing the efficiency of land. The example of land management provides a concept for innovation and its adoption in LAS. The paradigm as a set of principles and rules defines the conditions of land management as a rule. The principles and rules relate to the 4 functions of LAS - land entrepreneurship, land valuation, land use and land development, as well as their interrelationships. These 4 functions determine the efficient use of land and the efficient management of the land market. LAS fully reflects the duties of people within the unique social structure of each country. This includes effective management, organizational skills, community development, social interaction and a focus on users rather than providers. LAS should be organized in the direction of more efficiently meeting the needs of land users - citizens, the state and entrepreneurs (Ian Williamson et al.,2014).

The tasks of the society, people's thoughts about land form the core of LAS. This should be achieved through effective management. Implementation of a useful, sustainable process requires increasing the necessary knowledge of society, organizations and individual entrepreneurs in this matter. LAS is the basis for creating legal issues, limitations and responsibilities related to people, place and politics. Legal issues are mainly related to entrepreneurs and forms of ownership, while restrictions control land use and activities. Responsibilities are more related to social, ethnic obligations or attitudes towards the environment and agriculture (Mammadov. G. Sh.,2003).

The cadastre, which is the basis of LAS, ensures the geo-spatial integrity and unique identification of each land plot. Cadastre is a broad-scale indicator of how people divide land for land use. Many cadastres ensure the security of land ownership according to land rights in the land register. Spatial uniformity within the framework of the cadastre is ensured by cadastral maps updated by the cadastre. The uniformity of a land plot forms the link between cadastral maps and the land register and acts as the basis of LAS. Cadastre includes all forms of land ownership - state, municipal and private ownership. It should be noted that the Jalilbad cadastral district was taken as the research area, and 3 ownership forms were developed by us.

The dynamism of LAS is determined by 4 factors. The first includes changes affecting the sustainable development of human-land relations. This development can be caused by economic, social and natural forces. Information technologies and globalization are related to the second. The third factor is the dynamic nature of information within LAS. For example, change of entrepreneurship, assessment, change of land plots. The fourth factor covers changes in the use of land area data.

An efficient and useful LAS geo-spatial database that ensures sustainable development is required. A geospatial database is a tool that connects people with information. Ensures the creation of baseline environmental data for sustainable development. The geo-spatial data base also facilitates transfer of land data from the local scale to the national scale.

Note that the success of LAS is measured by low cost, value as well as the ability to manage and regulate land efficiently and effectively. The success of LAS is not determined by the complexity of the legal structure or the complexity of the technological processes.

MATERIAL AND METHODS

The main reason for society to manage the land is to satisfy people's needs. Land administration projects differ from land reform projects, although in many practical situations the distinction is not complete. A number of land administrations initiate activities, such as social justice and projects, as part of projects aimed at improving national and regional administration. Note that for the study of land management systems, we have systematized the following hierarchy of land problems (Figure 1):

- Land policy - defines the values, objectives and legal regulatory structure for the management of its land, the main asset of society.
- The land governance paradigm drives a holistic approach to land governance systems and their land administration processes to contribute to sustainable development. Land management activities include the core land administration functions of land ownership, value, use and development, while encompassing all activities linked to the management of land and natural resources required to achieve sustainable development.
- The land administration system provides the infrastructure for the implementation of land policies and land management strategies. Cadastre is considered the core of the land administration system.
- Cadastre provides spatial integrity and spatially unique identification of each land parcel, usually cadastral surveys are done through updated cadastral maps.

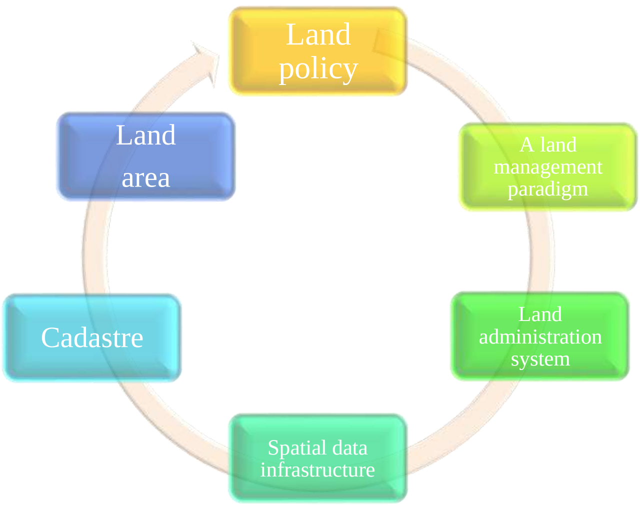

Figure 1. The system that organizes the hierarchy of land management systems

Land administration relies on a technical methodology to design, create and manage an effective organizational infrastructure to achieve its established political goals. Creating and managing dynamic land markets are the most common reasons for governments to invest in LAS. The land governance paradigm enables the understanding and expertise of land markets and offers opportunities for significant improvement of the LAS project. Most existing LAS treat land markets only as simple land trades. Land itself is regarded as a representation of place, and according to the analytical literature on land markets, the discipline of the economy is to buy, sell, rent, develop, use, etc. concentrates on its activities. The formation of national policies aimed at sustaining land markets and expanding markets into new areas are common global processes in land administration. This reflects the expectation that markets will release the inherent value of land into the general economy and raise the general standard of living (Mammadov G.S.,2014).

Thus, according to the cadastral data received from the State Committee for Real Estate Affairs of the Republic of Azerbaijan, as well as the research conducted by us, it can be said that the distribution of property types of Jalilabad cadastral region was as follows:

57034 hectares or 39.57% of Jalilabad cadastral district (irrigated areas 654 ha) is owned by the state, 20757 hectares or 14.40% is owned by municipalities (irrigated areas 432 ha), and 66352 hectares or 46.03% is privately owned. (irrigated areas 10224 ha) are given.

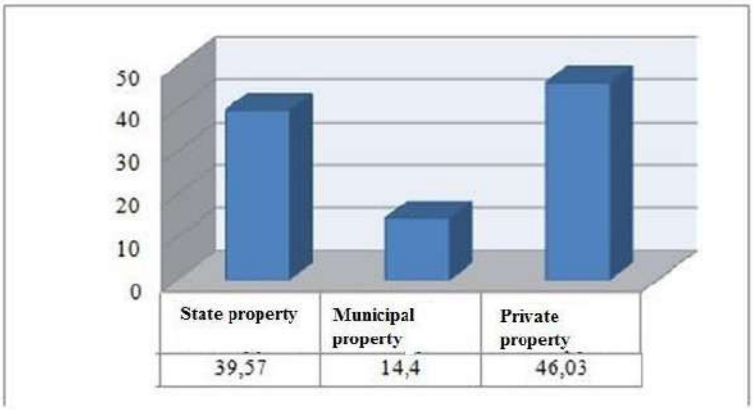

Diagram 1. Distribution of property types of Jalilabad cadastral district

The total number of agricultural lands, including other agricultural circulation areas, in state ownership is 27,895 hectares or 48.90% (irrigated areas - 654 hectares or 1.65%). Based on the distribution of state-owned land plots by natural-farming areas, it can be said that 11,043 hectares or 39.59% of the research area (irrigated areas - 654 ha) are cultivated, 245 hectares or 0.88% are perennial crops (vineyards), 269 hectares or 0.96% are fallow areas, 72 hectares or 0.26% are hayfields, and 16,266 hectares or 58.31% are grazing and grazing areas. Yard plots are not registered as state property.

A total of 14,903 hectares or 71.80% of agricultural land, including backyard land plots and other farm turnover plots in municipal ownership (irrigated areas - 432 hectares or 2.08%). According to the distribution of the land plots owned by the municipality by natural and agricultural areas, it can be said that 3,216 hectares or 21.58% of the research area are cultivated, 600 hectares or 4.03% are perennial crops (of which 539 ha are vineyards, 61 ha mulberry gardens), 10,982 hectares or 73.69% are meadows and pastures, and 125 hectares or 0.6% are homesteads. 105 hectares (0.7%) of the courtyard areas are suitable for agriculture.

The total amount of agricultural lands, including privately owned backyard plots and other farm turnover plots, is 65,813 hectares or 99.19% (irrigated plots - 10,224 hectares or 15.41%). Based on the distribution of privately owned land plots by natural-farming areas, it can be said that 50802 hectares or 77.19% of the research area (irrigated areas - 9931 ha) are cultivated, 1144 hectares or 1.74% are perennial crops (of which 429 ha are orchards, 715 ha are vineyards), 2661 hectares and 4.04% are hayfields (irrigated areas 72 ha), and 11697 hectares or 17.63% are backyard areas (irrigated areas 221 ha). 11,206 hectares or 17.03% of the courtyard areas (221 ha of irrigated areas) are suitable for agriculture (Mammadov. G.Sh., Najafova. N.Z.,2022).

RESULTS AND DISCUSSION

Modern land administration needs to make maximum use of new technologies. So they are as follows:

Data collection tools: Technology for measuring distances and angles is constantly evolving. Modern instruments such as "Complete Stations" were used to measure boundaries and angles to within 5 seconds of arc and distances of 1000 meters to an accuracy of better than 5 millimeters. In addition, the precise global navigation system (GPS) can also determine points in real-time with centimeter accuracy. Digital cameras that capture space images can automatically store global navigation system (GPS) coordinates.

Basic surveying techniques have been extensively used for cadastral cartography, which is associated with surveying. Less popular are photogrammetric methods, which are extensively used in other cartographic processes. Nevertheless, under appropriate conditions, photogrammetry can produce maps and measurements that are more accurate than those available by standard ground methods. The use of this alternative depends on the method of production of cadastral maps, in which case a systematic approach to demarcation and identification is adapted. Currently, the most common method of creating a digital cadastral database is to convert boundaries from cadastral maps into digital form.

Database system tools: Databases have traditionally been used to handle large volumes of data and to achieve consistency and integrity, which is critical to successful spatial data processing. The integration of information including spatial ownership, value, such as land divisions with non-geospatial information, is greatly improved in databases called geo-databases.

Data tools catalog: A data catalog describes and provides links to possible data. In particular, the data directory can organize land information distributed in subsystems held in internal databases within LAS (http:www.azgis.az).

A data catalog is usually accompanied by metadata or information about the data. Metadata elements and schema are used by data producers to characterize data. Metadata facilitates data discovery search and reuse. Users rely on land administration metadata for better access and use the information for various applications. The Open Geospatial Consortium has developed a standard conceptual metadata scheme intended to be used by information systems, program planners and developers of spatial information systems such as cadastral databases.

Data conversion tools: For LAS to be spatially accessible, data must be available in a variety of formats to accommodate the diversity of spatial databases. Format requirements can be met in two ways: special purpose translators or use of a generic format such as Geographic Mapping Language (GML) or Terrain XML. GML is an XML language written in XML format for modeling, transporting, and storing geographic information. The leading concepts GML uses to model the world are drawn from the OpenGIS abstract specification and the ISO 19100 series (International Organization for Standardization).

Information Dissemination: Dissemination of land information is one of the most important aspects of modern land administration. Information dissemination processes involve complexities resulting from the diversity of customers, users, and highly specialized processes and organizations. Dissemination can include the ordering, distribution and delivery of information, either offline or online. Technically, land information dissemination is carried out by GIS services supported by interoperability and Web services.

Finally, for a country to achieve a land market, its policymakers must achieve public commitment to the primary functions of property rights in land-stabilizing land distribution and creative capital. While land rights can exist without markets, markets cannot exist without land rights. Assessment of land administration and cadastral systems is still ongoing, taking into account future needs and progress in developed and developing countries.

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HOW CAN CIRCULAR ECONOMY AND ZERO WASTE CONCEPTS ACT AS CATALYSTS FOR BALANCED ECOSYSTEMS AND AGROECOLOGY

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The circular economy and zero waste concepts, central to sustainable resource management, offer innovative approaches that can harmoniously integrate into ecosystems and agroecology. This study explores the transformative potential of these concepts in fostering balanced ecosystems and sustainable agricultural practices, ultimately contributing to soil health and conservation. A circular economy underscores the importance of resource optimization, emphasizing waste reduction and viewing waste as a resource rather than a disposal issue. When applied to waste management, this concept results in waste to energy and biorefinery technologies, turning waste into valuable resources like biochar and digestate. These byproducts can enhance soil fertility, promote plant growth, facilitate reclamation, and support balanced ecosystems. Similarly, the zero-waste concept propounds eliminating waste through responsible consumption and efficient recycling and composting strategies. Applying this principle in agroecology can substantially mitigate the impact of agricultural waste on the environment. Anaerobic digestion and pyrolysis manage waste and generate bioenergy and nutrient-rich amendments that can supplement soil and improve plant nutrition. These strategies help mitigate climate change by reducing landfill waste and associated greenhouse gas emissions, preserving soil health, and promoting carbon sequestration in agricultural soils. In conclusion, we can catalyze sustainable transformations in ecosystems and agroecology by interweaving circular economy principles and zero waste. These approaches serve as strategic levers to maintain soil health, improve resource efficiency, and combat climate change, paving the way for a sustainable future.

Keywords*: Circular economy; Zero waste; Soil health and improvement; Ecosystem; Agroecology*

INTRODUCTION

The rising global concerns about climate change and the need for sustainable development have thrust the efficient management of resources into the spotlight. We find ourselves at a crucial crossroads, where the path chosen today has far-reaching implications for the future of our planet and our species. Amid these growing concerns, two innovative concepts have emerged as potential game-changers: the circular economy and zero waste concepts (Ahmed et al., 2022). These frameworks could pave the way for a future where sustainability is not just a desired goal but an inherent part of human practices.

The circular economy and zero waste principles sit at the heart of sustainable resource management, offering an alternative to the traditional linear economic model of 'take-make-waste.' Instead of viewing production and consumption processes as a one-way street leading to inevitable waste, these principles reimagine waste as an untapped resource, advocating for its reduction, repurposing, and optimal utilization (Song et al., 2015). The transformative potential of these concepts is immense, particularly when viewed through the lens of ecosystems and agroecology. As society realizes the ecological footprint of human activities, the need for practices that align economic progress with ecological balance becomes paramount. The circular economy and zero waste concepts may provide the key to this balance.

Both these concepts strive for a shift in perspective from seeing waste as a necessary byproduct of consumption to viewing it as a resource that can be used in the economic cycle. This paradigm shift in waste perception and management could allow these concepts to act as catalysts for balanced ecosystems and agroecology (Awogbemi et al., 2022). On the one hand, we have the circular economy, which emphasizes 'closing the loop' of product lifecycles. By promoting the recycling and reusability of products, the circular economy envisages an economic system where waste is minimized, and resources are continually utilized. Its implementation could pave the way for sustainable practices that conserve resources and mitigate the environmental impacts of waste.

The zero-waste concept takes the idea of waste minimization one step further, seeking to eliminate waste through responsible consumption and comprehensive recycling. It calls for a systemic product design and management change to avoid and eliminate waste, reducing the environmental burden (Song et al., 2015). Applying these concepts in agroecology, the study of ecological processes applied to agricultural production systems, could foster sustainable agricultural practices that nourish the land rather than deplete it. These concepts offer several potential benefits, from enhancing soil health to reducing reliance on chemical fertilizers (Ancona et al., 2022).

By mitigating the production of waste and promoting resource conservation, these principles can contribute significantly to climate change mitigation. With the agriculture sector accounting for nearly a quarter of global greenhouse gas emissions, the potential impact of adopting a circular economy and zero waste principles in this sector is significant (Rodríguez-Espinosa et al., 2023).

In the ensuing sections of this paper, we will delve deeper into these concepts and their potential applications in fostering balanced ecosystems and sustainable agricultural practices. We aim to provide insights into how the principles of circular economy and zero waste can be leveraged to conserve soil health, improve resource efficiency, and combat climate change, ultimately paving the way for a sustainable future (as illustrated in Figure 1).

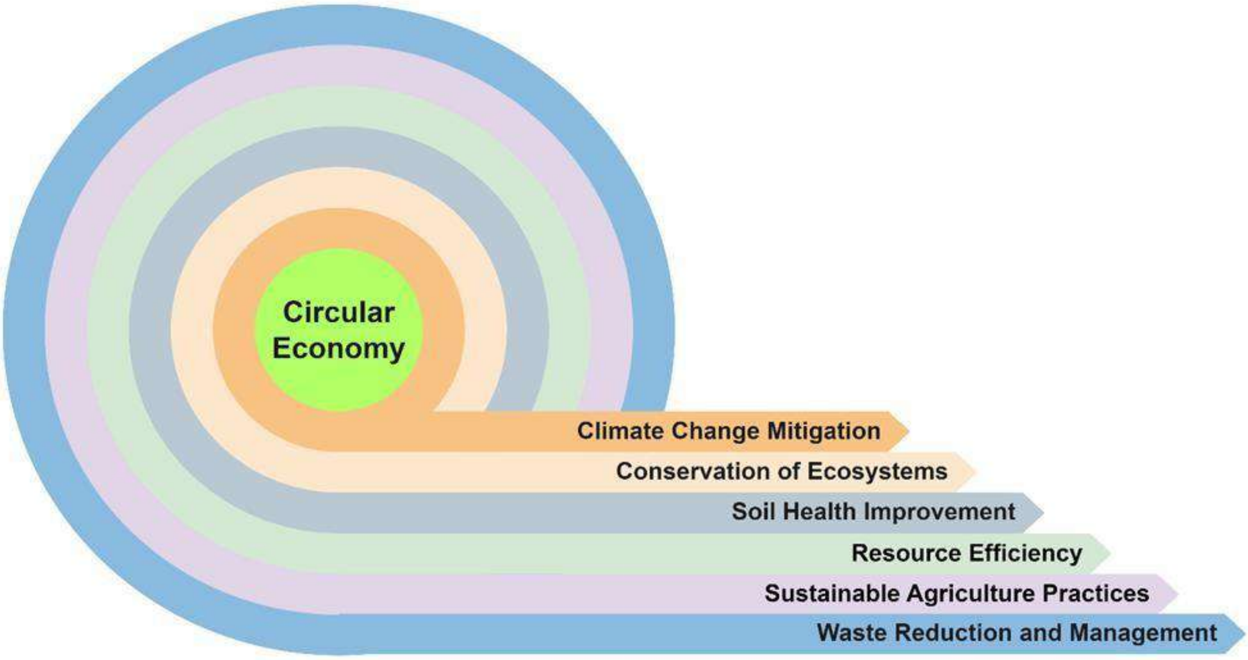

Figure 3: Graphical Abstract

2. Circular Economy and Ecosystems

In ecological conservation and sustainability, the role of the circular economy model cannot be overstated. This model deviates from the traditional linear economy, which follows a take, use, and dispose of pattern and focuses on a circular approach that emphasizes the continual use of resources. Central to this concept is the idea of 'closing the loop' of product lifecycles by improving recycling and reusability, advocating for converting waste into a resource instead of treating it as a disposal issue (Zhang et al., 2019).

A key aspect of the circular economy revolves around optimizing resources, which results in advanced waste management technologies such as waste-to-energy and biorefinery. These technologies herald a new approach towards waste by transforming it into valuable resources such as biochar and digestate (Jagaba et al., 2022). In this transformative process, waste takes on a new identity. It becomes a source of energy and a potential supplement to enrich the soil. The byproducts offer a sustainable energy source and possess properties that can enhance soil fertility, a fundamental requirement for any balanced ecosystem (Ancona et al., 2022).

Take biochar, for instance. This carbon-rich product, derived from the thermal decomposition of organic materials in a low or zero-oxygen environment, has the potential to revolutionize agroecology. The benefits of biochar extend beyond just waste management (Khedulkar et al., 2023). It can improve soil's water-holding capacity, increase soil pH, and provide a stable carbon pool. All these properties collectively contribute to promoting plant growth and facilitating ecosystem reclamation. The principles of the circular economy encourage the sustainable use of all resources, presenting an alternative to the harmful practices that degrade our ecosystems (Awogbemi et al., 2022). By promoting the recycling and reuse of materials, the circular economy can help to restore ecological balance, reduce waste, and drive sustainable development.

The circular economy provides a roadmap for maintaining the vitality of our ecosystems. Treating waste as a valuable resource can stimulate sustainable practices that promote resource efficiency and ecological conservation, which are essential for a balanced environment and a sustainable future.

3. Zero Waste Concepts and Agroecology

The zero-waste concept aligns with the principles of a circular economy. Still, it takes a more focused approach toward extinguishing waste through responsible consumption, effective recycling, and innovative design. This approach goes beyond merely managing waste; it seeks to redesign our economic and production systems to ensure that waste is not generated. The zero-waste approach encourages designing and managing products and processes to systematically avoid and eliminate the volume and toxicity of waste and materials (Ahmed et al., 2022). It envisions a sustainable system where resource input and waste, emission, and energy leakage are minimized by slowing, closing, and narrowing material and energy loops. It focuses on redefining the system to design waste out of the system from the beginning (Zhang et al., 2019).

When implemented in agroecology, the zero-waste approach is crucial in efficient waste management and reducing environmental impacts (Song et al., 2015). Agroecology is an area that traditionally produces substantial amounts of waste, including crop residues, livestock manure, and food waste. Therefore, adopting zero waste principles in this field can lead to significant environmental benefits. Emerging technologies like anaerobic digestion and pyrolysis have become significant tools for implementing agroecology zero waste concepts. Anaerobic digestion involves the breakdown of organic material by microorganisms in an oxygen-free environment, resulting in the generation of biogas - a renewable source of energy - and digestate (Ancona et al., 2022). This nutrient-rich substance can be used as a soil amendment.

Conversely, pyrolysis involves the thermal decomposition of organic material at high temperatures without oxygen. This process helps manage waste and generates biochar, which can be added to soil to enhance its fertility and sequester carbon (Jagaba et al., 2022). These technologies, therefore, help manage waste and generate valuable resources, such as bioenergy and nutrient-rich soil amendments. These products can supplement soil health, improve plant nutrition, and support sustainable agricultural practices (Rodríguez-Espinosa et al., 2023).

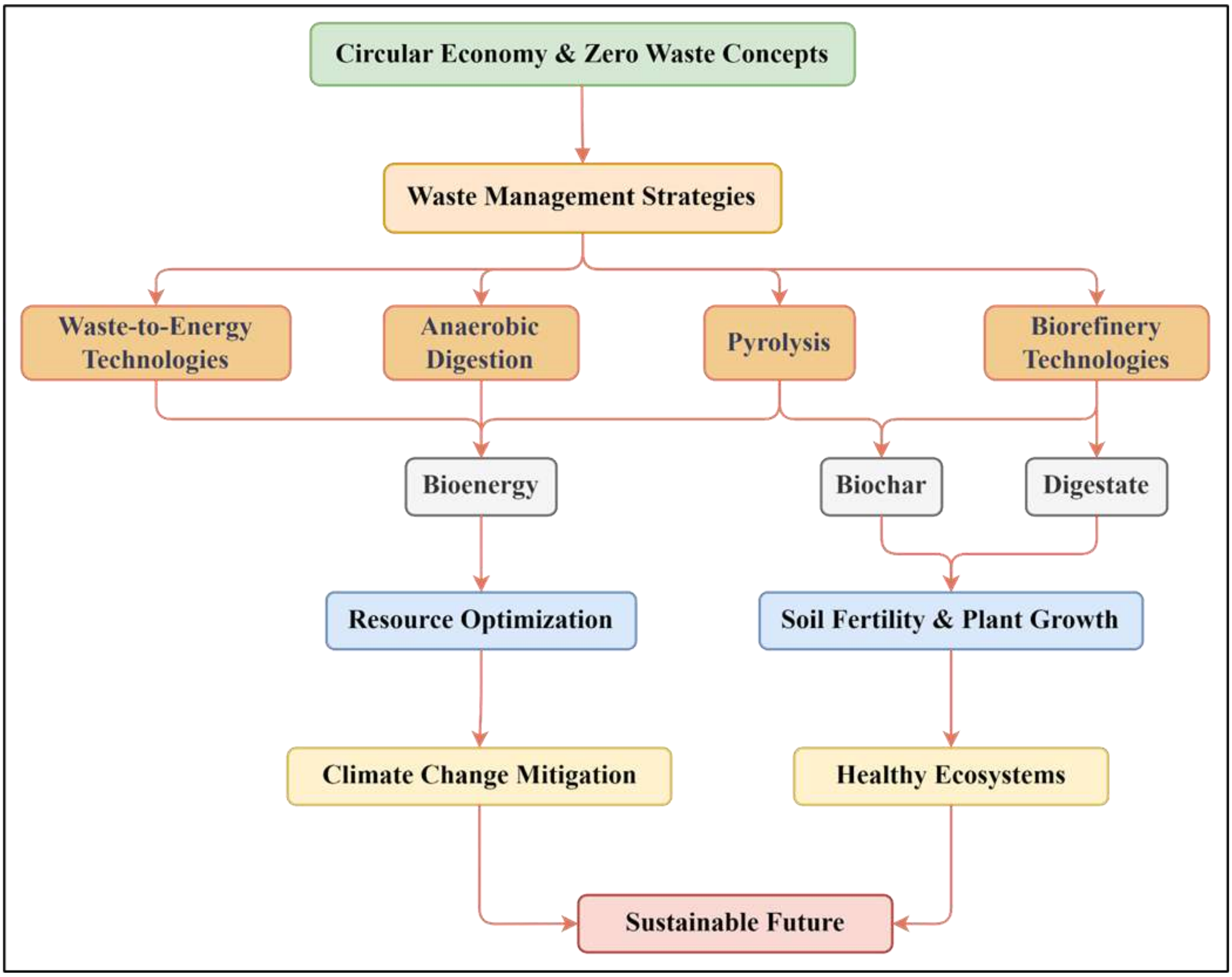

Figure 4: Circular Economy and Zero waste concepts

4. Current Challenges and Future Prospects

While the transformative potential of the circular economy and zero waste concepts is undeniable, their implementation is not without challenges. One of the primary obstacles is the entrenched linear economy mindset, deeply ingrained in our socioeconomic systems and behaviors. Since the industrial revolution, this 'take-make-waste' approach has been the cornerstone of global development, creating significant barriers to transitioning towards a circular, zero-waste economy. Overcoming this obstacle requires systemic change—reshaping manufacturing processes, business models, consumption habits, and waste management practices (Kerdlap et al., 2019).

Our current waste management infrastructure, primarily based on disposal and incineration, is often incompatible with circular economy principles. Upgrading this infrastructure to support recycling and repurposing will require significant investment and strategic planning. Similarly, market dynamics and policy frameworks do not always support the financial viability of recycling or reusing certain materials. Adjusting these mechanisms to incentivize circular practices is an additional challenge (Zhang et al., 2019).

Lack of awareness and understanding of these concepts among consumers, businesses, and policymakers can also hamper their uptake. Comprehensive education and advocacy are necessary to foster the systemic change these concepts demand. Despite these challenges, the prospects of implementing a circular economy and zero waste concepts, particularly in ecosystems and agroecology, are promising (Ahmed et al., 2022). As awareness of environmental issues grows and technological capabilities evolve, opportunities to implement these principles are expanding.

Adopting circular economy principles in agriculture could revolutionize the sector. We could reduce the sector's environmental impact and improve productivity by turning agricultural waste into valuable resources like bioenergy and biofertilizers (Rodríguez-Espinosa et al., 2023). In ecosystems, circular economy principles could promote the recovery and regeneration of natural systems by reducing waste and promoting resource efficiency. The zero-waste concept holds immense potential for the future (Ahmed et al., 2022). We can significantly reduce our environmental footprint by eliminating the waste at its source. The principle of zero waste can be incorporated into every aspect of our lives, from the products we buy to the way we manage our households. In agroecology, it can mitigate the environmental impact of agricultural waste and contribute to developing sustainable farming practices.

Both concepts can play a crucial role in mitigating climate change. By reducing waste and improving resource efficiency, they can help to lower greenhouse gas emissions. Biochar and similar byproducts can also promote carbon sequestration, mitigating climate change (Khedulkar et al., 2023).

In conclusion, while the path to a circular, zero-waste world presents several challenges, it also offers immense opportunities. It will require a concerted effort from all sectors of society, governments, businesses, and individuals, to overcome these challenges and realize the potential of these concepts (Zhang et al., 2019). With continued research, technological advancements, and policy support, the circular economy and zero-waste concepts could reshape our ecosystems and agroecology, paving the way for a more sustainable future (Kerdlap et al., 2019).

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LAND FRAGMENTATION AND THE NEED FOR THEIR CONSOLIDATION

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Along with the increase in the population of our planet, the problem of food shortages is growing more and more all over the world. According to the FAO, approximately 2 billion people in the world today suffer from hunger and food shortages. Given the current situation in the world in the field of food, each country, based on its own realities, takes all possible steps to provide its population with food, and the Republic of Azerbaijan is no exception. The leadership of the country, in order to provide food to the population and reduce dependence on foreign food supplies, after the acquisition of independence of Azerbaijan in 1991, began to reform in the field of agriculture, and these reforms are practically continuing to this day. During this time, more than 50 regulatory and legislative acts and state programs have been adopted in the field of agriculture. In our opinion, one of the most important of these legal acts was the law "On Land Reform", where the main goal was: the establishment of new land ownership relations based on the principles of economic freedom and social justice, the development of a market economy and entrepreneurial initiative, the achievement of economic independence, including the food supply of the country and, ultimately, the improvement of the well-being of the Azerbaijani people[1]. After the adoption of the law "On Land Reform", 3 types of land ownership appeared in Azerbaijan: state, municipal and private, where the main component of private land was formed from the lands of former collective farms and state farms.

Keywords: *land share, land fragmentation, land reform, land consolidation, land plot sizes, land redistribution.*

INTRODUCTION

Formulation of the problem. According to the law “On Land Reform”, as a result of the reorganization of former agricultural enterprises, arable land, one of the most valuable agricultural lands, was transferred free of charge to the private ownership of citizens of the country. The total number of people by that time who became the owners of such lands was 3187709 people and they were allocated approximately 1373202 hectares of land. [2]. And this essentially means that not when large land masses were highly fragmented into numerous parcels. The size of land parcels, depending on the regions of the country, ranged from 0.10 hectares to 1.23 hectares of land. Such sizes of land plots were initially very inconvenient for their cultivation and did not meet the agrotechnical and economic requirements that they had to meet. An example of such fragmentation can be seen in Figure 1.

The land reform being carried out in Azerbaijan has both positive and negative sides. The main positive aspect of the land reform is that the state monopoly over land was put to an end. In our article, we consider the main negative consequences of the ongoing land reform in the country. In our opinion, the most important negative of the land reform lies in the strong fragmentation of land plots with their small areas and inconvenient configurations for processing. Ultimately, the grinding of large land masses and the impossibility of concentrating in the hands of one peasant (owner) a land plot of the required size for highly efficient production led to a decrease in agricultural production.

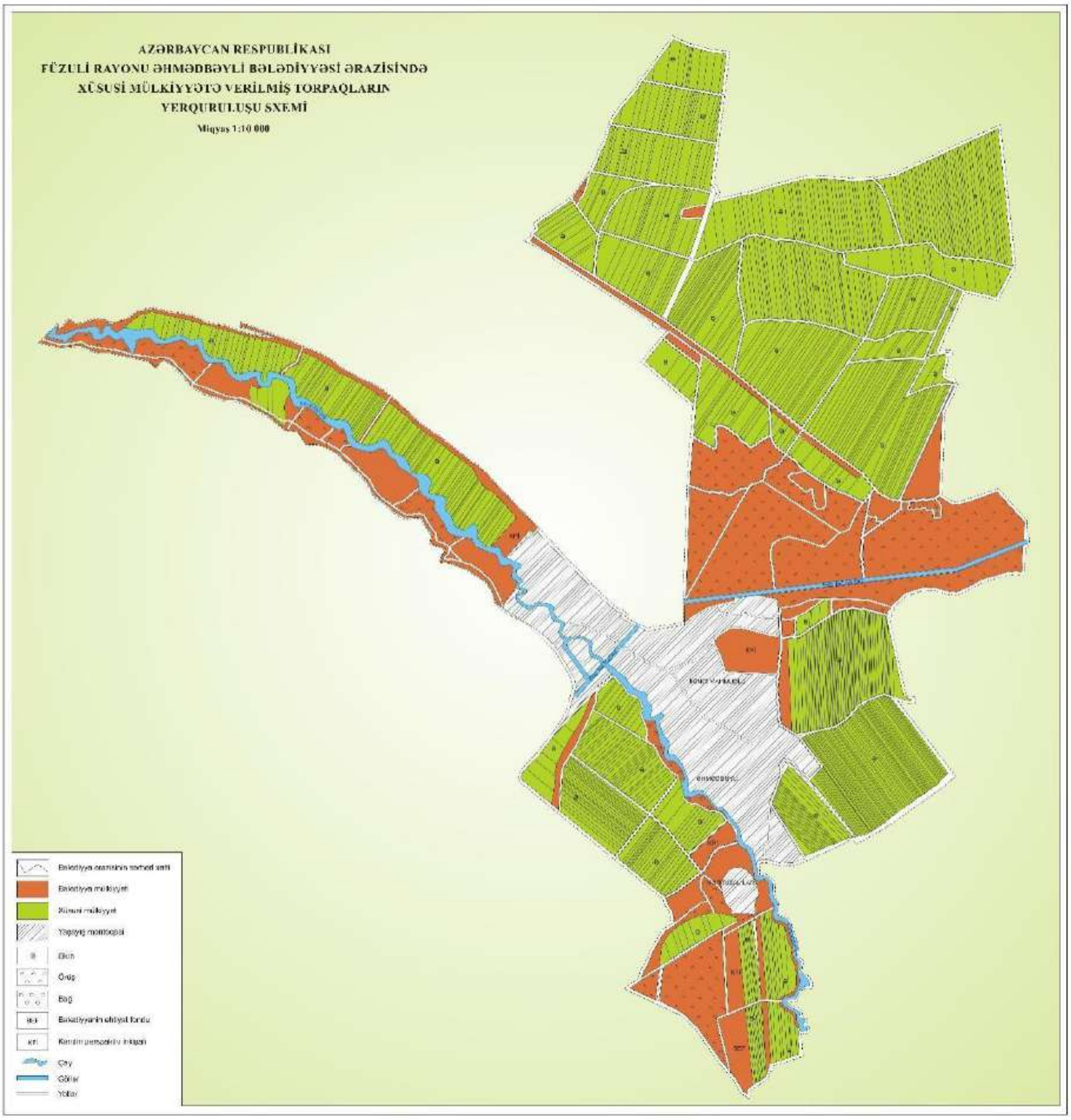

Figure 1. Fragmentation of agricultural land on the example of individual territories of the Fizuli region of Azerbaijan.

Purpose of the article. Study of the problem of land fragmentation arising as a result of the land reform in the country and, as a way out of the current situation, the consolidation of land shares in Azerbaijan.

RESEARCH METHODS

Scientific research was carried out with the help of a systematic structural analysis of the fragmentation of agricultural land, and as a preventive measure, the solution to these problems was proposed land consolidation, by analyzing the norms of the current land legislation of Azerbaijan and the adoption of new land legislative acts was proposed, with the help of which it was possible to carry out the consolidation of land plots. further reduction in the size of land shares was also not allowed. Parallel to this was proposed pre-emptive right to purchase land.

RESEARCH RESULTS

It is known that the consolidation of agricultural land is a set of measures for land management regarding the formation of compact land plots. The existing fragmentation of agricultural land in Azerbaijan necessitates the consolidation of these lands. Since the consolidation of agricultural land will solve the problem of fragmentation of agricultural land use, increase the competitiveness of agriculture, restore the infrastructure of rural areas and improve the country's food security[3]. One of the features of the consolidation of agricultural land is the formation of new land plots (land holdings) and, accordingly, a new land use structure for rural enterprises, in other words, land is redistributed.

Land redistribution is a key component of both voluntary and forced land consolidation. Through the mechanism of land redistribution, the current state of land use, ownership structure and land use, both in private and public interests, using land resources (determined during land consolidation) and reducing social tension. The redistribution of land plots should be carried out only with plots contained in the State Land Cadastre and whose boundaries are established [4]. The maximum and minimum sizes of the formed land plots during redistribution must comply with the requirements of the current legislation of the country. The final planning cartographic documents, indicating the formation of new land plots during the redistribution of land, should be plans for the boundaries of the formed land plots, drawn up based on the results of cadastral survey, which are the basis for entering into the state land cadastre[5].

It should be noted that at the moment there is no separate land-legal base that would regulate this process in Azerbaijan. Therefore, in order to solve the main problems of agricultural land fragmentation in the republic, it is necessary to adopt appropriate land - legislative acts on land management, which will create the possibility of applying measures regarding the consolidation of agricultural land.

CONCLUSIONS

The pre-emptive right to acquire an agricultural land plot should have: - the tenant or user of this land plot; - owners of adjacent land plots for agricultural purposes; - the state, represented by the relevant executive authorities; - local self-government bodies; - State land bank. Please note that the last three subjects can claim to acquire ownership of a land plot only if the first two persons do not have such a desire. And for this, first of all, it is necessary to make appropriate changes to the land legislation of Azerbaijan in order to earn the mechanism proposed by us to enlarge the areas of land plots.

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GREY BROWN SOILS IN ABSHERON, AZERBAIJAN: CHARACTERISTICS, FORMATION PROCESSES, AND LAND MANAGEMENT IMPLICATIONS

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Grey Brown Soils are important soil resources found in the Absheron region of Azerbaijan. Understanding their characteristics, formation processes, and land management implications is crucial for sustainable land use and agricultural practices in the region. This study aimed to investigate the properties and factors influencing the development of Grey Brown Soils and provide insights for effective soil management.

The research involved comprehensive soil sampling and laboratory analyses to determine the physical, chemical, and biological properties of Grey Brown Soils. The study also examined the influence of climate, parent material, and land use practices on the formation processes of these soils. Additionally, the implications of these findings for land management and agricultural practices were explored.

The results revealed that Grey Brown Soils in the Absheron region have a loamy to clayey texture with good water retention and adequate drainage. They exhibit a well-developed granular or crumb structure, promoting root growth and aeration. The soils displayed a grayish-brown color, indicating their composition of organic matter, iron, and other minerals. The chemical analysis showed a near-neutral to slightly alkaline pH, moderate to high organic matter content, and a moderate to high cation exchange capacity (CEC). These properties contribute to soil fertility, nutrient availability, and water-holding capacity.

The formation of Grey Brown Soils is influenced by the region's semi-arid climate, characterized by low rainfall and high evaporation rates. Limited precipitation and high evapotranspiration lead to leaching processes and the accumulation of organic matter in these soils. The parent material of Grey Brown Soils consists of alluvial and marine sediments composed of clay, silt, sand, and organic materials. Human activities, such as land clearance, cultivation, and fertilizer application, affect soil development processes. Improper land management practices can result in soil degradation, erosion, and fertility loss.

In conclusion, this study provides valuable insights into the characteristics, formation processes, and land management implications of Grey Brown Soils in the Absheron region of Azerbaijan. The findings highlight the importance of adopting sustainable soil management practices, soil conservation measures, and organic amendments to optimize soil health and agricultural productivity. These findings contribute to the development of effective strategies for the sustainable use of Grey Brown Soils and ensure the long-term viability of agricultural systems in the region.

Keywords: *Grey Brown Soils, Absheron, Azerbaijan, soil characteristics, formation processes, land management.*

INTRODUCTION

Grey Brown Soils are significant soil types in the Absheron region of Azerbaijan, characterized by their unique properties and formation processes. These soils play a vital role in agricultural productivity and land management practices in the region. Understanding the characteristics and implications of Grey Brown Soils is essential for sustainable land use and optimizing agricultural practices in Absheron.

The Absheron region, located along the western coast of the Caspian Sea in Azerbaijan, is known for its diverse agricultural activities and historical significance in food production. Grey Brown Soils are prevalent in this region and are widely distributed across its landscapes. They have formed through complex processes over time, influenced by various factors such as climate, parent material, and land use practices.

The importance of Grey Brown Soils in land management and agricultural practices cannot be overstated. These soils provide a favorable environment for plant growth, supporting the cultivation of a wide range of crops. Additionally, their ability to retain water and nutrients is crucial for sustaining agricultural productivity in the region's semi-arid climate.

Understanding the characteristics of Grey Brown Soils is essential for effective land management and sustainable agricultural practices. The physical, chemical, and biological properties of these soils influence their fertility, nutrient availability, and water-holding capacity. Additionally, the formation processes of Grey Brown Soils are influenced by climatic factors, the composition of parent material, and human activities such as land use and management practices.

Optimizing agricultural productivity and ensuring the long-term sustainability of land use practices in the Absheron region require a comprehensive understanding of Grey Brown Soils. By considering their unique characteristics and formation processes, land managers and agricultural practitioners can develop strategies for soil conservation, nutrient management, and erosion control.

Therefore, the aim of this scientific paper is to investigate the characteristics, formation processes, and land management implications of Grey Brown Soils in the Absheron region of Azerbaijan. By providing an overview of the soil properties, including their physical, chemical, and biological characteristics, this study aims to contribute to the existing knowledge on these soils. Furthermore, we will explore the factors influencing their formation and discuss the implications of these soils for sustainable land management. Recommendations for optimizing agricultural productivity while preserving soil health in the Absheron region will also be provided.

Understanding the unique characteristics and implications of Grey Brown Soils in the Absheron region will help pave the way for sustainable land use practices and agricultural development. By adopting appropriate land management strategies and conservation measures, the Absheron region can preserve and enhance the productivity of Grey Brown Soils while mitigating soil degradation and ensuring the long-term sustainability of agricultural practices.

MATERIAL AND METHODS

These studies was reported using Meteoblue and Weatherspark (mean Average monthly rainfall, frost days, snow days, windy days)

Figure 1. Average monthly rainfall in Baku

This chart is the average monthly rainfall in Absheron. The most rainfall occurs in January, February, March, April, September, October, November and December. The least precipitation falls in May, June, July and August.

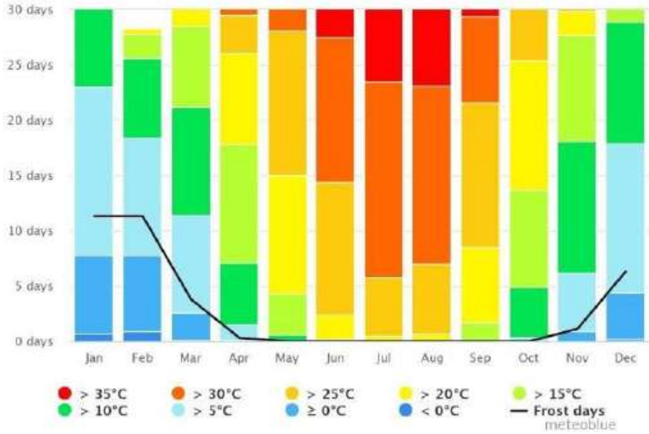

Figure 2. Average monthly frost days in Baku

This image shows the monthly average frost days. Absheron is one of the cities of Azerbaijan that is not exposed to frost.

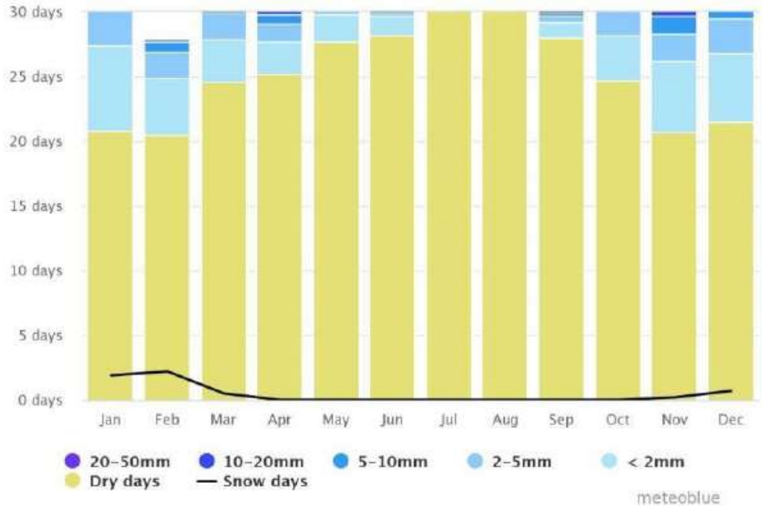

Figure 3. Average monthly snow days in Baku

Absheron's winter is mild. The most precipitation falls in the winter months, which mainly prevails in January, February, March, November and December.

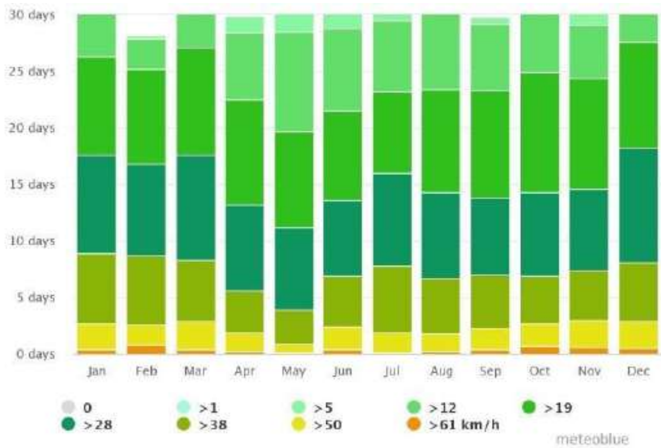

Figure 4. Average monthly windy days in Baku

Absheron is one of the most wind-eroded cities in Azerbaijan. To prevent wind erosion, trees with long roots and large leaves should be planted.

1. Soil Characteristics:

Grey Brown Soils in the Absheron region possess distinct physical, chemical, and biological properties that influence their fertility and suitability for agricultural practices. Understanding these characteristics is crucial for effective land management and sustainable agricultural production. The following parameters are essential in describing the soil properties:

1.1 Physical Characteristics:

Grey Brown Soils exhibit specific physical properties that affect their structure, water-holding capacity, and nutrient availability. Soil texture, which refers to the relative proportions of sand, silt, and clay particles, plays a significant role in determining soil structure and water movement. In the Absheron region, Grey Brown Soils typically have a loamy to clayey texture, allowing for good water retention while also maintaining adequate drainage.

Soil structure, the arrangement of soil particles, influences pore spaces, root penetration, and water infiltration. Grey Brown Soils often exhibit a well-developed granular or crumb structure, promoting good aeration and root growth. However, certain land management practices and compaction can lead to soil structure degradation, affecting water movement and nutrient availability.

Another important physical characteristic is soil color. Grey Brown Soils derive their name from the characteristic grayish-brown color, resulting from a combination of organic matter, iron, and other minerals. Soil color provides valuable information about the soil's drainage, organic matter content, and mineral composition.

1.2 Chemical Characteristics:

Chemical properties of Grey Brown Soils greatly influence nutrient availability, pH levels, and soil fertility. The Absheron region's Grey Brown Soils tend to have a near-neutral to slightly alkaline pH, which is generally favorable for most crops. However, variations in pH may occur depending on specific locations and land management practices.

Organic matter content is a critical chemical characteristic affecting soil fertility and nutrient retention. Grey Brown Soils usually contain a moderate to high amount of organic matter, providing a source of nutrients, improving soil structure, and enhancing water-holding capacity.

Cation exchange capacity (CEC) is another important chemical property that influences nutrient availability. Grey Brown Soils in the Absheron region generally have a moderate to high CEC, allowing for effective nutrient retention and exchange within the soil.

The presence of essential plant nutrients, such as nitrogen (N), phosphorus (P), and potassium (K), is crucial for plant growth and productivity. Grey Brown Soils often have a moderate nutrient status, with variations depending on specific management practices and previous land use.

1.3 Biological Characteristics:

Grey Brown Soils harbor diverse and dynamic soil microbial communities that contribute to nutrient cycling, organic matter decomposition, and soil health. Beneficial soil microorganisms, including bacteria, fungi, and other soil biota, play crucial roles in nutrient mineralization, disease suppression, and maintaining soil structure.

The abundance and activity of soil microorganisms are influenced by various factors, including organic matter content, moisture levels, temperature, and land management practices. Maintaining a balanced soil microbial community is essential for promoting nutrient availability, suppressing pathogens, and enhancing soil fertility.

In summary, Grey Brown Soils in the Absheron region possess physical properties that influence water movement, soil structure, and root growth. Chemical properties determine nutrient availability, pH levels, and soil fertility, while biological characteristics involve soil microbial communities that contribute to nutrient cycling and overall soil health. Understanding these soil characteristics provides a foundation for effective land management practices and sustainable agricultural production in the Absheron region.

2. Formation Processes:

The formation of Grey Brown Soils in the Absheron region is influenced by various factors, including climate, parent material, and land use practices. The interaction of these factors over time contributes to the development of the unique properties and characteristics observed in these soils.

2.1 Climate:

Climate plays a significant role in the formation of Grey Brown Soils. The Absheron region experiences a semi-arid climate with hot summers and relatively mild winters. The low annual precipitation and high evaporation rates create conditions of water scarcity and high rates of water loss from the soil.

Limited rainfall and high evapotranspiration result in leaching processes, where water percolates through the soil profile, carrying away soluble minerals and leaving behind residual deposits. This leaching process affects the distribution and composition of minerals within the soil, influencing its fertility and nutrient content.

Additionally, the semi-arid climate contributes to the accumulation of organic matter in the soil. The slow decomposition of organic materials in dry conditions leads to the gradual buildup of organic matter content in Grey Brown Soils. This organic matter enhances soil fertility, nutrient cycling, and water-holding capacity.

2.2 Parent Material:

The parent material of Grey Brown Soils in the Absheron region primarily consists of alluvial and marine sediments. These sediments are composed of a mixture of clay, silt, sand, and organic materials deposited by rivers and the Caspian Sea over thousands of years.

The composition of the parent material influences the texture, structure, and mineral composition of the soils. The alluvial and marine sediments provide a diverse range of mineral particles that contribute to the formation of soil aggregates and affect water movement and nutrient availability within the soil profile.

2.3 Land Use Practices:

Human activities, such as land use practices, also play a role in the formation processes of Grey Brown Soils in the Absheron region. The region has a long history of agricultural activities, including crop cultivation and grazing.

Land clearance, cultivation, and the application of organic and inorganic fertilizers influence the nutrient cycling and organic matter content in the soils. These practices can contribute to the accumulation of organic matter, increase nutrient availability, and affect the soil structure.

However, improper land management practices, such as intensive cultivation without adequate soil conservation measures, can lead to soil degradation, erosion, and loss of soil fertility. Unsustainable agricultural practices can disrupt the natural processes of soil formation and degrade the physical, chemical, and biological properties of Grey Brown Soils.

Anthropogenic activities, including urbanization and industrialization, also impact the formation processes of Grey Brown Soils. Urban development and industrial activities often involve soil sealing, compaction, and contamination, which can alter the natural processes of soil formation and degrade soil quality.

Understanding the formation processes of Grey Brown Soils in the Absheron region provides insights into the factors influencing their characteristics and properties. The interplay of climate, parent material, and human activities shapes these soils over time. By considering these formation processes, land managers and agricultural practitioners can implement appropriate land management practices that promote soil health, fertility, and sustainability.

3. Land Management Implications:

Grey Brown Soils have important implications for land management and agricultural practices in the Absheron region. The unique characteristics and formation processes of these soils provide insights into effective strategies for sustainable land use and optimizing agricultural productivity. Consideration of the following aspects is crucial for managing Grey Brown Soils:

3.1 Soil Fertility:

Grey Brown Soils generally possess moderate to high fertility, attributed to their organic matter content, nutrient availability, and favorable physical properties. Effective soil fertility management is essential for optimizing agricultural productivity in the Absheron region.

Appropriate nutrient management practices, such as the application of organic and inorganic fertilizers based on soil testing, can ensure the supply of essential nutrients for plant growth while minimizing environmental impacts. Balancing nutrient inputs with crop requirements helps prevent nutrient imbalances, such as excessive nitrogen application, which can lead to water pollution and ecological disruptions.

Conservation agriculture practices, including minimum tillage, cover cropping, and crop rotation, can enhance soil fertility and organic matter content. These practices minimize soil disturbance, improve water infiltration, and promote the accumulation of organic matter, thereby sustaining soil health and nutrient cycling.

3.2 Erosion Control:

Grey Brown Soils are susceptible to erosion, especially in the semi-arid conditions of the Absheron region with sporadic rainfall and high evaporation rates. Soil erosion poses a significant threat to soil productivity and landscape integrity.

Implementing soil conservation measures, such as contour plowing, terracing, and windbreaks, helps mitigate erosion by reducing the velocity of water and wind, and by promoting water infiltration into the soil. These practices help maintain soil structure, preserve topsoil, and minimize the loss of nutrients and organic matter.

Maintaining vegetative cover through the use of cover crops and perennial vegetation helps protect the soil surface from erosion, improves water retention, and enhances biodiversity. Conservation practices that combine vegetation with engineering measures can effectively control erosion and maintain the integrity of Grey Brown Soils.

3.3 Water Management:

Water scarcity is a challenge in the Absheron region, and efficient water management practices are crucial for sustaining agricultural production. Grey Brown Soils have the capacity to retain water due to their texture and organic matter content, which is advantageous for crop growth in arid and semi-arid environments.

Applying appropriate irrigation methods, such as drip or micro-irrigation systems, helps minimize water loss through evaporation and deep percolation. Monitoring soil moisture levels and employing technologies like soil moisture sensors can aid in optimizing irrigation scheduling, ensuring water-use efficiency, and reducing the risk of waterlogging or drought stress.

Conserving soil moisture through mulching, such as using organic or plastic mulches, helps reduce evaporation and maintain soil temperature, thereby supporting plant growth and reducing irrigation requirements.

3.4 Nutrient Cycling:

Grey Brown Soils exhibit dynamic nutrient cycling processes that involve the decomposition of organic matter, mineralization, and nutrient uptake by plants. Managing nutrient cycling is essential for sustainable land use and minimizing nutrient losses from the system.

Practices such as crop residue management, organic amendments, and the use of leguminous cover crops contribute to increasing organic matter content, improving nutrient availability, and enhancing soil structure. These practices promote the cycling of nutrients, reduce the need for external inputs, and support sustainable agricultural systems.

Applying precision agriculture techniques, such as variable rate fertilization and site-specific nutrient management, can optimize nutrient application based on soil variability within fields. These practices ensure that nutrients are applied at the right time and in the right amounts, minimizing losses to the environment and maximizing nutrient use efficiency.

RESULTS AND DISCUSSION

The study on Grey Brown Soils in the Absheron region of Azerbaijan has yielded valuable insights into their characteristics, formation processes, and land management implications. Through a comprehensive analysis of soil properties and factors influencing their development, several key findings have emerged. These findings provide a foundation for understanding the unique nature of Grey Brown Soils and offer practical recommendations for sustainable land management and agricultural practices in the region.

- Present the key findings related to the characteristics of Grey Brown Soils in the Absheron region, including physical, chemical, and biological properties.
- Describe the major factors influencing the formation processes of these soils, such as climate, parent material, and land use practices.
- Present any additional findings or data that are relevant to your study objectives.
- Interpret the results and relate them to existing knowledge in the field.

In terms of soil conservation, implementing erosion control measures is crucial. Contour plowing, terracing, and the establishment of windbreaks can help prevent soil erosion by reducing water runoff and wind erosion. Conservation tillage practices, such as no-till or reduced tillage, can also be employed to maintain soil structure and minimize erosion risk. Discuss the significance of the findings and their implications for land management and agricultural practices in the Absheron region.

- Analyze the strengths and limitations of your study and address any uncertainties or potential sources of bias.
- Provide recommendations for sustainable land management practices based on your findings.
- Identify areas for further research and suggest potential directions for future studies.

CONCLUSION

Grey Brown Soils in the Absheron region of Azerbaijan play a crucial role in agricultural productivity and land management practices. Understanding their characteristics, formation processes, and land management implications is essential for optimizing soil health and ensuring sustainable land use practices.

Grey Brown Soils exhibit unique physical, chemical, and biological characteristics, including moderate to high fertility, organic matter content, and nutrient availability. These soils are formed under the influence of various factors, such as climate, parent material, and land use practices. The semi-arid climate, alluvial and marine sediments as parent material, and human activities shape the properties and behavior of these soils.

Effective land management strategies can be implemented to harness the potential of Grey Brown Soils while mitigating soil degradation. Maintaining soil fertility through appropriate nutrient management practices, erosion control measures, and water management techniques are crucial considerations. Conservation agriculture practices, such as minimum tillage, cover cropping, and crop rotation, aid in preserving soil structure and organic matter content.

Case studies have demonstrated the positive impacts of sustainable soil management practices, soil conservation measures, and the use of organic amendments. Implementing these approaches has led to enhanced soil fertility, reduced soil erosion, improved water management, and increased agricultural productivity. By adopting such practices, farmers can promote the long-term sustainability of agricultural systems while minimizing environmental impacts.

To ensure the preservation and enhancement of Grey Brown Soils, it is important to raise awareness among farmers, land managers, and policymakers about the significance of soil health and sustainable land management practices. Providing support and incentives for the adoption of these practices, such as training programs, financial assistance, and policy frameworks, can contribute to widespread implementation.

In conclusion, Grey Brown Soils in the Absheron region are valuable resources for agricultural productivity and land management. By understanding their characteristics, formation processes, and implementing appropriate land management strategies, the Absheron region can optimize agricultural productivity, preserve soil health, and ensure the sustainable use of these soils for future generations.

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STUDY OF THE İRRİGATED LANDS OF THE GARABAGH PLAİN

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The article studied the irrigated lands of the Garabagh plain. All agricultural products obtained in Azerbaijan and the Garabagh plains are obtained from irrigated lands. Almost all irrigated land is used for grain and perennial crops. Part of the non-irrigated land is used for arable land, and the rest is used for pastures and hayfields. The total area of non-irrigated (also used in grain growing) agricultural land is 235052.91 hectares in the Garabagh plain, which is 57.68% of agricultural land.

Keywords: *Garabagh plain, irrigation, grain production, gray-brown soils*

INTRODUCTİON

The most important factor in the development of grain farming in the Garabagh plain is land irrigation. Azerbaijan is considered one of the centers of ancient irrigated agriculture. 80-85% of agricultural products obtained in Azerbaijan and the Garabagh plain are obtained from irrigated lands. Almost all irrigated land is used for grain and perennial crops. Part of the non-irrigated land is used for arable land, and the rest is used for pastures and hayfields. The total area of non-irrigated (also used in grain growing) agricultural land is 235052.91 hectares in the Garabagh plain, which is 57.68% of agricultural land [5].

MATERIAL AND METHODS

When studying the soil cover of the Garabagh plain, we used our field research and archival materials of many scientists who conducted research in these areas in the past.

RESULTS AND DİSCUSSİON

The total area of irrigated land is 172431.08 ha, which is 42.32% of agricultural land in the study area. Of these lands, 106973 ha or 62.03% are “irrigated”, 65,458.08 ha or 37.96% are “anciently irrigated” lands. (figure 1).

The irrigated lands of the Garabagh plain have different weight both in terms of soil subtypes and within soils.

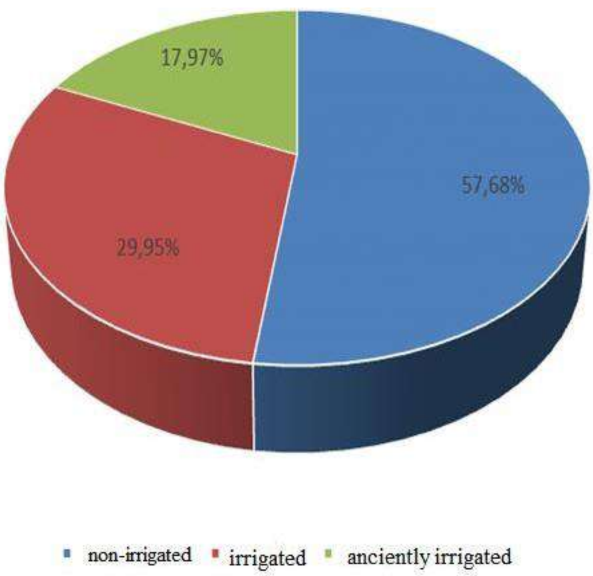

Figure 1. Distribution of lands of the Garabagh plain by irrigation

From the analysis of field indicators of the lands of the Garabagh plain, it can be seen that the largest indicator of irrigated lands falls on light chestnut (26.77% or 46165.96 ha), chestnut (22.03% or 37984.41 ha) and light meadow gray (21.04 % or 36290.08 ha) soils (table 1).

Table 1.

Share of irrigated lands by soil subtypes of the Garabagh plain (ha/%)

Soils	Area	
	ha	%
Dark chestnut	2011,1	1,17
Chestnut	37984,41	22,03
Light chestnut	46165,96	26,77
Meadow-chestnut	5548,15	3,22
Gray-brown	1136,4	0,66
Meadow-gray	3183,6	1,85
Light meadow-gray	6166,7	3,58
Dark meadow gray	11455,23	6,64
Ordinary meadow gray	22489,45	13,04
Light meadow gray	36290,08	21,04
Total:	**172431,08**	**100%**

The share of irrigated lands is almost evenly distributed among the other soil subtypes: ordinary meadow gray (13,04% or 22489,45 ha); dark chestnut (1,17% or 2011,1 ha); meadow chestnut (3,22% or 5548,15 ha); gray-brown (0,66% or 1136,4 ha); meadow-gray (1,85% or 3183,6 ha); light meadow-gray (3,58% or 6166,7 ha); dark meadow gray (6,64% or 11455,23 ha) [1,2].

An analysis of the distribution of irrigated lands by administrative regions shows that the largest part of them is concentrated in Aghjabadi region (33.4% or 57592.78 ha). For other regions, this indicator is distributed as follows: Aghdam (26.7% or 46121.75 ha); Barda (24.8 or 42726.9 ha); Tartar (15.07 and 25989.65 ha). The share of irrigation also differs within the soil subtypes distributed across administrative regions (table 2).

Table 2.

Distribution of irrigated lands by administrative regions

Name of soil subtypes	Area by regions				
	Aghdam	Aghjabadi	Barda	Tartar	Total
Dark chestnut	1504,45 3,26	506,65 0,88	-	-	2011,1
Chestnut	15694,69 34,03	8577,66 14,89	1088,7 2,55	12623,36 48,57	37984,41
Light chestnut	27549,01 59,73	11505,61 19,98	414,5 0,97	6696,84 25,77	46165,96
Meadow-chestnut	1072,9 2,33	-	-	4475,25 17,22	5548,15
Gray brown	-	683,10 1,19	453,3 1,06	-	1136,4
Meadow gray	300,7 0,65	2882,9 5,01	-	-	3183,6
Light meadow gray	-	3972,5 6,90	-	2194,2 8,44	6166,7
Dark meadow gray	-	3893,25 6,76	7561,98 17,70	-	11455,23
Ordinary meadow gray	-	8823,58 15,32	13665,87 31,98	-	22489,45
Light meadow gray	-	16747,53 29,08	19542,55 45,74	-	36290,08
Total:	**46121,75**	**57592,78**	**42726,9**	**25989,65**	**172431,08**

59.73% or 27549.01 hectares of the irrigated land in Aghdam region is light chestnut soils. Most of the irrigated lands in Aghjabadi (29.08% or 16747.53 ha) and Barda region (45.74% or 19542.55 ha) are due to light meadow-gray soils. Only 48.57% or 12,623.36 hectares of irrigated land in Tartar region is covered by chestnut soils [3,4].

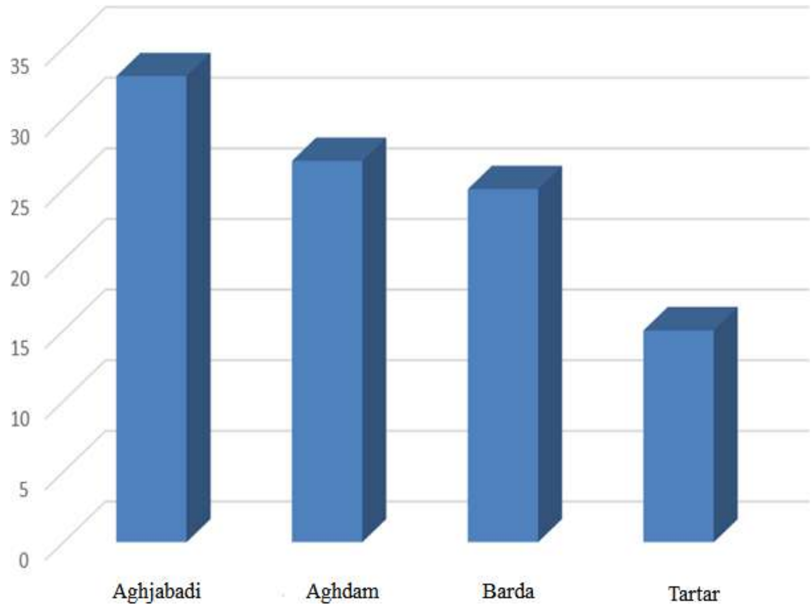

Figure 2. Distribution of irrigated lands by administrative regions (%)

In other lands, the specific weight of irrigated lands by administrative regions was as follows:

Aghdam: dark chestnut (3,25% or 1504,45 ha), chestnut (34,03% or 15694,69 ha), meadow-chestnut (2,33% or 1072,9 ha).

Aghjabadi: dark chestnut (0,88% or 506,65 ha), chestnut (14,89% or 8577,66 ha), light chestnut (19,98% or 11505,61 ha), gray-brown (1,19% or 683,10 ha), meadow-gray (5,01% or 2882,9), light meadow-gray (6,90% or 3972,5 ha), dark meadow-gray (6.76% or 3893,25 ha), ordinary meadow-gray (15,32% or 8823,58 ha).

Barda: chestnut (2,55% or 1088,7 ha), light chestnut (0,97% or 414,5 ha), gray-brown (1,06% or 453,3 ha), dark meadow-gray (17.70% or 7561,98 ha), ordinary meadow-gray (31,98% or 13665,87 ha).

Tartar: light chestnut (25,77% or 6696,84 ha), meadow-chestnut (17,22% or 4475,25 ha), light meadow-gray (8,44% or 2194,21 ha).

CONCLUSİON

Thus, the analysis of irrigated lands both by soil subtypes and by administrative regions shows that the Garabagh plain has sufficient area potential for the development of grain farming under irrigation.

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UDC:626;8;631.6

EVALUATION OF CLOSED DRAINAGE FROM AN ECOLOGICAL ASPECT

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This article is devoted to the drainage effect of existing closed tubular drains, their role in regulation of groundwater table, removal out of the mineralized drainage water from the area, prevention of repeated salinization of the soil by studying the effects of desalination in the active soil layer, determination of the optimal water-salt regime and the impact of drainage on the environment, environmental advantages of closed drainage compared to open drainage the territory of the Azerbaijan Republic.

It was shown that on irrigated lands, where about 80-90% of agricultural products were produced, the soils were subjected to repeated salinization as a result of the proximity of mineralized groundwater to the Earth's surface, a weak degree of natural drainage or its absence. The main means of combating soil salinization is their leaching against the background of drainage. Reclamation improvement of these lands, their return to crop rotation, restoration of their ecological balance, development of reliable methods of combating salinization in various natural and economic conditions is one of the most important tasks facing reclamation science.

It has been recognized that, unlike open drains, there is no loss of arable land on lands where covered drains are built. In order to ensure the normal operation of open drains, a lot of public funds are spent every year to remove sludge, environmental conditions are disturbed. Therefore, the gradual replacement of open drains and collectors with closed networks in the reconstruction of irrigation systems should be considered as an important component of agricultural ecology. In addition, in the article has been indicated that drainage protects the normal ecological environment of the area, and also ensures the sustainable agricultural production. Also the system of economic and technical measures for improvement of the unsuitable natural conditions for the efficient use of the land, the implemented amelioration measures by regulating the water, air, food and heat regimes of the land were discussed.

Keywords: *irrigation, open drainage, closed drainage, collector-drainage system, groundwater regime, salinization, mineralization.*

INTRODUCTION

It has been defined that in irrigated areas, where approximately 80-90% of agricultural products are produced, mineralized groundwater table is close to the surface of the earth as a result of weak or no natural drainage rate, therefore the soils are under the risks of the repeated salinization. The main mean of the soil salinization control is their leaching with the application of the drainage. Thus, improving these lands in terms of reclamation, their reuse for agriculture, restoring of their ecological balance, developing reliable methods for soil salinization control in various natural and economic conditions are most important tasks which shall be solved by the amelioration sciences.

The article discusses that for the development of agricultural production, reclamation measures are carried out on a large scale and volume every year in the country. At the same time, the performed works allow to protect and improve the natural-ecological environment. Talking about the existing drainage systems, it has been noted that their rehabilitation is an effective reclamation measure, that ensures the improvement of their efficiency, the efficiency of the use of land and irrigation water, and the increase of the productivity of agricultural plants.

The reclamation measures are carried out on a large scale and volume every year in the country in order to develop agricultural production. The implemented water facilities constructions and land reclamation provides the favorable conditions for the lands under the agricultural use, and it allows for the protection and improvement of the natural-ecological environment.

The irrigated agricultural production should be carried out on the basis of a reliable reclamation measures. Year by year the demand for land reclamation, which is considered an ecological factor, has not decreased at all, on the contrary, it is increasing.

Reclamation measures mean to provide irrigation water to cultivated areas in timely manner and in the necessary volume by the applying of the irrigation methods in accordance with natural conditions, regulating the groundwater table in the soil, ensuring that the soil does not become salinized, the drainage systems applied to leach the saline soil, improving the water-physical properties of the soil, agro-reclamation measures, implementation of an efficient farming system to preserve and increase the soil fertility, embankment works for the prevention of the mechanical effect of water (erosion, landslide, flooding, etc.), regulation of river flows, use the water energy for the various purposes and other measures. [1,2].

MATERIALS AND METHODS

Materials for this study has been obtained from the researches made for the assessment of the closed type drainage systems in different regions of the Azerbaijan Republic. Traditional methods which accepted in amelioration investigations are applied for the drainage investigations, including soil and climatic characteristics, crop patterns, degree and type of the soil salinity and ground water, ground water table, drainage calculation, construction methods and operation. The best experience has been introduced for evidence of necessity of the wide application of the closed drainage systems.

RESULT AND DISCUSSIONS

Reclamation measures have a direct or indirect effect on soil fertility and growing conditions of agricultural plants, plant productivity and quality, microclimate, flora and fauna, human and animal health. Rather, it should maintain the balance of the ecological environment. However, measures implemented without a detailed study of the natural conditions (climate, soil and hydrogeology) of the areas and a proper assessment of their condition do not give the expected results, and the ecological condition become more worsening. Currently, 23 collector-drainage systems with a length of 30.2 thousand km, 205 irrigation systems with a length of 49,054 thousand km (of which only 5.4 thousand km are concrete lined) are under operation in the country. These systems include 135 reservoirs of different volumes, 14 water junctions, 876 pumping stations, 8,000 sub-artesian wells, 109,000 hydrotechnical facilities, 1,700 km of protective dams, etc. available [1,2].

The crop water consumption depends on the environmental conditions - temperature, air humidity, soil fertility, as well as the physiological characteristics of the plant and its cultivation methods. It was determined that 2-3 thousand m3 of water is required for the production of the one ton of cotton, 1-1.5 thousand m3 - for one ton of wheat, 0-0.5 thousand m3 - for one ton of dry grass. Currently, in reality, 2-3 times more water is used for this due to the poor irrigation water management.

During irrigation, the excess water seeping down from the subsoil layer raises the groundwater level, the soil becomes swampy which leads to the soil salinization. During 6-8 years, the intensive irrigation carried out in undrained areas through the previously built Upper Karabakh, Upper Shirvan and Samur-Devachi earth irrigation canals raised the groundwater table from 6-10 to 1-3 meters, and the soils have became saline. Agriculture suffers from this "disease" even now.

In the irrigated lands of the country, open drainage was built in the low-slope Mugan-Salyan massif, and covered drains were built in Shirvan, Karabakh Mil, South Mughan plains and Samur-Absheron massif [3].

The open drains consisting of the ordinary trapezoidal canals with a depth of 3.0-3.5 m and a slope coefficient of 1.5-2.0. Under their location, a 25-35 m wide strip is used and consequently this land suitable for agriculture is lost, which reduces reclaimed land use coefficient.

In order to ensure the normal operation of open drains, they are periodically (every 3-5 years) cleaned of sludge, and every year considerable public funds are spent on this (otherwise, the drains become silted and lose their design parameters and cannot perform their regulatory function).

The reeds and other aquatic plants grow in the channels bed of the open drains and collectors, due to the low velocity of the water and the aeration of the drainage water is disturbed, therefore favorable conditions are arisen for the development of microbes, insects, pests and weeds that cause human and plant diseases. In order to prevent development of the such situations, it become necessary to apply excessive amounts of harmful chemicals and pesticides to the fields, which, as a result, have a negative effect on human and animals, destroy useful insects, and poison water and soil. Therefore, in the reconstruction of irrigation systems, the gradual replacement of the open drains and collectors with closed type networks should be considered as an important component of agricultural ecology [4, 5].

Unlike open drains, there is no loss of arable land on land where closed drains are constructed. During operation, the depth of the drainage remains constant, there is no need for additional construction where the drainage intersects with canals and roads. In the process of constructing a closed drain, the drainage ditch is filled with counter-poured soil, and the land above the drainage can be used for planting.

By using modern trenchless drain construction machines in the construction of the drainage, the humus, fertile upper layer of the soil is preserved. Semi-mechanized drainage construction by digging a trapezoidal trench is environmentally harmful. In this method, the structure of the top layer of the soil along the drainage track is completely destroyed, and it becomes unsuitable for planting in a certain period of time. In order to speed up the removal of mineralized groundwater from the fields in the basic washing of heavy clay salinized soils, it is more appropriate to construct a crot drainage network instead of applying a temporary open shallow drainage systems [5].

The research results has determined that the application of crotch drainage increases the drainage module up to 1.7-2.0 l/sec/ha, there is no loss of soil in its application, the ecology of the soil is not disturbed, and after thorough washing, aeration in the top layer of the soil is improved for several seasons, giving an ecological effect. [3].

The direct function of drainage in irrigated lands is to ensure to establish of the required ameliorative regime in the lands by removing excess water and salts from the upper soil layer where the plant roots are located, and to create the water-salt, nutrient and air regimes that provides normal plant growing. In addition, drainage should protect the normal ecological environment of the area, as well as favorable condition for sustainable agricultural production, ensure the maintenance of these conditions. The construction of the drainage affects the natural conditions of the region and preserves and improves the hydrogeological-ameliorative situation for irrigation, and provides normal conditions for the development of plants. The drainage makes it possible to optimize soil temperature and thus increase crop cultivation time by extending the growing season. At the same time, drainage in many cases contributes to the ecological balance of the area, provides other factors that positively affect plant growing and soil fertility.

The effective operation of the drainage and its positive effect on environment depends on the design of the drainage, which shall be in accordance with the soil and hydrogeological conditions, mainly on the correct selection of the filtration coefficient, the calculation scheme and construction of the drainage, as well as from the quality of construction works and operation of the system [5].

It should be noted that the closed drainage network built in Azerbaijan in 1928-1931 at the Mugan experimental reclamation station, consisting of highly water-permeable soils formatted from the sediments brought by the Araz River, is still functioning successfully. During the 40 years as a result of the successful leaching, the thickness of the desalinized layer of the previously heavily salinized soils and groundwater has reached 10-12 m above the ground surface, which is much more than what is required for crop growing.

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SUSTAINABLE MANAGEMENT OF SOIL RESOURCES IN KAZAKHSTAN IN TERMS OF CLIMATE CHANGE

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The article presents data on the state of soil resources in the Republic of Kazakhstan. The principles of soil resource management under the conditions of global climate change are outlined. The results of research by the researchers of the Institute on the development of criteria of soil degradation, technologies of restoration of saline, abandoned lands, methods of increasing soil fertility and, on this basis, the productivity of agricultural crops, are presented.
***Keywords**: Degradation, Dehumification, Salinization, Desertification, Fertility, Soils*

The Republic of Kazakhstan is a State in the center of Eurasia, with total area of 272.5 mln ha. Kazakhstan is located at a great distance from the World Ocean, which causes a sharp continental climate with hot and dry summers and very cold snowy winters, high aridity, and has complex topographic features.

This, in turn, influenced on the formation of various natural and climatic zones and a unique soil surface that is regulated by the laws of geographical distribution and soil zoning: from north to south black soils are replaced by brown and gray-brown soils, in mountainous areas there is a belt of gray soils, brown, chestnut soils, mountain black soils. An important feature of soil surface is its heterogeneity and great complexity associated with the aridity of climate, topography, and soil-forming rocks.

The land fund of the RK by types of land plots is distributed as follows: agricultural lands - 219.6 mln.ha, including arable land - 26.7, perennial - 0.15, hayfields - 5.1, pastures - 184 mln ha [1].

Most of soil resources of the republic in natural and economic zones are represented by brown and gray-brown soils (31.2%), dark chestnut, chestnut (28%), light chestnut (16.1%), the share of most fertile black soils leached, ordinary, southern account for 11.1%.

Today, global climate changes- is one of the most important challenges of our time, which affect the interests of the world scientific community, various intergovernmental, government, and public organizations.

The seriousness of the problem of global climate change is obvious. For Kazakhstan, as a country with a large share of production in agricultural sector, the impact of climate change on agriculture is significant. During the last 70 years, the annual and seasonal surface air temperatures have been increasing [2]. The total duration of warm periods becomes 1-4 days longer in 10 years, and almost everywhere throughout the territory there is a tendency of reduction of frequency of frosty days [3]. The distribution of precipitation over natural zones has a fairly large amplitude - from 1600 mm in the mountainous regions of the republic to 300-100 mm or less in the central and southern regions, with evaporation in the south 10-20 times higher than in the north. That is, the limiting factor in obtaining high yields of grain crops in grain belt of the Republic of Kazakhstan on black soils and chestnut soils is insufficient moisture.

Global climate change affects all components of biosphere, including soil surface, primarily due to the fact that climate is one of the main factors of soil formation. The climate determines the energy level and hydrothermal regime of soils, level of biological productivity of ecosystems, and involvement of organic carbon in soil processes.

The soil is a kind of reservoir of mineral and organic substances, regulating the direction, speed and scale of their migration and transformation in terrestrial ecosystems. These processes take place on the background of a certain climatic situation and are largely shaped by it.

Therefore, in the context of global climate change, a strategy for sustainable soil management is very important. Since soil - as the main means of production in agriculture is the basis of food security.

In human history, several civilizations have perished as a result of the fact that they could not ensure the sustainable fertility of soils used in agriculture. The great German scientist Justus Liebig spoke about the importance of preserving soil fertility back in the middle of the XIX century "... *the reason for the emergence and fall of the nations lies in the same thing. The plundering of soil FERTILITY causes their destruction, the maintenance of this fertility ensures their life, wealth and power*" F. D. Roosevelt said the same thing: “A nation that destroys its soil destroys itself” [4].

That is, it is fertility that provides the prospects for the growth of the welfare of society and stability of human civilization.

A constant background for the development of human civilization is the threat of depletion and degradation of soil resources, which Academician G.V. Dobrovolsky called "the quiet crisis of the planet". However, the threat of this crisis is mentioned less frequently than catastrophes and epidemics [5].

Sustainable management of soil resources implies a two-sided approach: resources, as such, and soil fertility management, in the first case it is associated with protection and rational use of soil surface, in the second case, application of a set of agrotechnical measures in agricultural production and prevention of the development of degradation processes in scientifically- justified approach.

In Kazakhstan, as in many countries of the world, the problem of soil degradation is a serious concern, and soil scientists of the republic make great contribution to their solution. According to scientists, in Kazakhstan, the areas of degraded and deserted lands make up 75% of the entire territory, therefore, 25% remains as the share of fertile soil, which is also subject to the increased risk of environmental destabilization caused by the extensive development of agricultural production, the intensive development of the resource-extracting industry, and a wide network of military testing and training grounds.

There are more than 90 mln ha of eroded and erosion-hazardous lands in the republic, of which 29.3 mln ha are actually eroded.

The problem of melioration state in the irrigated lands in the south of Kazakhstan is of great concern. According to the Committee for Land Resources Management, out of 1.55 mln ha of irrigated lands, 236.9 thous. ha or 15.2% are not used in four southern regions of the republic. Over time, these areas gradually become saline with the formation of solonchaks, overgrown with halophytes and become sources of eolian salt transport. The area of saline and solonetzic soils is 93.7 mln ha (42.1%).

The area of pastures covered by desertification processes is 191.1 mln ha, pasture degradation (overgrazed) is 27 mln ha.

As a result of the extensive use of land resources, there have been significant changes in the direction of humus concentration reduction in soil. More than 70% of the arable land has a very low and low humus concentration. The weighted average humus concentration in soils of the republic decreased from 1.5 to 20.5%. In general, the loss of humus after the development of virgin and fallow lands amounted to 40% of its initial concentration, the annual loss of humus in agriculture in Kazakhstan is 0.5-1.4 t/ha.

Over the past 10 years, for all soil types, there has been a decrease in concentration of nutrients available to plants: more than 55% of arable land has a very low and low concentration of easily hydrolysable nitrogen, in the concentration of available phosphorus, more than 47% of the area of the surveyed arable land belongs to a very low supply (less than 15 mg/ kg), 39% - have an average supply (16-30 mg/kg). The problem of technogenic disturbance of soils is of great concern, of which 2.7 thous. ha are disturbed, 0.3 thous. ha are worked out, 0.3 thous. ha are reclaimed.

The use of modern technologies allowed the scientists of U.U. Uspanov KazRISA to create electronic large-regional soil map of the southeast of Kazakhstan which is the first in the history of domestic geographic and genetic soil science, which made it possible to identify patterns of formation and current state of soil surface under changing climatic conditions and anthropogenic impact.

In the desert zone of brown and gray-brown soils, where soil formation processes proceed under conditions of a large moisture deficit, soils are most susceptible to degradation and desertification. Scientists of the U.U. Uspanov Kazakh Research Institute of Soil Science and Agrochemistry at the time developed criteria for soil degradation that can be used as soil management tools: reduction of concentration of physical clay; soil profile thickness; decrease in humus reserves in soil profile (A+B); change in the pH of soil environment; depth of erosions and waterholes; deflationary infertile layer deposition; projective cover of pasture vegetation; area of moving sands; concentration of the amount of salts in the upper fertile layer; increase in the content of exchangeable sodium [6]. Based on conducted soil surveys and taking into account the developed criteria, maps of soil surface degradation were compiled, which provide the possibility of monitoring the soil state.

As noted above, large areas in the republic are occupied by saline soils, which, if appropriate measures are taken, can be involved in agricultural turnover and be a source of additional crop production. The Institute has developed a technology of development of highly saline, solonetzic and alkaline soils for rice cultivation without preliminary soil leaching and obtaining yield in the year of development, which ensures the secondary use of drainage and waste water with mineralization of up to 3 g/l without a significant deterioration in soil fertility and decrease in rice yield; saving irrigation water; acceleration of rice ripening by 7-12 days; increase in productivity by 25% or more on saline soils with a salt concentration of up to 3% without their preliminary washing; reduces the rate of application of phosphate fertilizers twice; excludes the use of anticereal herbicides of contact action [7]. This technology has been introduced in all rice-growing farms of the Balkhash district of the Almaty region using conventional agricultural equipment.

A technology on increase of the fertility of saline soils for corn for grain has also been developed. The use of this technology in the conditions of the Turkestan region of the republic contributed to the increase in the energy of germination and seed germination, plant resistance to diseases and extreme environmental conditions; increased growth of roots and aerial parts of plants. At the same time, the terms of corn ripening were reduced by 7-16 days, grain yield increased by 20-60% with a net income from 1 ha to 100 thousand tenge [8].

BioEcoGum biofertilizer from vermicompost with enrichment of macro- (N, P, K, Ca, Mg), microelements (Mn, Mo, Zn, Se) with content of specific strains of microorganisms, phytohormones, growth stimulants, which has an integrated effect on yield and quality of crops and on indicators of soil fertility. The yield of winter wheat, corn, soybeans increased by 25-40% while reducing the cost of fertilizer use by 4-5 times. Fertilizer is universal in terms and methods of application [9].

To solve the problems of restoration of degraded pastures, methodology of ground and space monitoring of the state of pastures in the desert, foothill semi-desert (vertical), semi-desert (latitudinal), dry steppe, steppe and forest-steppe zones of the republic has been developed. This provides:

- operational accounting of the state of fodder pasture resources, their changes, objective and timely choice of measures for their rational use, provision of rest and improvement.
- definition of specific area of pasture land with different levels of degradation; localization of degradation development through the use of technology for restoration and improvement of degraded areas (grass overseeding, the use of organic fertilizers, etc.). As part of these studies:
- database was created on indicators: on physical indicator - soil type, morphology, granulometric composition, humus concentration in soil layer of 0-30 cm, etc.; according to biological indicator - botanical and species composition of herbage, productivity, and projective soil surface with vegetation.
- maps-schemes of 33 polygons were compiled with a breakdown into plant contours according to the degree of degradation with analysis of NDVI vegetation index in the context of degradation contours.
- a map of degree of degradation of pastures in desert, foothill semi-desert (vertical), semi-desert (latitudinal), dry-steppe, steppe and forest-steppe zones of Kazakhstan M 1:1000000 was developed and an interactive electronic map of pasture degradation M 1:750000 was created on this basis.

At the State level, control over the rational use of land resources is carried out by the Committee for Land Management of the MA RK.

As measures to strengthen control over the rational and efficient use of land, the Committee adopted:

- double increase in the tax rate from 10 to 20 times for unused land;
- terms for the withdrawal of unused agricultural land from 2 years to 1 year are reduced;
- new mechanism of State control through space monitoring without on-site visits has been introduced;
- the platform "JERINSPECTR" was developed and launched, through which remote control is carried out;
- authorities to control in the field of land relations are fully transferred to the MA RK;
- The President of the State lifted the moratorium on inspections in the field of land relations;
- limiting sizes of agricultural lands for PF and F were set in the amount of 35 thous. ha, for legal entities - 51 thous. ha;
- in order to minimize violations of the law and strengthen the responsibility of local executive bodies, amendments were made to the Code of Administrative Violations;
- a law was adopted that foresees the simplification of the procedure for granting land, minimizing the interaction of service recipients with service providers by converting services in the field of land relations into an electronic format;
- an information system has been developed to ensure equal and full access to information on occupied or vacant land plots, registered real estate objects.

To date, 6.1 mln ha of unused land have been returned to the State, and 2.5 mln ha of agricultural land are being developed by operating entities.

According to space monitoring data, 10.2 mln ha of irrational land use and 11.7 mln ha of unused land have been identified.

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WATER SCARCITY – HOW OVERCOME GROWING CHALLENGE IN AZERBAIJAN

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This article is devoted to the problem of water resources management and water use in Azerbaijan Republic. Based on the analysis of the current situation, proposals for improving the water sector, including irrigation management, are justified. The water scarcity in the arid zones of the country has recently become a more acute problem requiring urgent integrated solutions. Therefore, the article discusses the political, institutional and infrastructural needs for future development to mitigate the negative effects of climate change, with the critical water scarcity on lands of intensive farming. The main water policy plans should be adopted in a new Water Strategy document. The planned Water Strategy should address the observed problems of water availability and usage, as well as propose a comprehensive policy for sustainable use of the water to meet demand and protect the environmental safety of the water bodies and agricultural land from the negative effects of current irrigation practices. The article proposes the main directions for the implementation of the water strategy, taking into account all main influencing factors of the country development, including population growth, water resources availability forecasting for the main consumers, future water demand, integrated measures to develop up to date water accounting system to prevent unproductive losses and water reuse.

INTRODUCTION

Water scarcity is the noted global problem in all over the world, especially for the developing countries [UNESCO, 2019). Since the early 2000-s the international literature discusses water scarcity problem in more intensively and the ways to overcome this challenge depending on the country of location, potential of water resources, status of the infrastructure, availability of the precise water accounting system, structure of the consumers, including agricultural water use, irrigation technology, cropping pattern, soil characteristics and other conditions [Liu J. et al, 2017, Liu, X. et al, 2022]. It is estimated that approximately 20% of the world's population lives in areas where there is a physical shortage of water to meet all needs. Over 2 billion people already live in areas subject to water stress. Some 3.4 billion people, 45% of the global population, lack access to safely managed sanitation facilities. According to independent assessments, the world will face a global water deficit of 40% by 2030 [UN, 2021]. Therefore, the elaborated and implemented adaptation and modernization policies depends on the above conditions and therefore differs in each country.

The water shortage problem has become critical for the Republic of Azerbaijan as well, where the main agricultural lands under the intensive farming are located in arid zones [Aliyev, 2018, Aliyeva et al, 2023]. The increase in temperature in recent years is very damaging to irrigated agriculture and more critically affects to rain-fed agriculture, requiring their forced transfer to irrigated lands, installation of the new infrastructure and demanding more water for irrigated areas in the whole country.

Water resources in Azerbaijan are limited and during the last 30 years, reduced by 15% and this negative tendency is going on in the country, accounting in 2022 totally 25,7580 billion cub meters [GoA,2022].

Most of the irrigated lands in Azerbaijan located in the dry climate and very low humidity in the summer time, therefore mostly agricultural farming is provided with the wide application of the irrigation systems. In the other hand most of the irrigated lands exposed to the salinization and therefore the irrigation is applied with the combination of the drainage system to control soil water salt regime to prevent soil salinity. The situation is critical due to the lack of the existing irrigation infrastructure. Most of the irrigation systems are presented with the open type earth canal systems from main canals up to the on-farm infrastructure. In addition, due to the wide application of the traditional irrigation methods the technological water losses approximately reaches up to 40% in the fields. Overall during transportation water losses are averagely 30% from the water taking from the natural sources [SSC,2022].

The population raise and demand for the centralized water supply is increasing year by year, which also require enlargement of the service area and rehabilitation of the existing water supply systems and waste water treatment facilities. Therefore, demanding huge investments every year to approach to the sustainable development goals to provide everybody access to the clean water [UN, 2022].

The water scarcity problem in Azerbaijan shall be addressed during the upcoming period for sustainability of the water delivery for main consumers such as irrigation, hydro-energy, municipal drinking water supply, industry and others, but with the consideration of the necessary environmental flows. It means that IWRM (Integrated Water Resource Management) principles shall be elaborated and implemented to protect water for future and sustainable use for the benefit of all society. Finally, the updated water resource management strategy shall be adopted and realized.

MATERIALS AND METHODS

This study takes an integrated approach to the problem of water scarcity, therefore both physical and economic aspects of water scarcity have been investigated for the country. The problem was addressed at the local level, but a review of some international experiences was also made on the topic of the water scarcity and its addressing in Chine, Turkiye and Italy for better understanding of the crisis extend and to familiarize with the improvement measures for adaptation and mitigation against the negative effects of the on-going climate changes.

In the process of conducting research and analysis, reliable information was used covering the national level, including the annually approved water balance of the country, hydro-meteorological, statistical data on the water resources and their use by the different consumers, some performance indicators and other available sources.

Therefore, the recommendations were developed on the basis of the analysis of the current situation and relevant solutions of the observed problems are proposed. All these measures should be reflected and considered in the country's new Water Strategy, in which water resources in essence should be perceived and treated as wealth, and not just common resources.

Methodically, integrated approach has been applied to understand the scale of the problem and its influence to the environment, water resources availability, demand of the main water consumers, including agricultural water usage.

The recommendations describe the structure of the intended Water Strategy with the planned scope of the analyses, studies and assessments including for the water policies and management, water resource availability, status of the water consumption, forecasting demands, measures for the water resource increase and their environmentally friendly rational use.

RESULTS AND DISCUSSION

Current situation

The limited water resources of Azerbaijan are primarily originated from the country geographical location and climate characteristics. Compared to other South Caucasus countries the water resources in Azerbaijan is more limited. There are 119,000 cubic meters of local water resources per square kilometer in the country, this figure is 769,000 cubic meters in Georgia, and 218,500 cubic meters in Armenia. [Imanov, 2016, Rzayev, 2018]. Irrigated agriculture is concentrated mostly in the Kura-Araz lowland, which faces with the high temperatures and a deficit of soil natural moisture during the growing season necessary for crop growing, so agriculture is impossible without applying irrigation.

Increase in temperature throughout the country is estimated by 1,3°C in 2010, compared with the average annual temperatures observed in the period 1961–1990. The increase in temperature was observed mainly in summer, which amounted to about 0.90°C in the Kura-Aras lowland, which creates a serious water shortage, especially during in the summer months. Due to the temperature rising, the loss of glaciers is estimated to approximately 50% in Azerbaijan over the period 1906-2006. According to the future climate modelling it is expected, in Azerbaijan in the coming decades, rising temperatures are likely to lead to more reductions in river flows, putting critical pressure on the fresh water. Based on the model estimations, by 2100 river flows will fall by approximately 26–35%. Water shortages will be more severe in the arid regions of the country and could reduce crop yields. This negative effect may be strengthened if existing irrigation infrastructure problems, including water losses are not addressed properly [WB, 2021]. Even currently, there are difficulties in obtaining the planned crop yields due to the lack of irrigation in the rain-fed farming zones. The occurrence of water shortage has created problems not only in agriculture, but also in drinking water supply and hydropower. This is due to the occurring depletion of drinking water sources and decreasing of the river flows.

Taking into account the tension of the situation, in 2020 the government of Azerbaijan established the State Commission to ensure the efficient use of water resources, and in the same year adopted the Action Plan, which includes realization of a number of infrastructure projects shall be implemented for the short term period [GoA, 2020].

The Commission, chaired by the vice-premier, included all the main ministries and organizations involved in the national water management.

The Action Plan contains the implementation of the measures for:

1. Assessment, protection and sustainable use of water resources;
2. Digitalization of water management, improvement of accounting and data delivery;
3. Increasing efficiency of the water use resources in energy generation;
4. Efficient and economical irrigation water use, development of the new water resources;
5. Improvement of drinking water supply system;
6. Increasing efficiency in the field of financing infrastructure projects;
7. Information spread and awareness raising;
8. Improvement of land reclamation, degradation and desertification control.

The Action Plan includes construction of the ten number of reservoirs as well as the hydraulic structures, irrigation canals and collectors. The reservoirs will be designed to collect mountain river waters to be used for irrigation and water supply schemes.

Since the establishment of the Commission, continues inter-ministerial work has been established in various formats on the irrigation, municipal water supply problems and the ways for solution. The number of the field trips have been organized to get acquainted with the situation in water facilities. New projects to be implemented in accordance with the Action Plan were considered and some of them has been already realizing. Since the establishment of the Commission, water resources allocation and management has been improved and implementing on equal basis to satisfy water users demand and environmental requirements.

Since the establishment of the Commission, which acts as the main regulator of the sector, the transition to the principles of integrated water resources management has accelerated to the benefit of the all users.

The issue of water scarcity in different countries

Since the early 1990s, the study of water scarcity has become a debated issue and relevant models was developed to assess it using key indicators such as the number of population, water availability for the various users, but there is a need to incorporate green water, water quality, and environmental flow requirements in water scarcity assessment [Liu, J., 2017]. The solutions are different depending on the country.

Due to the uneven spatial and temporal distribution and the availability of water resources China plans to provide national water security through improvement floods and droughts control, water resources conservation, water allocation optimization and ecological protection of the large rivers and lakes.

Currently agricultural water consumption is about 65 percent of China's water use, which was 88 percent in 1982. Under the new plans, it is intended to mitigate both of the physical and economic water scarcity through raising the efficiency of water agriculture water use by the wide installation of the efficient water-saving irrigation technologies in the different regions, including sprinkler, micro-irrigation and cultivation drought-tolerant and low water required crops. Thus, the intention is to intensify reduction of the water use in agriculture.

The reduction of the non-revenue water is planned through leak detection program in water networks. Important water conservation activities and educational programs will be implemented to support whole process.

The country planned to control the amount of water withdrawn from river basins and groundwater usage, new water permits in water-scarce regions will not be issued to avoid over-exploitation and additional pressure on local water resources. Within the new FYP plan, non-traditional water sources, including treated wastewater, brackish water and harvested rainwater will be used more widely [UN, 2021, Donnellon-May, 2022].

Even though Turkiye is one of the water-rich countries in the Mediterranean, but due to the huge population growth to 85.3 million in 2022, the availability of water resources has already decreased to about 1322 m^3 per capita per year. Water demand in Turkey has roughly doubled in the second half of the last century. The overall demand for water in Turkey continues to grow, especially in light of the effects of drought or climate change, so Turkey's suffering from water scarcity is more than obvious in the coming years. The country need to develop Water Management Plans against the drought events. Therefore, it became very important to consider to obtain the meteorological forecasting data in advance to enable develop adequate water management plans for the regions and whole country depending on the expected water shortages. In preparation of the such plans water saving measures shall be dominantly elaborated. Water conservation measures shall also include educational programs with the efficient water use tools by the main consumers. Water saving plans shall also shall consider unpreventable events such as water emergencies and shortages can be occurred because of other disaster evens such as earthquakes, breakdown of the infrastructure failure and sanitation networks etc.

These plans shall introduce to overcome possible conflicts between different consumers and by specifying more comprehensive instructions and actions against water shortage. Future drought management planning should include all main consumer’s participation, including agriculture, municipal water systems, industry and others. Therefore, reservoir capacities must allow to provide above consumers’ demands, hydroelectric power generation. New water resources shall be developed to overcome consequences of water scarcity. Mitigation plans shall include taking measures against natural disaster events as well [Bobat, 2016 , Glied & Kacziba,2021].

In the past decade, of the many problems associated with water use in Italy, two trends have been particularly observed- resource scarcity and water pollution. Therefore, among the various possibilities

for proper water use, it is necessary to improve the surface and groundwater intake, with proper protection of sources from possible pollution and rational use of the available resource. In the last twenty years, the Italia has been affected by different water crises and requiring the realization of the emergency measures to mitigate negative impacts [Brussolo, et al, 2022]. Water scarcity is more critical in southern Italy regions. Water networks loss inefficiency is estimated on average 47,9% [EIT, 2021]. Weaknesses of modern water system management are the use of a sectoral approach to water treatment, insufficient maintenance of waterworks, disagreements between different levels of system management, and most importantly, the immediate preparation for climate change and its mitigation. Supporting factors are the positive impact on risk reduction for water and food quality in accordance with European directives. Therefore, the ability to withstand the challenges of global change and mitigation for irrigation and water supply requires updated legislation to achieve the goals of the climate change adaptation plan, improved regulation of surface water abstraction, taking into account the optimization of use permits to ensure environmental flow and prevent overexploitation of groundwater, reform to improve coordination between various bodies at the central and regional levels, strengthen public awareness, plan to reduce the risk of drought and water scarcity at the district level, including in water supply systems. Two interrelated conditions are prerequisites for taking concrete action - the application of a multidisciplinary approach to solving water problems and the importance of recognizing ethical responsibility for water.

In principle, due to critical climate change and the emergence of challenges in the water sector, it is necessary to recognize the magnitude of the problems and the widespread application of the new "water culture" at all levels of responsibility, both in science and in practice [Rossi and Peres, 2023].

As can be seen from the above examples, water scarcity continues to cause problems in various countries and requires the implementation of a targeted program for the efficient use of water resources as the part of the integrated measures against climate change. The national programs shall be adopted in time and to aim to mitigate consequences of the water scarcity in each country. In this context it is important to adopt and realize new water strategy program in Azerbaijan enable to address current challenges arisen from water recent crises.

New water strategy-solution to address water scarcity

In accordance with the Action Plan, the draft "National Strategy on the Effective Use of Water Resources in Azerbaijan" shall be prepared and introduced to the government for approval for the upcoming period.

This strategic document should cover all aspects of water management in the coming years, the implementation of which should contribute to the formation of a healthy attitude towards water resources in society, ensuring their careful consumption, protecting the environment, mitigating the effects of climate change and meeting the needs of water users, thereby accelerating the country development.

Therefore, this document is recommended to be structured addressing the following strategic issues.

1. Diagnostic analysis of the water resources and water management system in the country.

These analyses shall cover current water resources, forecasts and anticipated challenges due to the climate changes. Assessment shall be made to define the state of the existing infrastructure of the whole water management system, including reservoirs, irrigation and drainage systems, Water User Unions controlled on-farm networks, water supply and waste water systems. These studies shall address forecasts of the expected water demand of the main water users-agriculture, household, energy, industry, fishing and other consumers. Based on the results of the forecasting calculations, adequacy of the availability of the water resources against demand and the required ecological flows will be forecasted. Other activities shall be taken for the assessment of the current condition of flood protection facilities and monitoring of river beds and assessment of status of the water measurement network.

2. Increasing water resources and development of water management facilities. These measures shall include:

-Construction of new reservoirs on the internal rivers, programs for repair and restoration of existing reservoirs, canals and collectors, construction of rain water collection systems;

- Forecast of available volumes of waste water (domestic waste water, waste water of industrial production, collector-drainage water in agriculture, etc.) and defining the planned volumes of processing and their reuse;

-Determination of the water demands for different water users based on the current consumption and forecasted levels depending on the population raise and economic development;

- Analyses of the current water losses in agriculture, drinking water supply and other areas of water use and their forecasted reduction targets over the years by the investment programs;

-Adaptation of the quality of drinking water to the standards of the World Health Organization;

-Improvement of water use through the application of modern technologies in irrigation and water supply;

- Preparation of a digital scheme for the setting of the sustainable water supply system of the country based on existing and future reservoirs' capacity and their location.

3. Improving the management of the country's water management complex. The measures shall cover the following topics:

- Institutional improvements for better water policy and water infrastructure governance;

-Development of the updated Water Code taking into account the country and best international experience;

-Improvement of the water use permit licensees for the water bodies depending on the purpose of their use;

- Continuation of the improvement of "Digital water management" information system covering whole country;

-Determining management principles for the transition to the basin and integrated water resources management;

- Strengthening of the infrastructure of the water organizations, including with the water measurement facilities, improvement of the accurate water accounting system and continuation of the digitalization of the operation and maintenance;

- Improving water management at the on-farm level.

4. Measures for efficient use of water. They shall cover set of the interrelated activities which include as below:

-Determining the principles for demand management and the introduction of the improved methodology on the tariff policy for the fair distribution and elimination of wasteful water use;

-Improving the accounting system for water use, mechanisms for paid water use, subsidy policies;

-Measures for the cost optimization aimed at obtaining sustainable revenues for the provision of services in the field of water management;

- Improvement of the operation rules of hydraulic facilities and rules for the use of river flows with the consideration of the environmental restrictions;

-Preparation of interactive irrigation maps on the priority irrigated areas and crop pattern based on the calculated and predicted water sources and improvement of permit mechanism for optimization of the area of irrigation;

- Elaboration of the standards to the assessment of the river ecological flow, strengthening of the flow control mechanism and the preservation of the river ecosystem;

-Ensuring efficient use of underground water resources and management of sub artesian wells;

-Improvement of the mechanisms forward to the effective land use;

- Application of the public-private partnership models in the irrigation water and drinking water supply projects;

-Proposals for the enlargement of the use of alternative sources, including ground, treated waste, collector-drainage water, water used in fisheries and water of the Caspian Sea;

-Forecasting the volume of investments from the public budget and possibly international donor organizations, as well as the amount of the assumed private investments within public-private partnership projects and proposals for the investment promotion tools;

-Elaboration of the tasks for defining and implementing educational measures among all users' category on the rational water use, including mandatory promotional measures in kindergartens, secondary and higher schools, workplaces;

- Improvement of education of the water related specialists and higher education curricula. Expansion of scientific-research works on innovative solutions in water economy

5. Water security of the country and international cooperation. As the water security of the country require to strength transboundary cooperation, the strategy shall consider the comprehensive diagnosis of the current situation and in the context of international water legislation and conventions, determinate goals and ways of solving existing and future problems in the management of transboundary and cross-border rivers. Therefore, analyzes shall be planned on the use, distribution, pollution, and monitoring of river water resources in upstream countries. Strengthening cooperation with water related international organizations and mutual exchange of skills and experiences will be required. In order to improve existing situation will be necessary to develop joint regulatory documents and a clear monitoring system for the protection and prevention from pollution transboundary flows which includes assessments for ecological and biological safety, especially with the consideration of their use for drinking purposes.

6. Measures for the reintegration of territories freed from Armenian occupation.

Due to the fact that there was not access to the occupied areas since last 30 years, comprehensive assessment of water resources in these territories shall be conducted. Based on the water resource prognosis and the intensity of the population resettlement, the demand for water for the agriculture, drinking, energy and other consumers is required to be forecasted. This assessment will allow development of water infrastructure according to the settlements, agriculture and industry development. Forecasting the required investment costs with the indicating of the financial sources for the implementation of the rehabilitation and reconstruction programs in the each released regions shall be also calculated and defined for the de-occupied territories.

CONCLUSION

The analysis carried out in this article demonstrates that in Azerbaijan as in the other countries water scarcity became more critical and continues to be series challenge due to the on-going climate change.

Therefore, problems of water availability for irrigation, water supply and other sectors require the acceleration of reforms in the water sector, enabling to adapt and mitigate the current challenges.

In recent years, the Azerbaijani government has initiated serious reforms for this purpose, as in early 2020 the Water Commission was established, and in practice currently the water economy regulation is carried out by this collegiate body. Also, within the framework of the adopted Action Plan, measures the for improvement of the water sector governance and projects for the construction of the more important water management facilities have been identified.

Urgently comprehensive mechanisms should be developed to mitigate the negative effects of the water scarcity in the coming years. In this aspect, the preparation and adoption of a new water strategy for the efficient use of the water resources is important to be prepared and realized.

Experiences in Chine, Turkiye and Italy demonstrates that challenges arisen from the climate change and water scarcity is common, making problems starting from environmental regulation of the water use to the agriculture water consumption, drinking water supply and other subsectors. Therefore, adoption of the strategy against challenges of the water scarcity should be carried out taking into account the particular characteristics of the countries. The emergency of the current water challenges shall be delivered to the whole society and accepted by everybody, in any case it shall formulate completely clear understanding and view on the water resources, new water use culture by everybody.

Based on the analyses, the article proposes a structured composition of the critical topics to be addressed in the new water strategy of Azerbaijan Republic.

The main issues, the solution of which contributing to the achievement of the country's planned indicators for sustainable development goals in the coming years, should be particularly fixed and included into the new strategy for their future realization. Therefore, it requires proper setting of the integrated tasks aiming for the updated national water management policies, water protection, increasing the volume of the water resources, improving the culture of consumption and the transition to an environmentally friendly way of the water use.

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THE SOIL RESEARCH CONDUCTED AROUND THE MAIN MIL-MUGAN RESERVOIR

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The restoration and preservation of the fertility of every inch of soil of our country is the priority direction of the Institute of Soil Science and Agrochemistry. For this purpose, it is necessary to carry out complex research works in order to determine the causes of land reclamation affecting the fertility of the Kura-Araz plain. Failure to fully comply with agro-technical rules, unsystematic felling of forests, failure to use irrigation water sparingly and efficiently, in-farm irrigation and collector-drainage network that was in the balance of collective farms, state farms, and agricultural enterprises falling into disrepair due to neglect, etc. caused the acceleration of the erosion and salinization process.

For this purpose, in recent years, a number of local scientific research works have been carried out in the Kura-Araz plain in the direction of saline soil melioration at the Institute of Soil Science and Agrochemistry. Thus, an expedition was organized on the topic of "Study of the modern condition of the Main Mil-Karabagh, Main Mil-Mugan, Main Shirvan collectors and the lands served by them and ways to increase the efficiency of water use in Kura-Araz".The expedition was carried out on 01.11.2011-30.11.2011, and fifty employees of the institute were involved in field-camera and laboratory research. Soil and water samples taken for the purpose of assessing the suitability of collector-drainage water for irrigation were chemically analyzed. Water quality assessment based on total water minerality, sodium relative potential ratio (SAR), magnesium content, alkalinity, salt cation ratio, etc. were analyzed and relevant conclusions were drawn. At the same time, according to the results of chemical analysis of the soil samples taken from the influence zone of the Main Mil-Mugan Collector, the soils of the area were evaluated and it was concluded that these areas are mainly chloride-sulfate type weak and moderately salinized soils.

Key words: *Collector-drainage, soil, salinization, melorization, irrigation channel.*

INTRODUCTION

Kur-Araz lowland is the largest irrigation region of the Republic of Azerbaijan, and its role in the country's economy is very important. The main irrigated agricultural crops of the republic are grown in this plain. Kura-Araz lowland is also a very interesting object from the point of view of land reclamation. In our country, 30% of the lands that are irrigated in the near future are prone to salinization or have become salinized. It is impossible to obtain a high yield of agricultural crops in the soil without taking special measures to combat salinization.

The main means of combating soil salinization is washing them in the background of drainage. This is the development of reliable methods of combating salinization in various natural and economic conditions, including conducting research in the Main Mil-Mugan collector, which is very relevant and at the same time of great scientific and practical importance.

Table 1.

Locations and coordinates of soil sampling points.

№	Location, designation of the area where the soil sample was taken	Geographic coordinates	
		Latitude Circle	Longitude Circle
1.	Farmland to the left of the 2nd bridge	$39^0$50'01,1”	$48^0$23'42,4”
2.	Before reaching the 2nd Mugan canal, after the connecting drain, cotton field	$39^0$49'30,1”	$48^0$25'18,8”
3.	Grain field near Cascade	$39^0$42'30,1”	$48^0$36'18,3”
4.	Plowed field around Suguvushan	$39^0$26'55,1”	$48^0$59'23,4
5.	Cotton field between the II and III bridges in the direction of Neftchala	$39^0$35'33,6”	$48^0$59'23,4”
6.	In the direction of Neftchala, an empty field to the right of the 7th bridge	$39^0$22'10,9”	$49^0$04'54,5”

Table 2.

Results of chemical analyzes of soil samples taken from the scope of the Main Mil-Mugan Collectorate

№	CO_3	HCO_3	CI	SO_4	CA^{2+}	Mg^{2+}	Na^++K^+	Dry residue g/l	Sum of salts, g/l	Soil classification according to degree of salinity
1.	-	$\frac{0,119}{1,95}$	$\frac{0,040}{1,15}$	$\frac{0,108}{5,49}$	$\frac{0,017}{0,87}$	$\frac{0,007}{0,59}$	$\frac{0,164}{7,13}$	0,460	0,455	Weakly salted
2.	-	$\frac{0,085}{1,40}$	$\frac{0,011}{0,30}$	$\frac{0,047}{2,39}$	$\frac{0,020}{0,98}$	$\frac{0,006}{0,48}$	$\frac{0,061}{2,63}$	0,240	0,230	Salted
3.	-	$\frac{0,095}{1,55}$	$\frac{0,016}{0,45}$	$\frac{0.062}{3,15}$	$\frac{0,016}{0,78}$	$\frac{0,002}{0,20}$	$\frac{0,096}{4,17}$	0,295	0,287	Weakly salted
4.	-	$\frac{0,079}{1,30}$	$\frac{0,065}{1,85}$	$\frac{0,122}{6,20}$	$\frac{0,020}{0,98}$	$\frac{0,006}{0,48}$	$\frac{0,182}{8,24}$	0,483	0,474	Medium salted
5.	-	$\frac{0,064}{1,05}$	$\frac{0,196}{5,60}$	$\frac{0,154}{7,83}$	$\frac{0,023}{1,17}$	$\frac{0,003}{0,27}$	$\frac{0,277}{12,04}$	0,725	0,717	Medium salted
6.	-	$\frac{0,104}{1,70}$	$\frac{0,107}{3,05}$	$\frac{0,077}{3,91}$	$\frac{0,014}{0,68}$	$\frac{0,007}{0,59}$	$\frac{0,170}{7,39}$	0,486	0,479	Medium salted

Table 3.

Determination of the quality composition of salinization (according to Y.P. Lebedev)

a) a) According to the anion content, mg.eq							
№	CI'	SO_4”	CL'+SO_4	$HCO_{3'}$	$\frac{CI}{SO_4”}$	$\frac{HCO_3'}{CI'+SO_4”}$	Type of salinization
1.	1,15	5,49	6,64	1,95	0,21	0,29	Chloride-sulphate
2.	0,30	2,39	2,69	1,40	0,13	0,52	Sulphated
3.	0,45	3,15	3,60	1,55	0,14	0,43	Sulphated
4.	1,85	6,20	8,05	1,30	0,30	0,13	Chloride-sulphate
5.	5,60	7,83	13,43	1,05	0,72	0,10	Chloride-sulphate
6.	3,6	3,91	6,96	1,70	0,78	0,24	Chloride-sulphate

a) According to the composition of the cation, mg.eq							
№	Na+K	Ca”	Mg”	Ca”+Mg”	$\frac{Na'+K'}{Ca”+Mg”}$	$\frac{Mg”}{Ca”}$	Type of salinization
1.	7,13	0,87	0,59	1,46	4,88	0,68	Sodium
2.	2.63	0,98	0,48	1,46	1,80	0,49	Calcium-sodium
3.	4,17	0,78	0,20	0,98	4,96	0,26	Sodium
4.	8,24	0,98	0,48	1,46	5,64	0,49	Sodium
5.	12,04	1,17	0,27	1,44	8,25	0,23	Sodium
6.	7,39	0,68	0,59	1,27	5,82	0,87	Sodium

The soils taken from points 1, 4, 5 and 6 belong to chloride-sulfate type saline soils. According to V.A. Kovidov's classification, the soils taken from points 1, 2 and 3 are not salinized, the soil taken from point 4 is weakly saline, and the soils taken from points 5 and 6 are considered to be strongly saline [2].

Table 4.

Classification of soil samples according to the degree of salinization
(In V.A. Kov. According to B.B. Yegorov)

№	**Type of salinization**	**Indicator**	**Type of salinization**
1.	Chloride-sulphate	0,21	Unsalted
2.	Sulphated	0,13	Unsalted
3.	Sulphated	0,14	Unsalted
4.	Chloride-sulphate	0,30	Weakly salted
5.	Chloride-sulphate	0,72	Strongly salted
6.	Chloride-sulphate	0,78	Strongly salted

At the same time, it should be noted that the indicators of those points (0.72 and 0.78) slightly exceed the maximum limit of medium salinity soils (0.70), so in fact, the location of those soils can be considered at the end of medium salinity soils and at the beginning of strongly salinity soils. the soils in the middle part of the collector in its sphere of influence are saline or weakly saline, and the soils located in the final part can be attributed to the class of moderately and strongly saline soils [3].

MATERIALS AND METHODS

In order to study the effectiveness of the operation of the Main Mil-Mugan collector, which is considered the largest collector in the republic, from the point where the collector intersects with the Saatli-Imishli road (under the Sabir canal) to the Caspian Sea (Neftchala region), along with water surveys, research is carried out on the lands in the immediate vicinity of the collector has been done. So, initially, soil samples were taken from 6 points and chemically analyzed based on existing methods. The coordinates of the place where soil samples were taken are shown in Table No. 1, and the results of chemical analyzes are shown in Table No. 2 [4].

ANALYSIS AND RESULTS

A more accurate classification of soil salinization can be assessed by its anion and cation content. Tables 3 and 4 show the results of the calculations and evaluation of the soil according to its chemical composition. The summarization and analysis of the results of the conducted studies show that according to the amount of dry residue contained in the soil, the soils taken from the first and third points are considered to be weakly saline, the soil taken from the second point is saline, and the soils taken from the 4th, 5th and 6th points are evaluated as moderately saline [1].

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THE EFFECT OF EROSİON ON THE NATURAL-ECOLOGİCAL CONDİTİONS OF THE MOUNTAİN GRAY-BROWN (CHESTNUT) SOİLS UNDER THE PERENNİAL GRAPE PLANT İN THE SHAMKİRCHAY RESERVOİR BASİN

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In the article, the analysis, dynamics and comparative characteristics of the current state of the erosion process in the underdeveloped mountain gray-brown (chestnut) soil under grapevines in the Shamkirchay reservoir basin on the northeastern slope of the Lesser Caucasus, the diagnostic indicators and fertility parameters of arable soils are given . the effect of the erosion process is shown. In the article, the soil samples taken from the soil sections placed in the characteristic places of the research area were analyzed by modern methods, chemical analyzes were carried out, and the obtained results were specified by mathematical and statistical methods. In order to improve soil erosion protection in the research area, the study of the amount of nitrogen, activated phosphorus and exchangeable potassium under the grape plant was also studied.
Key words: *mountain gray-brown (chestnut), erosion process, soil sections, arable soils, diagnostic index, fertility parameters*

INTRODUCTİON

Azerbaijan has rich natural conditions, its land is used for various agricultural crops. In addition to grain growing, cotton growing, animal husbandry, horticulture, viticulture, tobacco growing, potato growing, subtropical and other crops occupy a large area in our republic. Multi-field agriculture of our republic is developed in zones with different natural conditions [1, 2, 3, 4, 5, 6, 7]. Shamkir region is located in the west of the country, on the northeastern slope of the Lesser Caucasus. It was organized in 1930. The territory of the district is 1656.8 km². Its average height above sea level is 331 m. The district is located at $40^{0} 49^{/} 57^{//}$ north latitude and $46^{0} 01^{/} 35^{//}$ east longitude. Mountain gray-brown soils are distributed mainly in the low mountainous and foothill zones at 150-900 meters above sea level according to the regularity of vertical zonation in Shamkir region [4, 7, 8, 9, 10]. There are 7 subtypes of the mountain-gray brown (chestnut) soil type in the region: underdeveloped mountain gray-brown (chestnut); common gray-brown (chestnut) shorakatvari mountain watered from ancient times; irrigated mountain light gray-brown (chestnut); irrigated common mountain gray-brown (chestnut), watered late mountain common gray-brown (chestnut); irrigated mountain common gray-brown (chestnut); anciently irrigated saline mountain ordinary gray-brown (chestnut) (Table 1).

Table 1.

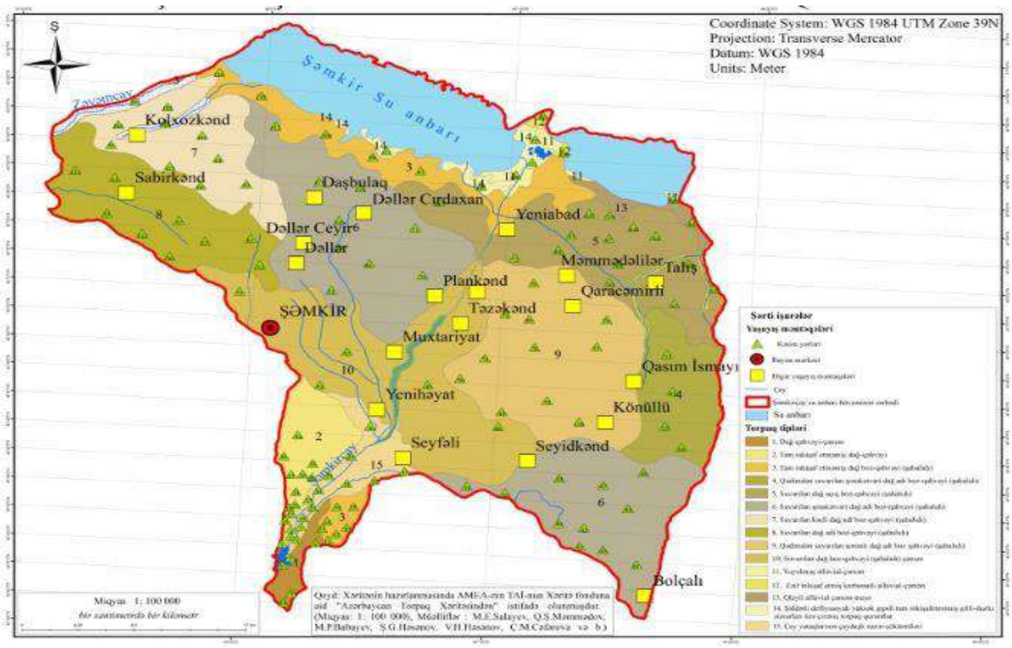
Areas of mountain gray-brown torpars by subtypes (ha) in the territory of Shamkir region

The name of the lands	Area	
	yes	%
Immature mountain gray-brown (chestnut)	4485.11	10.49
Common gray-brown (chestnut) irrigated shorakatvari mountain	1062.14	2.49
Watered mountain light gray-brown (chestnut)	6543.42	15.30
Watered shorakatvari mountain ordinary gray-brown (chestnut)	9682.10	22.64
Watered late mountain common gray-brown (chestnut)	5042.91	11.79
Watered mountain common gray-brown (chestnut)	6220.10	14.55
Anciently irrigated saline mountain common gray-brown (chestnut)	9724.01	22.74
Total:	42759.79	

Mountain gray-brown soils have been studied by a number of researchers [8, 9, 10, 11, 12, 13]. Underdeveloped mountain gray-brown (chestnut) soils have developed under dry steppe vegetation in the low mountain and foothill zones of the region. These lands are considered deforested lands. Since the climate of these lands is dry and hot, it accelerates mineralization, as a result of which the amount of humus formed in the soil is small. So, in these soils, humus almost does not pass below 40-45 cm. The granulometric composition of mountain gray-brown soils is heavy gritty and clayey. Horticulture, viticulture, and animal husbandry have developed in these lands. Currently, grain farming is predominant. In the lands of Shamkir region, sowing of grain crops is preferred. These lands are also distinguished by their slightly sloping areas. Thus, the inclination of the slope in mountain gray-brown soils is mostly up to 10 degrees. Despite the fact that the inclination of the area is not high, it was determined that the erosion process is spreading in the cultivated fields during the research. Erosion is weak to moderate in the study area.

MATERIALS AND METHODS

Researches were conducted on the basis of methodologies adopted in Azerbaijan. Soil samples taken by us were analyzed based on modern methods and results were obtained. Land names in the article are adapted to international land names (WRB) and a land map is drawn up based on the ArcCIS program. During the research, the soil horizons were indexed, the genetic characteristics of the soils were adapted to the correlation of the WRB system with the main indicators of the Azerbaijani soil classifications [6, 9, 11, 12, 13, 15]. The main purpose of the research is to study the condition of undeveloped mountain gray-brown (chestnut) soils formed in the territory of Shamkir region under the cultivation of grape plants, to conduct morphogenetic analysis, and to study the dynamics of the erosion process in the area. The cut sections were specified based on modern methods and tools (geographical coordinates were set) (Picture 1).



Picture 1: In typical places on underdeveloped mountain gray-brown (chestnut) soils description of laid cuts

The geographic coordinates of the soil samples taken were determined using the Garmin GPS map 62s device (Table 2). The analysis results of 5 land sections are given in the article. Among the diagnostic indicators, granulometric content, soil color, structure, hardness and a number of morphological signs were determined. Soil analyzes were conducted in the "Ecological Engineering" laboratory of the Azerbaijan State University of Economics [1, 4, 5, 6, 10, 12, 14].

Table 2.

Undeveloped mountain gray-brown (chestnut) soils sections placed on geographic coordinates

S/s	Section number	X coordinate (east longitude)	Y coordinate (north latitude)
Immature mountain-brown (DQ_v^{te})			
1	Section 11	X.46 ^{0} 3 $^/$ 21,051 $^{//}$ E	Y.40 ^{0} 42 $^/$ 42,381 $^{//}$ N
2	Section 13	X.46 ^{0} 3 $^/$ 36,816 $^{//}$ E	Y.40 ^{0} 42 $^/$ 18,738 $^{//}$ N
3	Section 14	X.46 ^{0} 3 $^/$ 32,059 $^{//}$ E	Y.40 ^{0} 42 $^/$ 58,109 $^{//}$ N
4	Section 19	X.46 ^{0} 3 $^/$ 53,690 $^{//}$ E	Y.40 ^{0} 43 $^/$ 28,922 $^{//}$ N

I.M. total humus in the soil during field studies. Total nitrogen was measured by the Tyurin method, and carbonates were measured by a calcimeter. The total phosphorus (P) and total potassium (K) were analyzed by the titration method in the form of $CaCO_3$, with the ICP-MS (agilent) device, and the granulometric content was analyzed by the NA Kaczynski method. To determine the absorption capacity of the soil, the absorbed cations are determined by the D. Ivanov method, the hygroscopic moisture is determined by the thermal method (the soil is dried at a temperature of x 05 degrees), the environmental response of the soil is determined with a pH meter (in the ratio of 1:5), ammonia absorbed from nitrogen forms is determined by Konyev, dissolved in water Ammonia Nesler, nitrates were analyzed by Grandal-Laju method. The integrity of the obtained results was specified by the mathematical statistical (BADospexov) method [3,5,8,9]. The location of the sections placed in the characteristic areas is given in figure 1.

RESULTS AND DISCUSSION

The undeveloped mountain gray-brown (chestnut) soils studied by us in Shamkir region have been under industrial use for 100 years. In order to obtain accurate results, the granulometric composition of the soil samples taken first was analyzed and the percentage of absolute dry soil was studied. The obtained results are analyzed in table 3.

Table 3.

Granulometric composition of underdeveloped mountain gray-brown (chestnut) soils (in % on absolute dry soil)

Cut No	Depth, in cm	Size of particles in mm, amount in %						
		1-0.25	0.25-0.05	0.05-0.01	0.01-0.005	0.005-0.001	< 0.01	< 0.001
1 1	AUv0-26	1.26	21.85	17.34	11.27	22.19	26.08	59.54
	AUvzca26-32	2.09	13.95	22.05	13.05	25.33	23.52	61.90
	BTjaz32-57	0.90	15.48	21.08	13.15	24.90	24.48	62.53
	B\ Cca (cs)L 57-83	1.66	13.58	24.62	12.18	25.31	22.64	60.13
	CcaL83-102	1.36	16.76	23.79	10.09	24.43	23.56	58.08
13	AUv0-23	1.10	12.99	24.93	13.07	20.74	27.16	60.97
	AUvzca23-38	1.10	14.52	24.65	11.48	23.30	24.94	59.72
	BTjaz38-64	7.97	12.56	18.34	13.58	23.98	23.56	61.12
	B\ Cca (cs)L 64-96	0.94	18.07	22.42	10.67	24.81	23.08	58.56
	CcaL96-125	1.90	12.51	24.62	15.08	20.41	25.47	60.96
14	AUv0-20	1.20	16.83	26.28	13.47	18.67	23.54	55.68
	AUvzca20-39	1.09	15.07	26.47	13.03	18.46	25.87	57.36
	BTjaz39-60	1.09	12.02	25.52	10.73	27.84	22.79	61.36
	B\ Cca (cs)L 60-76	4.09	13.33	23.33	14.58	18.55	26.11	59.24
	CcaL76-98	9.66	15.48	19.75	11.07	16.37	27.66	55.10
19	AUv0-17	1.09	18.01	19.00	19.05	13.20	29.65	61.90
	AUvzca17-48	0.71	14.98	24.77	14.67	16.79	28.07	59.53
	BTjaz48-72	0.78	14.22	21.86	8.87	28.30	25.96	63.13
	B\ Cca (cs)L 72-99	4.71	21.38	22.82	10.01	10.90	30.17	58.08
	CcaL99-132	1.11	20.05	22.06	12.01	16.36	26.08	59.54

Immature mountain gray-brown (chestnut) the soils are mainly light and medium clay soils. This According to the international classification, soils are included in the class of anthropogenically modified soils. In the subtype, which covers a very large area, the thickness of the Accumulative AUvz layer fluctuates between 26-57 cm. The color is dark gray-brown, the structure is fine granular dust, and the humus layer is mainly between 4.36-0.82% along the profile. Total absorbed bases ranged from 32.8 to 22.0 mg-eq in aqueous pH 8.1 to 6.6. According to the granulometric composition, particles smaller than 0.01 mm range from 30.17 to 22.64 %, and particles smaller than 0.01 mm range from 55.10 to 68.48 % (tables 3 and 4). Immature mountain gray-brown (chestnut) To characterize the morphological properties of soils , we provide a field description of only one of the soil-profile sections (Section 11) placed in a typical area [3, 7, 8, 9, 10].

AUv 0-26 cm - dark gray-brown, ball-nut-shaped, granular structure, light clay, rich in soft half-decayed plant remains and fringed grass roots. Low moisture, abundance of decay, roots and rhizomes, optimal biological processing and traces of small insects are clearly visible, white rhizome, transition is clear, does not boil under the influence of HCL ; **AUvzka 26-32 cm** - greyish-brown clay, granular structure, medium clay, few plant roots and rhizomes, small tree roots and semi-decomposed plant remains are found. It is gradual, not clearly structured. Sometimes it is possible to come across worm tracks. Does not boil under the influence of HCL, low moisture, gradual transition, boils under the influence of HCL; **BTcaz 32-57 cm** – calcareous, light-brown, the structure is not distinguished, medium clay, hard, rust spots, carbonate molds, single tree and large plant roots, dense, low moisture, gradual transition, low boiling due to the influence of HCL; **B\Cca(cs)L** 57-83 cm – light brown, the structure is not distinguished, medium clay, hard, dense, low-moisture, gradual transition, weak boiling due to the influence of HCL; **CcaL** 83-102 cm – brown-like, the structure is not distinguished, light clayey, hard, dense, low-moisture, gradual transition, weak boiling due to the effect of HCL [3, 5, 7, 8, 10, 11].

Table 4.

In the territory of Shamkir region DBQ $_v{}^{te}$ - Underdeveloped mountain gray-brown (chestnut) analysis of the main diagnostic indicators of soil sections placed on the soil subtype

Section №	Depth, cm	Hum-mus %	Nitrogen , with %	Hygros . moisture	According to CO 2 CaCO3 _with %	UAC mg-eq	pH	Phosphorus, mg / kg	Interchangeable potassium , mg / kg
Weak degree erosion suffered									
1 1	AUv0-26	3.86	0.276 _	5.83	6.95	22.68	7.1	12.51	364
	AUvzca26-32	2.43	0.187	6.01	7.05	23.12	7.1	10.57	314
	BTjaz32-57	2.07	0.164	6.01	----	22.72	7.0	8.19	303
	B\ Cca (cs)L 57-83	1.53	0.131	5.60	8.25	25.44	7.2	7.22	267
	CcaL83-102	0.91	-----	5.72	8.14	29.28	7.1	7.31	289
Weak degree erosion suffered									
13	AUv0-23	3.97	0.283	7.87	6.97	28.19	6.8	12.05	294
	AUvzca23-38	3.12	0.230	7.08	6.57	28.26	6.8	10.98	283
	BTjaz38-64	2.21	0.173	6.83	6.95	32.84	6.9	8.21	279
	B\ Cca (cs)L 64-96	1.06	0.101	7.07	7.53	----	6.8	7.63	263
	CcaL96-125	0.82	Be the moment	6.94	7.22	28.19	7.0	7.02	271
Zero degree erosion suffered									
14	AUv0-20	4.36	0.307	5.39	8.64	24.94	7.2	14.58	310
	AUvzca20-39	3.53	0.256	4.84	10.16	22.01	7.1	12.94	275
	BTjaz39-60	2.28	0.177	6.31	-----	----	7.2	10.67	269
	B\ Cca (cs)L 60-76	2.14	0.169	5.42	-----	-----	7.2	9.07	223
	CcaL76-98	1.61	0.136	5.11	11.42	24.83	7.2	6.82	282
Zero degree erosion suffered									
19	AUv0-17	4.09	0.291	5.83	7.82	30.39	7.2	14.04	362
	AUvzca17-48	2.53	0.193	6.01	13,41	31.13	7.2	13.57	333
	BTjaz48-72	2.01	0.161	7.45	-----	29.42	7.3	11.85	321
	B\ Cca (cs)L 72-99	1.30	-----	5.66	14.02	31,24	7.1	9.72	315
	CcaL99-132	-----	-----	4.72	13.40	29.97	7.1	8.61	292

As can be seen from the morphological description of the section, the color of the soil in the cultivated area gradually changed from dark gray-brown to brownish-brown, its structure was broken (the structure is not visible in the lower layers), and the subsoil layer was very hardened. In these soils, there are processes that differ from each other in separate genetic layers. However, in general, it is noticeable that the soil profile is poorly developed in each layer. Carbonates are washed from the upper layer and spread to the lower layers. A humus layer is found buried towards the middle and deep layers. Towards the lower layers, the boiling due to the effect of HCl increases and the dry residue becomes noticeable.

In Table 4, the main diagnostic indicators of soil sections placed on the underdeveloped mountain gray-brown (chestnut) soil subtype were analyzed and analyzed based on the determined fertility parameters (table 4);

Section 11: The thickness of the humus layer along the profile is 3.86-0.91%. According to humus, nitrogen is 0.276-0.131%. Hygroscopic moisture 6.01-5.72%, $CaCO_3$ according to CO_2 8.25-6.95 %, the total absorbed bases ranged from 29.28 to 22.68 mg-eq, and the pH ranged from 7.2 to 7.0. Phosphorus is 12.51-7.22 mg/kg, and exchangeable potassium is 364-267 mg/kg; **Section 13: The thickness of the humus layer along** the profile is 3.97-0.82%. According to humus, nitrogen is 0.283-0.101 %. Hygroscopic moisture 7.87-6.83%, $CaCO_3$ 7.53-6.57 according to CO_2 %, the total absorbed bases ranged from 32.84 to 28.19 mg-eq, and the pH ranged from 7.0 to 6.8. Active phosphorus fluctuates between 12.05-7.02 mg/kg. Exchangeable potassium is 294-263 mg/kg; **Section 14: The thickness of the humus layer along** the profile is 4.36-1.61%. According to humus, nitrogen is 0.307-0.136%. Hygroscopic moisture 6.31-4.84%, $CaCO_3$ according to CO_2 150.16-8.64 %, the total absorbed bases ranged from 24.94 to 22.01 mg-eq, and the pH ranged from 7.2 to 7.0. Dry solids were not analyzed. Phosphorus fluctuates between 14.58-9.07 mg/kg. Exchangeable K is 310-223 mg/kg; **Section 19: The thickness of** humus layer is 4.09-1.30%, nitrogen is 0.291-0.161%. Hygroscopic moisture 7.45-4.72%, $CaCO_3$ 11.03-8.26 %, the total absorbed bases ranged from 30.22 to 29.64 mg-eq, and the pH ranged from 7.3 to 7.1. Dry solids were not analyzed. Phosphorus is 14.04-8.61 mg/kg, and exchangeable potassium is 362-292 mg/kg.

The analysis of the diagnostic indicators of the soil sections shows that the erosion process was not observed in Section 14 and Section 19. The low inclination (0-2 degrees) in the areas where the sections are located did not create conditions for the erosion process to proceed. A weak level of erosion was observed in the other 3 soil sections. In order to improve soil erosion protection in the area, the study of the amount of nitrogen, activated phosphorus and exchangeable potassium under the grape plant was also studied. Thus, during the vegetation and development stages of the grape plant in the mountainous and foothill areas, it absorbs humus, nitrogen, active phosphorus and exchangeable potassium compounds from the nutrients in the soil. The supply of nitrogen to the soil from mineral fertilizers is mainly in the form of ammonium and almost completely meets the needs of plants. About half of the nitrogen given to the soil by ammonium salt within 30 days, and after 2 months, about the main part of the nitrogen is converted into nitrate form. In the study area, in 2021 and 2022, the amount of phosphorus fertilizers was first studied (in the range of 14-17 mg), then as a result of the application of phosphorus fertilizers in the same area (2021-2022), the amount of available phosphorus increased and reached 18-22 mg. A decrease in the amount of phosphorus compounds in the soil was also observed. The main reason for the decrease is the long-term use of ammonium sulfate fertilizer in the cultivated area changes the soil environment from alkaline to acidic and acidifies the soil. This process prevents phosphorus from reacting with iron and aluminum oxides in the soil and eventually being absorbed by grape roots. When such situations occur, the application of carbamide and ammonium nitrate fertilizers to ensure phosphorus uptake will lead to reduced fertility. In applied potassium fertilizers, the main part integrates into the exchangeable potassium form [14, 15].

Table 5

Immature mountain gray-brown (chestnut) under vine the amount of nitrogen, available phosphorus and exchangeable potassium in soils

Variants	Depth, cm	Vegetation (flowering) period				fully ripe next period					
		N/NH 3	N/A 3	P_2O_5	K_2O	N/NH 3	N/A 3	N/NH 3	N/A 3	P_2O_5	K_2O
Fertilizer free control	0-20	14.11	5.66	16.32	134.5	12.69	4.45	10.61	3.23	11.54	115.8
	20-50	11.27	4.02	11.54	105.8	9.88	3.05	8.52	2.64	9.25	90.6
	50-100	7.82	2.04	9.62	84.6	7.06	2.07	6.41	1.82	8.29	79.4
The impact there is 10 t / ha manure (1 time in 3 years)	0-20	21.05	8.44	20.07	169.4	17.68	7.27	13.47	5.86	16.89	141.5
	20-50	16.11	6.96	16.35	114.5	13.41	5.46	11.32	4.65	11.58	106.5
	50-100	9.74	4.55	10.02	90.7	8.47	3.68	7.84	2.83	8.53	86.4
$N_{30}P_{60}K_{60}$	0-20	17.89	6.78	20.88	170.8	14.11	5.08	11.34	3.44	16.35	153.7
	20-50	14.94	5.89	16.94	123.5	12.42	4.25	10.03	2.84	10.93	115.2
	50-100	9.15	4.52	10.96	96.8	7.84	2.67	7.32	2.03	8.08	91.5
$N_{60}P_{90}K_{120}$	0-20	25.17	7.86	24.78	189.4	22.04	6.46	16.23	4.85	19.88	163.7
	20-50	18.93	6.51	17.45	135.6	15.96	4.85	12.71	3.84	11.96	121.5
	50-100	10.24	5.93	10.78	96.4	9.78	2.88	8.47	2.22	8.93	90.6
$N_{90}P_{120}K_{120}$	0-20	26.42	8.92	30.15	204.2	23.67	7.11	18.35	5.28	24.63	189.4
	20-50	22.37	7.06	20.59	142.0	17.68	5.12	13.42	4.26	16.92	129.4
	50-100	12.61	4.66	11.58	105.7	9.95	3.49	9.18	2.44	9.33	96.8
$N_{30}P_{60}K_{60}$ +10t/ha manure (once in 3 years)	0-20	26.11	10.0	25.62	197.2	22.73	8.14	17.66	6.11	21.08	170.8
	20-50	22.08	8.09	17.99	139.2	17.06	6.72	14.11	4.94	13.80	127.5
	50-100	11.92	6.52	10.84	98.8	9.68	4.25	8.49	3.26	9.86	91.4
$N_{60}P_{90}K_{120}$ +10t/ha manure (once in 3 years)	0-20	29.14	11.4	29.48	216.4	25.94	9.16	21.05	7.15	24.82	198.2
	20-50	25.61	9.07	20.64	149.8	20.02	7.11	17.32	5.348	17.39	115.6
	50-100	13.49	7.29	11.19	98.7	11.34	4.48	9.68	3.26	9.66	90.3
$N_{90}P_{120}K_{120}$ +10t/ha manure (once in 3 years)	0-20	32.86	11.9	34.93	241.6	26.83	9.77	22.59	7.69	26.82	216.4
	20-50	28.34	10.4	26.51	162.8	24.72	8.12	21.42	6.22	19.48	142.9
	50-100	14.74	8.16	13.52	109.7	12.31	4.69	10.28	4.08	10.09	105.7

Knowing the amount of fertilizers that plants will receive during the periods of vegetation (flowering), fruiting and full maturity, and correct sowing times are important for the correct justification of food systems. Due to the effect of phosphorus and potassium fertilizers, soil fertility increased and productivity had a positive effect. However, during the growing season, the amount of phosphorus and potassium fertilizers absorbed from the soil by the plant's root systems decreased, and the remaining parts were converted into phosphate forms that are difficult to absorb.

Table 5 presents the analysis and results of the analyzes taken from the experimental lands in the vineyard plots around Yeni Hayat village, Shamkir region. As it is known from Table 5, the dynamics of nutrients were studied and mainly the difference between the flowering stage and the full maturity stage of vegetation was compared. Let's take into account that the vineyard areas are irrigated through the right bank canal separated from Shamkirchay. The experimental area conducted in the local area covers an area of approximately 100 ha and the distance between rows is 2.5 meters and the distance between plants is 1.5 meters. In table 5 DBQ $_{v}^{te}$ - In immature mountain gray-brown (chestnut) soils, comparative characteristics of vegetation (flowering) and full maturity development stages are given and absorbed ammonia, nitrate, available phosphorus and exchangeable potassium are analyzed.

THE RESULT

Complex characteristics of granulometric composition in genetic profiles of underdeveloped mountain gray-brown (chestnut) (DBQvte) soils were studied, morphogenetic indicators were analyzed. **Analyzes of diagnostic indicators of fertility parameters of** 4 soil sections placed in characteristic places were analyzed, morphological analysis of sections was interpreted: humus, nitrogen, hygroscopic moisture, CaCO 3 according to $_{CO\ 2}$, total absorbed bases, pH, granulometric content, mobile phosphorus and exchangeable potassium AUv, Auvzca , Btcaz, B\Cca(cs)L , CcaL layers were studied. It was found that the thickness of the humus layer, the amount of nitrogen, the formation, depth and solidification of the illuvial carbonate Btcaz and B\Cca(cs)L layers, their structure-aggregates, granulometric composition, hygroscopic moisture and other morpho- There are differences between the diagnostic signs. Applying mineral fertilizers to the soil separately and together with manure increased soil fertility and had a positive effect on productivity. Changes and dynamics of nutrients in the soil at each stage were observed as a result of the application of mineral and organic fertilizers to the fields together and separately. In the process itself, it was observed that the fertility of the soil gradually decreases from the upper layers to the lower layers. The main reason for this is the increase in grape productivity. It was determined that considering the increase in market prices, instead of $N_{30} P_{60} K_{60}$, $N_{60} P_{90} K_{120}$ and $N_{90} P_{120} K_{120}$ fertilizer norms, $N_{30} P_{60} K_{60}$ +10t/ha, $N_{60} P_{90} K_{120}$ + It was possible to maintain soil fertility by giving 10t/ha and $N_{90} P_{120} K_{120+10}$t/ha manure.

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ECORECLAMATION FEATURES OF IRRIGATED TERRITORIES IN THE MOUNTAINOUS ZONES OF AZERBAIJAN

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Limitation of land resources in lowlands, a low specific indicator of supply of irrigated land per a person (0,21 ha) in the future, complicated demographic situation, and agricultural direction of the Republic demand search for additional opportunities to increase the area of irrigated land owing to the mountain belt. That is why it is necessary to improve the principles of study and usage eco melioration conditions and forming a scientific conception allowing to analyze in detail the ecological state of the lands, to develop a comprehensive forecast, to substantiate a scientific and technical solution.

The mountain ranges in Azerbaijan are characterized by various natural and historical conditions: vertical zonality, having eroded soils, steep slopes, scatteredness and small contours of irrigated fields, uneven distribution of precipitation, drustic climate change along vertical zones, lack of agricultural monoculture. That's why design, building and exploitation of hydro melioration systems in mountain conditions are connected with certain difficulties and demand to conduct proper theoretical and practical work to find the most correct solutions providing the right organization of agricultural areas.

Key words: *Agricultural orientation, river thalwegs, morphogenetic relief type, terrace, geomorphological structure, erosion basis.*

INTRODUCTION

The land of the mountainous region of Azerbaijan is public property and a colossal source of national wealth. Its careful study, comprehensive assessment, protection and rational use are the most important national economic tasks. About 3/5 of the entire territory of the republic is occupied by mountains, ½ of which approximately is the low and middle mountains located below 1500m. The share of agricultural land in the mountain zone is only 28% [2] of all agricultural land used. In this regard, it is very important not only to expand the land fund of the republic at the expense of foothill and mountainous regions, but also scientifically based measures to actively influence the soil in order to obtain high and sustainable crop yields. The mountainous zone of Azerbaijan has favorable natural-climatic and ecological conditions for agriculture. There is enough heat for cultivated crops and a sufficient amount of precipitation falls. The main part of the zone is densely populated and has good transport links. Large areas of agricultural land, with the rational use of local water resources, can make it possible to produce here such a quantity of agricultural products that would satisfy the growing needs of the population. However, in order to realize the enormous potential of agriculture in mountainous and foothill areas, it is necessary to carry out their typification and zoning, the ascertainment of lands suitable for agricultural use with a further assessment of their reclamation disorder (high slope, fine contour, moisture deficiency, sharp natural fertility) [2]. In order to ascertain lands suitable for irrigation, their surface slopes, we carried out a morphometric analysis of river basins located in economic regions in the mountainous part of the republic.

The territory of Azerbaijan, located in different climatic belts, is indented by numerous rivers, the basins of which have different shapes and sizes. The shape, size, exposure of slopes and other elements of river basins, on the one hand, are important indicators characterizing the horizontal and vertical dissection of the territory, and on the other hand, they play an important role in the development of irrigated lands and the study of their specific irrigation features [1]. Each of these elements influences the conditions of irrigation in its own way, playing a certain role in the complex process of interaction between irrigation and the geographic environment.

The study of morphometric indicators of the characteristic river basins of the mountainous zones of the republic was carried out on the basis of geomorphological maps, using materials on regional, soil, climatic, hydrological studies, which were carried out by various institutions of the republic [1,4]. Geomorphological maps of an analytical type, which are compiled by the staff of the Institute of the National Academy of Sciences of the Republic of Azerbaijan for certain natural and economic regions of the country are designed to solve irrigation and reclamation issues. In addition to the general geomorphological characteristics of the relief and the display of surface deposits, they provide extensive additional information necessary for the development of irrigation design and selection of areas for irrigation. The definition of morphometric indicators on the map was carried out by us according to the skeletal (abbreviated) scheme. Skeletal analysis began with the identification of river thalwegs on maps. Then they sequentially found terraces of the first, second and third order. Watershed areas were also identified by constructing watershed lines. Drawing up the scheme of vertical planning, we limited ourselves to the allocation of only the largest terraces of the corresponding catchment areas. At the same time, it was taken into account that the features of irrigation systems in various morphogenetic types of relief are determined by a combination of natural factors, the main of which are the following: the prevailing slopes of the surface, the density and depth of dissection, hydrological and soil-reclamation conditions. Evaluation of the territory of land according to the prevailing slopes of the surface in irrigation is associated with the possibility of using one or another method of irrigation.

The possibility of their application is mainly determined by the corresponding slope values. The maximum value of slopes, at which irrigation development of the territory is possible with the use of sprinkling, as the most progressive and universal method of irrigation, is one of 0.05. Hence, territories with slopes greater than this value are excluded from irrigation development. Slopes in the range of 0.02-0.05 characterize hard-to-master surface irrigation techniques. A slope of 0.002 within the platform plains delimits low and elevated plains, in irrigation it defines the boundary of the possible application of the method of irrigation by strips and furrows. Floodplains of large lowland rivers have slopes less than 0.005, floodplains of small rivers and large ravines, as well as river terraces, etc have slopes from 0.002 to 0.005.

As a result of the method used on the geomorphological map, it was possible to synthesize very numerous and diverse factual data obtained by analyzing the stock materials of regional physical and geographical studies. All this made it possible to purposefully characterize the geomorphological structure of the mountain belt of the republic, in order to establish areas suitable for irrigation and their surface slopes (tables 1, 2)

Table 1

Distribution of the land fund suitable for irrigation along the belts of vertical zonality (thousand ha) and surface slopes

	economic regions	total area suitable for irrigation	including along the belts of vertical zoning							including slopes	
			to 0	0-200	200-500	500-1000	1000-1500	1500-2000	above 2000m	0,1	0,1-0,4
1	Mil-Karabakh*	485,5	12,9	284,3	98,8	68,5	17,1	4,9	-	397,5	88,2
2	Kalbajar	144,8	-	4,6	45,9	49,2	24,8	20,3	-	108,0	36,8
3	Приараксинская	250,0	58,7	120,4	64,2	6,7	-	-	-	216,5	33,5
4	Qazax	200,8	-	7,3	133,9	22,7	21,7	15,7	-	151,9	48,9
5	Ganja	134,9	-	45,0	10,7	23,9	8,5	16,7	0,1	83,5	51,4
6	Shirvan	692,8	190,8	309,2	58,5	103,7	26,5	3,9	0,2	628,6	64,2
7	Sheki	322,7	-	49,2	230,7	41,3	1,5	-	-	279,2	43,5
8	Lankaran	169,6	17,9	37,8	63,4	31,6	11,7	7,2	-	117,0	52,6
9	Xachmaz**	259,2	7,8	48,4	116,2	68,8	12,6	5,4	-	231,6	27,6
10	Nakhchivan AR	154,3	-	-	-	96,8	48,1	9,1	0,3	133,4	20,9
	total:	2814,8	288,1	906,2	512,7	512,7	172,5	83,2	0,6	2347,2	467,6

Note: *) taking into account the territory of mountainous Karabakh **) taking into account the foothills of the Apsheron economic region

Table 2

Distribution of the land fund suitable for irrigation according to the relief conditions according to altitudinal belts and gradations of slopes (in thousand ha)

№	Altitude belts	total area suitable for irrigation		including in sections of slopes									
				до 0,02		0,02-0,05		0,05-0,10		0,10-0,20		0,20-0,30	
		abs	%	abs	%	abs	%	abs	%	abs	%	abs	%
1	up to 0 meters (abs.)	288,1	10,2	287,0	16,4	0,7	0,2	0,4	0,1	-	-	-	-
	-- --- %	100	-	99,9	-	-	-	0,1	-	-	-	-	-
2	from 0 to 200 m.	906,2	32,2	880,5	50,4	16,1	4,8	7,7	2,9	1,3	0,5	0,6	0,3
	-- --- %	100	-	88,7	-	6,9	-	3,0	-	1,1	-	0,3	-
3	from 200 to 500 m.	851,5	30,1	392,2	22,4	215,7	64,4	125,2	47,4	70,9	28,0	47,5	22,1
	-- --- %	100	-	36,8	-	28,6	-	19,0	-	10,6	-	5,0	-
4	from 500 to 1000 m.	512,7	18,2	186,1	10,8	82,1	24,5	95,8	36,3	97,1	38,4	51,6	24,0
	-- --- %	100	-	14,4	-	18,1	-	23,2	-	25,3	-	19,0	-
5	from 1000 to 1500 метr	172,5	6,1	1,5	0,1	19,4	5,8	28,5	10,9	47,7	18,9	75,4	35,1
	-- --- %	100	-	1,0	-	12,5	-	24,5	-	20,8	-	33,2	-
6	from 1500 to 2000 метr	83,2	3,0	0,6	-	0,1	0,3	6,7	2,5	35,5	14,1	39,4	18,3
	-- --- %	100	-	0,9	-	1,6	-	9,2	-	30,6	-	57,7	-
7	c above 2000 m (abs.)	0,6	0,2	-	-	--	-	-	-	0,2	0,1	0,4	0,2
	-- --- %	100	-	-	-	-	-	-	-	30,0	-	70,0	-
	TOTAL	2814,8	100	1747,9	100	335,0	100	264,3	100	252,7	100	214,9	100

CONCLUSIONS

1. According to the relief, Azerbaijan is divided into flat regions occupying and mountainous regions occupying 40% and 60% of its territory repectively. Despite the diversity of environmental conditions, the issues of agriculture, land reclamation and agricultural technology in the mountainous part of the republic have not been sufficiently studied and require further research.
2. The soil cover of the foothill and mountainous regions is characterized by a high content of nutrients. The content of humus in the upper horizon ranges from 2.5 to 3.8% in the chestnut soils of the foothill zone and up to 7-8% in the mountainous brown and brown soils.
3. By conducting a morphogenetic analysis, taking into account the physical-geographical and economic conditions of the territory, it was possible to ascertain lands suitable for irrigation, to evaluate them according to the prevailing slopes.
4. On the territory of the mountainous region of the republic, 1,620.5 thousand hectares of area are suitable for agricultural development in irrigated agriculture. The low-mountain and foothill regions (200-1000 m) occupy 10,364.2 thousand hectares, the middle and high mountain regions (more than 1000 m) - 258.3 thousand hectares.

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CURRENT STATUS AND EVALUATION OF MOUNTAIN FOREST SOILS OF THE LOWER AND MIDDLE MOUNTAIN BELT OF THE NORTH-EASTERN PART OF THE GREATER CAUCASUS

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In our republic, forest ecosystems have undergone significant changes both in mountainous and lowland areas. On the territory of the northeastern slope of the Greater Caucasus within Azerbaijan, the forest area is almost 15% of the entire territory of this zone, with most of the forests concentrated in the mountainous part. At present, due to the increased anthropogenic impact on natural complexes, it is necessary to carefully study and evaluate the current state of natural landscapes and, first of all, the soils cover. Therefore, the study of the current state and the evaluation of forest soils in the study area is an important and timely task

The object of research is forest soils of the middle and low-mountain parts of the northeastern slope of the Greater Caucasus with a total area of 98,400 thousand hectares. Based on the methodology, we carried out a grading according to the properties and diagnostic features of soils that correlate with the productivity of forest plantations. As the main evaluation criteria, the indicators of humus reserves, gross nitrogen, phosphorus, potassium and the amount of absorbed bases were chosen. The soil with the highest average values of these factors is taken as a standard and evaluated at 100 points, and the bonitet scores of other soils are calculated accordingly. As a standard for the assessment of forest soils in the study area, mountain-forest greyish-brown typical soils (Mollic Cambisols) were taken, which are characterized by the highest content of the selected indicators, so their quality score was taken as 100 points.

A comparative assessment of soils showed which soils are primarily in need of agrotechnical and reclamation measures to increase soil fertility. To preserve and restore the vegetation and soil cover, it is necessary to carry out protective measures, restore forest areas by planting tree species suitable for given environmental conditions.

***Keywords**: Anthropogenic Impact, Erosion Processes, Evaluation Scores, Forest Cover, Mountain-forest Soils, Soil Evaluation.*

INTRODUCTION

Human intervention in natural ecosystems, destruction of forests and pastures, misuse of land resources have led to a decrease in soil fertility and land degradation [2]. In our republic, forest ecosystems have undergone significant changes both in mountainous and lowland areas.

Deforestation of most mountainous regions with suitable climatic conditions for mesophilic and xerophilic broad-leaved forests, as well as arid light forests, is largely associated with anthropogenic factors.

On the territory of the northeastern slope of the Greater Caucasus within Azerbaijan, the forest area is almost 15% of the entire territory of this zone, with most of the forests concentrated in the mountainous part. Difficult physiographic conditions of the northeastern slope of the Greater Caucasus and anthropogenic load contribute to the development of erosion processes. Thus, 48.3% of the entire territory of the northeastern slope is more or less subject to erosion processes [5]. At present, due to the increased anthropogenic impact on natural complexes, it is necessary to carefully study and evaluate the current state of natural landscapes and, first of all, the soil cover. Therefore, the study of the current state and the evaluation of forest soils in the study area is an important and timely task.

MATERIALS AND METHODS

The object of research is forest soils of the middle and low-mountain parts of the northeastern slope of the Greater Caucasus with a total area of 98,400 thousand hectares. Based on the methodology [3, 4, 6, 7], we carried out a grading according to the properties and diagnostic features of soils that correlate with the productivity of forest plantations. As the main evaluation criteria, the indicators of humus reserves, gross nitrogen, phosphorus, potassium and the amount of absorbed bases were chosen. The soil with the highest average values of these factors is taken as a standard and evaluated at 100 points, and the bonitet scores of other soils are calculated accordingly.

The history of studying the soil cover of the northeastern slope of the Greater Caucasus (within Azerbaijan) is connected with the expedition of S.A. Zakharov, carried out in 1925-1926. Later, G.A.Aliev [1], M.E.Salaev [9] and other scientists conducted soil studies in this area. Based on these studies, we have specified the following types and subtypes of soils in the study area.

RESULTS AND DISCUSSION

Mountain-forest brown and mountain-forest brown soils are mainly distributed under broad-leaved mountain forests.

Mountain-forest greyish-brown soils are distributed at an altitude of 900 to 1800 m above sea level. Due to the difference in ecological and geographical conditions, mountain forest brown soils are divided into the following subtypes: weakly unsaturated (lessified), typical, residual carbonate, and steppe soils [8]. These soils are formed mainly under beech and beech-hornbeam plantations.

The average content of humus in these soils is from 0.22 to 0.36% of total nitrogen in the upper soil horizons. The content of gross phosphorus is 0.18-0.28%. The absorption capacity is quite high: 27.5-42.5 mq/100 g of soil. The pH of the aqueous suspension in the upper horizon is 5.5-6.8, sometimes becoming slightly alkaline with depth (pH 7.3-7.6), which is mainly observed in the steppe variants. The granulometric composition is mainly clayey and heavy loamy (the content of physical clay is 44.25-67.80%) in the steppe variants and on soils developed for agricultural crops, the content of physical clay decreases (28.27-40.95%) and the granulometric composition lighter. In sparse forests, especially in areas where they are reduced, soils (under postforest meadows and shrubs) are intensively washed away and subject to erosion, since a sparse forest is not able to retain atmospheric precipitation and contributes to the formation of runoff and soil erosion [10].

At present, the upper forest boundary does not rise above 1800–2000 m, although it used to reach a height of 2500–2700 m [4]. As a result of deforestation and long-term grazing, numerous treeless glades and steppe slopes have formed. With the cessation or normalization of grazing and other negative human activities on the territory of the upper forest boundary, it is possible to restore natural conditions for the renewal of forest cover, thereby raising its upper boundary. Artificial planting of forests can be carried out around springs, in landslide areas and eroded slopes.

Mountain-forest brown soils occupy a significant part of the middle and low mountains of the study area. These soils developed most typically under light oak-hornbeam forests with well-developed undergrowth and xerophilic herbaceous cover. The humus content in the upper horizons of these soils is 4.2-7.6%, and in the erosional areas (where forests have been cut down), the humus content is almost 2 times lower. The content of gross nitrogen is 0.20-0.33%, and in areas devoid of forest - 0.12-0.25%. The content of gross phosphorus corresponds to nitrogen - 0.17-0.26%, in eroded areas it is 0.12-0.18%. The pH of the aqueous suspension in the upper horizons varies from 7.1 to 7.4, increasing with depth (7.8-8.0), which is associated with the carbonate content of parent rocks. In the steppe variants of these soils, the reaction of the environment increases in the upper horizons to 7.2-7.8, which is associated with the change of forest formations by steppe cenoses [10].

Mountain-forest brown steppe soils are confined to forest clearings or distributed in separate patches in open areas among sparse forests and shrubs. Steppe formation processes are manifested in the replacement of forest vegetation with steppe formations and in the formation of a sod layer on the soil surface. The most powerful factor that determines the development of the process of steppe formation is human economic activity. All that has been said above about the development of erosion processes in areas with sparse forests applies in full measure to these soils.

As a standard for the grading of forest soils in the study area, mountain-forest greyish-brown typical soils were taken, which are characterized by the highest content of the selected indicators, so their bonitet score was taken as 100. The bonitet scores for the rest of the soils were calculated accordingly, and the main bonitet scale for forest soils on the northeastern slope of the Greater Caucasus was compiled (table).

As can be seen, the quality score of mountain-forest brown leached and mountain-forest brown typical soils approaches the standard - 94 points, slightly lower for mountain-forest sod-calcareous, mountain-forest brown calcareous and mountain-brown cultivated soils - 87 points. The soil quality scores are not very high for mountain forest greyish-brown steppe soils (78) and mountain forest brown steppe soils (72), which is apparently associated with their emergence from under the forest. The lowest score (53) is in mountain brown underdeveloped soils, which is due to low fertility and thin profile.

CONCLUSION

Based on the foregoing, it can be concluded that the soil and vegetation cover of the forest belt of the northeastern slope of the Greater Caucasus has undergone noticeable changes. The sparseness and partial destruction of forests leads to the replacement of forest vegetation by steppe formations, resulting in steppe soils. In the future, the improper use of these soils (grazing, plowing along the slope for agricultural use, etc.) leads to the development of various types of erosion processes. To preserve and restore the vegetation and soil cover, it is necessary to carry out protective measures, restore forest areas by planting tree species suitable for given environmental conditions.

As a result of the grading, it was revealed that mountain-forest brown typical soils, taken as a standard, have the best fertility indicators, and mountain-brown underdeveloped soils have the lowest soil grading score (53). A comparative assessment of soils showed which soils are primarily in need of agrotechnical and reclamation measures to increase soil fertility.

Table

The main scale of bonitet of mountain forest soils of the northeastern slope of the Greater Caucasus

Soil name	Humus, t/ha			Gross nitrogen, t/ha		Gross phosphorus, t/ha		Gross potassium, t/ha		Sum of absorbed bases, mg-eq/100 g of soil		Average score			Final score
	Depth, in centimeters														
	0-20	0-50	0-100	0-20	0-50	0-20	0-50	0-20	0-50	0-20	0-50	0-20	0-50	0-100	
Mountain-forest greyish-brown unsaturated	111,92* 93	194,97 96	300,69 90	5,53 82	11,29 90	4,25 88	8,87 89	50,29 99	134,49 99	22,90 73	22,73 78	87	90	90	89
Mountain-forest greyish-brown typical	120,16 100	204,03 100	334,26 100	6,71 100	12,60 100	4,82 100	9,99 100	50,54 100	135,80 100	31,55 100	28,96 100	100	100	100	100
Mountain-forest greyish-brown residual-carbonate	77,92 65	144,31 71	239.85 72	4,86 72	9,79 78	3,74 78	7,89 79	46,59 92	127,21 94	30,25 96	28,38 98	81	84	72	79
Mountain-forest greyish-brown steppe	73,98 62	142,89 70	246,25 74	4,89 73	10,21 81	4,29 89	9,06 91	43,23 85	112,81 83	25,76 82	24,31 84	78	82	74	78
Mountain-forest sod-carbonate	89,21 74	173,99 85	274,91 82	5,46 81	11,40 90	3,99 83	8,84 88	50,36 100	135,09 99	28,92 92	27,81 96	86	92	82	87
Mountain forest brown leached	100,32 83	187,19 92	327,60 98	5,88 88	12,19 97	4,20 87	9,38 94	50,22 99	133,59 98	29,12 92	26,65 92	90	95	98	94
Mountain forest brown typical	100,56 84	188,99 93	322,83 97	5,84 87	12,00 95	4,28 89	9,38 94	48,12 95	135,00 99	28,99 92	28,50 98	89	96	97	94
Mountain forest brown carbonate	80,97 67	158,75 78	278,96 83	5,12 76	11,00 87	3,82 79	8,75 88	48,39 96	133,25 98	29,52 94	29,03 100	82	90	83	85
Mountain forest brown steppe	61,17 51	130,01 64	224,67 67	4,07 61	9,35 74	3,03 63	7,26 73	48,53 96	138,50 102	24,98 79	25,09 87	70	80	67	72
Mountain forest brown cultivated steppe	85,38 71	168,00 82	266,32 79	5,04 75	10,90 87	3,66 76	8,40 84	42,97 85	117,10 86	25,74 82	24,68 85	78	85	79	81
Mountain brown cultivated	89,29 74	184,31 92	286,37 86	5,11 76	11,62 92	3,99 83	9,32 93	48,3396	128,63 95	27,24 86	25,43 88	83	92	86	87
Mountain brown underdeveloped	35,86 30	82,94 41	-	2,91 43	6,38 51	2,27 47	5,50 55	30,20 60	84,26 62	21,97 70	21,13 73	50	56	-	53

*Above the line is the content of each indicator in different horizons, in t/ha; under the line - the bonitet scores calculated in comparison with the standard.

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EVALUATION OF IRRIGATION EROSION OF SHIRVAN PLAIN USING SATELLITE AND GIS TECHNOLOGIES

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The use of remote sensing data in design, monitoring, and evaluation of irrigation systems is becoming popular due to rapid advances in remote sensing technology, ease of access to data, and decreasing costs of obtaining and processing the data. Satellite spatial resolution as fine as 30 meters is available and the remote sensing data, combined with adequate cropland information, can provide detailed analyses not otherwise available. The technology is also particularly suitable for river basins and large irrigation systems in developing countries where available resources are generally not enough for field surveys, and data collection and reliable recorded data are limited. This study used GİS, remote sensing satellite data and field observations to assess the irrigation in the Shirvan plain in the Republic of Azerbaijan, as part of the purpose presents operational identification of irrigation erosion,, key aspects unique to irrigation that must be considered in the models.

Keywords: *GIS, NDVI, Remote Sensing, Soil erosion, infiltration, RUSLE*

INTRODUCTION

Application of furrow irrigation in watershed can cause high soil erosion. However, if soil erosion occurs faster than necessary due to human activities, it will cause negative effects on the environment and economy [1].

The complete spatial data with various scales can assist in preparing a variety of strategies for all organization levels and for determining the priority setting and location of conservation programs [2].

Rapid developments occurring in the technology of Remote Sensing (RS) and Geographic Information Systems (GIS) provide a new approach to meet various demands related to the modeling of resources stated that the integration of RS in a GIS database can reduce costs, and time as well as improve the detailed soil survey information. Therefore, the use of RS and GIS in watershed management would be very helpful to the managers in making the decisions.

MATERIAL AND METHODS

Location and Description of Study Area. "Shirvan plain" of the Aran economic region, which is the research area, is located at 40°12′30″ N. e. 48°25′10″ N. u. coordinates. The area covers the Araz, Kur, Alijanchay, Turyanchay, Goychay, Girdimanchay river valleys and covers Shirvan, Hajigabul, Kurdamir, Goychay, Ujar, Zardab, Agdash regions. The site selection model is based on the land cover condition in the study area. The Shirvan Plain has major irrigated agricultural land, covering a total area of 800,000 hectares. The Shirvan and Mughan plains of sedimentary origin are located in the south of the economic region, on the left bank of the Southeastern Shirvanduzu Kur River. The main areas of agricultural production are cotton growing, grain growing, dry subtropical fruit growing, and melon growing. More than 90 percent of the cotton produced in the Republic of Azerbaijan belongs to this region. The active temperature in the center is from 400 degrees C to 460 C, sunny hours are 2200-2400 hours. The average temperature of June reaches 26-28 0C, and the summer is dry and hot. The temperature in January is 1-3 0C, mostly frost-free and mild. The annual amount of precipitation is 15-50% of the vapor, and it is weakly humid.

Depending on the natural conditions and human economic activities, the process of salinization and erosion in the region has developed in different forms and to different degrees. Thus, 27.7% of the land of the region has been eroded. Since the territory is a plain, the erosion process occurring in these regions is mainly attributed to irrigation erosion.

Digital Image Processing to Produce Land Cover Map. Analysis of land cover is based upon the interpretation of Sental-2 Thematic Mapper images (TM), date in 2019. Methods for the identification of land cover in this study using nearest neighbour Method. The types of land cover classes consisting of: 1) Forest, 2) Estates, 3) Dryland farming, 4) Farm/moor, 5) Bush, 6) Village, 7) Wetland farming, 8) Open land, and 9) Water bodies. The result of land classification is used to determine the sampling points in field activities. Delineation of the image generated based on the results of field inspection and land cover classification by using Nearest Neighbour Method, in order to obtain land cover map of in the Shirvan plain of the Republic of Azerbaijan In the of the Bash Shirvan canal watershed in 2019 and 2020 year.

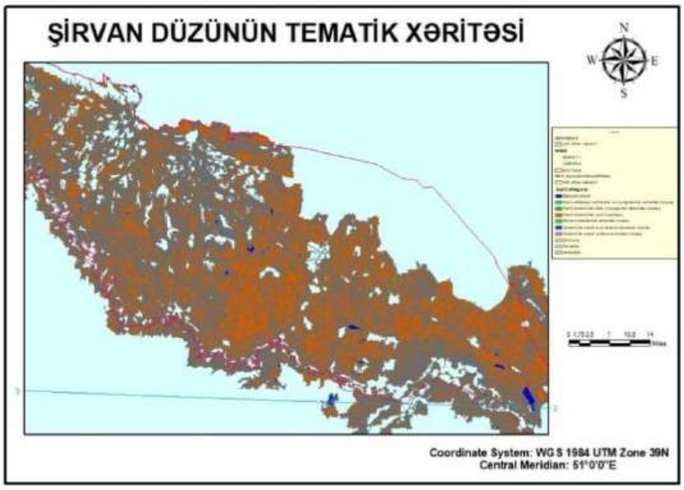

Figure 1. Land Cover Map of Shirvan plain

The Slope Map. Slope map of DEM is processed with the help of ArcGIS 9.8 as presented in Data processed by GIS contains information on slope and the number of pixels or extensive information. The majority of the slope is more than 1 %. The Slope factor will influence the speed and volume of surface runoff.

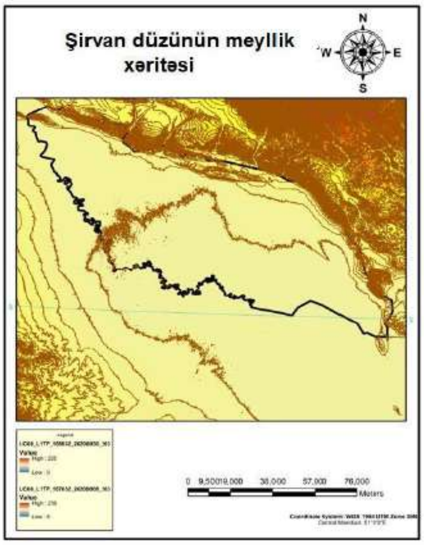

Figure 2. Slope map of Shirvan plain

The importance of modeling irrigation-induced erosion. Soil erosion models are indispensable tools for conservation planning, erosion inventory, risk assessment, and policy development. The most successful rain-fed soil erosion models have been the statisticallybased Universal Soil Loss Equation (USLE), its successor the Revised Universal Soil Loss Equation (RUSLE), and more recently the process-based Water Erosion Prediction Project (WEPP).

RESULTS AND DİSCUSSİONS

Erosion of agricultural land is the leading cause of surface water quality impairment, accounting for one-third to nearly one-half. Because much of irrigated agriculture systematically returns runoff to surface receiving waters, the link between soil erosion and surface water contamination is stronger than for rain-fed agriculture.

Less Recognized Impacts of IrrigationInduced Erosion Exposed and transported subsoil contributes to crusting, sealing, compaction, and nutrient deficiencies that impair seedling emergence, rooting, absorption of water and nutrients, and ultimately reduces crop quality and yields. Thus, erosion raises production costs, while reducing potential yields and profit. In addition, the fertile soil layer is washed away and lost.

Many long-term costs associated with irrigation-induced erosion are neglected in economic analyses. Irrigation-induced erosion lowers production and farm income, which ultimately leads to higher commodity prices. Costs accumulate for ditch and canal maintenance, river dredging, algal control, habitat restoration, biodiversity protection, water quality remediation, fishery restoration, as well as for mitigation of recreational resource losses, reduced reservoir capacity, and accelerated hydro-electric generator wear.

Irrigation Water Quality Effects Irrigation water often contains a substantial sediment or suspended biotic load. In furrows, the loads change systematically as the stream advances, influencing carrying capacity and surface sealing [3] . Solids in sprinkler-applied water can also contribute to surface sealing, reducing infiltration, and thus increasing runoff and erosion.

Rain is nearly pure water and does not vary significantly in chemistry (electrical conductivity [EC], sodium adsorption ratio [SAR], or other organic or mineral constituents). Rain-induced erosion theories and models concentrate on the physical properties of relatively pure raindrops and/or water streams and how they affect erosion. Laboratory simulations and rainfall simulator studies [4] have demonstrated that EC and SAR significantly influence the erosivity of water. Soil and water chemistry effects, to the extent that they exist in rainfed conditions, are indirectly integrated into rain-induced soil erosion models via a given soil's erodibility. The degree and mode of water quality effects on irrigation-induced erosion are far more pronounced.

Water Temperature and Temporal Effects Soil and water temperatures vary systematically over the course of a season, both among storm events and diurnally. In models of rain-induced erosion, temperature effects on water viscosity and solubility relationships of soil chemical components have not been considered directly. To the extent they are incorporated into models, they are dealt with indirectly via statistical correlations of storm events and erosion observations. Soil and water temperatures are more likely a factor in irrigation-induced erosion than for raininduced erosion. Rain is usually preceded by and accompanied by reduced solar irradiance and thus soil cooling. Temperature of rainwater is nearly constant at or near the dew point during a rain event. Droplets reaching the ground from sprinkler irrigation also tend to match the dew point temperature. In contrast with rain, irrigation usually occurs on sunny days when soil surfaces are hot, especially in arid settings. In furrow irrigation, this causes large temporal and spatial variation of irrigation stream temperature [6]. The controlled temporal patterns of irrigation events are also very different from the more random nature of rain events. Irrigation-induced erosion tends to occur in a series of several relatively small runoff events, whereas rain-induced erosion is typically generated in a few relatively large storms each season. Rainfall-induced erosion is predicted by deriving yearly or seasonal hydraulic or erosion relationships based on meteorological inputs averaged from sporadic events of varied intensity occurring over long time periods across a geographic region. Irrigation hydrology is much more controlled and predictable and much more sensitive to small variations in conditions.

Because the duration of irrigation runoff is longer, temporal changes in infiltration, furrow size and shape, and soil erodibility parameters are more important for furrow irrigation than for rain. For example, sediment concentration in furrow irrigation runoff usually decreases with time, even though there is a constant inflow stream, and runoff usually increases over time. Long runoff times also allow relatively low erosion rates to result in substantial cumulative erosion, so it is important to be able to predict these low erosion rates.

Modeling Irrigation-Induced Erosion Models developed for rain-induced erosion cannot be used for irrigation without substantial modification. The USLE and its successor, RUSLE, are the most commonly used models for estimating erosion rates associated with rain-fed cropland agriculture [6] (Wischmeier and Smith 1965 and 1978; Renard et al. 1997).

The basic form of the USLE and RUSLE equations is as follows:

A=RxKxLxSxCxP, (1)

where

A = average annual soil loss over the part of the field that experiences net loss (Mg ha- 1 yr-1), R = rainfall erosivity (MJ mm hr- 1 ha-1 yr-1), K = soil erodibility (Mg hr mm-1), L = the slope length factor (unitless ratio), S = the slope steepness factor (unitless ratio), C = the cropping factor (unitless ratio), and P = the conservation practices factor (unitless ratio).

Three models have been or are being developed to estimate soil loss from irrigated fields: the Surface Irrigation Soil Loss model

RUSLE was for soil erosion loss assessment. The final quantitative RUSLE values (eq. 1) indicate quantitative soil loss in tons/ha per year ranging from less than 1 to very high soil loss rates (223.6 t/ha). This quantity can vary because it can depend on the various environmental "factors" in which these studies are conducted. For a better visual understanding of these quantities, the RUSLE values are grouped in five classes of soil erosion risk according to the Bergsma classification (Table 1)[7].

Table 1.

Soil erosion risk Classes and equivalent RUSLE values

SOIL EROSION RISK CLASS	RUSLE VALUE
Very Low	(0 to 5 ton/ha*y)
Low	(5 to 12 ton/ha*y)
Medium	(12 to 25 ton/ha*y)
High	(25 to 60 ton/ha*y)
Very High	more than (60 ton/ha*y)

The process-based WEPP model [7] categorizes soil erosion into rill and inter-rill processes.

Inter-rill erosion involves soil detachment and transport by raindrops and shallow sheet flow. Inter-rill erosion delivers sediment to rills. Rill erosion processes describe soil detachment, transport, and deposition in rill channels [8] (Flanagan and Nearing 1995).

The WEPP model uses the following steady state sediment continuity equation to calculate change in sediment load along the rill:

dG-dx = Df Di , (3) where G = sediment load in the rill per unit width (kg ci) X = down-slope distance (m), and Df and D. = rill erosion rate and interrill (lateral) sediment delivery rate to the rill, respectively, each per unit length and width of rill (kg s^{-1} m^{2}).

Closer to the main Shirvan channel, the slope length factor increases significantly and the absence of stone bars along the contours allows for significant soil loss, which is not sufficiently stopped by the ground cover (shrub).

LS is the slope length-gradient factor. The longer the slope, the greater is the volume of surface runoff and the steeper the slope, the greater is its velocity. LS is 1.0 on a 9% slope and for a 22.1 meter long plot.

The soil erodibility factor to account for the soil loss rate is an erosion index unit which is defined as the soil loss from a plot 22.1 m long on a 0.9 % slope under a continuous bare cultivated fallow. It ranges from less than 0.1 for the least erodible soils to close to 1.0 in the worst possible case.

90% of irrigation worldwide is surface irrigation, an inherently erosive process. Regional and national assessments of erosion and water quality impairment from irrigated land runoff have been hampered for decades by the lack of appropriate simulation models. This inadequacy adversely affects management choices, resource conservation strategies and policy, as well as conservation practice compensation. We have demonstrated the potential of process based models for predicting the effects of changes in design and management of furrow irrigation. Given the high productivity of irrigated lands and their fragility, development and validation of appropriate irrigation-induced erosion models should be among the highest priorities for agricultural research in general and for natural resource management in particular.

CONCLUSION

Crop management factor for diferent land use was derived from satellite images based on land use and land cover maps and its attribute data analysis. Te cover and management factor is the ratio of soil loss from land with specifc vegetation to the corresponding soil loss from fallow with the same rainfall [57]. Te SENTAL-2 satellite image was used from USGS on 2019, to drive

Land use and cover map. Supervised digital image classifcation techniques were employed using ArcGIS 10.8.1 software.

Land use classifcation was conducted by the maximum likelihood classifcation method creating 150 training signatures. 123 reference points were generated from Google Earth for validation.

Soil loss analysis. Te average annual soil loss was calculated on a grid cell basis by multiplying the respective USLE factor values (R, K, LS, C, and P) interactively using the "Spatial Analyst Tool Map Algebra Raster Calculator" in Arc GIS environment.

Where A is the annual soil loss (t ha^{-1} $year^{-1}$); R is the rainfall erosivity factor (MJ mm h^{-1} ha^{-1} $year^{-1}$); K is soil erodibility factor [Mg ha^{-1} MJ^{-1} mm^{-1}]; LS=slope length factor (dimensionless); C is management factor (dimensionless); and P is conservation practice factor (dimensionless).

Slope length and gradient factors were estimated by ArcGIS 10.8.1. Te fow accumulation, slopesteepness, and slope gradient were generated from DEM in the Arc GIS environment. Te LS map was generated using Eq.

LS = (X/22.1)m (4) 0.065 + 0.045S + 0.0065S2 - , X = (Flow accumulation * Cell value)

Where, LS is slope length–steepness factor, X=slope length (m), m=a variable slope-length exponent, and S=slope gradient (%). Flow accumulation is a grid theme of fow accumulation expressed as a number of grid cells while cell size is the length of a cell side in meter (m). Flow accumulation was derived from the DEM, after conducting fll-and-fow direction processes in the Arc GIS environment in line with the Arc Hydro tool and was calculated by the raster calculator of the map algebra expression, whereas the value of S was directly derived from 30-m resolution DEM.

GIS and RS have been successfully implemented to determine potential soil erosion rates. In 2020, the average annual rate of potential soil erosion in the Shirvan plain was 3.00 tons ha-1 year-1. In 2020, it increased to 5.03 tons ha-1yr^{-1}. These should be prioritized in soil and water conservation activities. To reduce the rate of erosion that is occurring, we need a sustainable agriculture and conservation management system.

Table 2.

Erosion rate of Shirvan plain soils

Number	The Mean Erosion (ton/ha/year)	Erosion Hazard	The Mean Soil Loss (mm/year)	Erosion Hazard Index	Class of Erosion Hazard Index
1	7.36	Very Low	0.74	0.28	Low
2	0.13	Very Low	0.01	0.00	Low
3	0.38	Very Low	0.03	0.01	Low
4	0.029	Very Low	0.03	0.01	Low
5	0.11	Very Low	0.01	0.00	Low
6	0.15	Very Low	0.01	0.01	Low
7	1.50	Very Low	0.18	0.40	Low
8	0.03	Very Low	0.00	0.00	Low
9	1.30	Very Low	0.12	0.04	Low
10	18.3	Middle	1.84	1.10	Middle
11	40.1	Middle	5.0	1.8	Middle
12	1.55	Middle	1.5	0.05	Middle

In conclusion, it can be said that the final quantitative values of RUSLE are calculated from the combination of many parameters of soil erosion that interact with each other in a complex manner. The data showed that factors that have a stronger influence on the erosion process are factors that consider topography (LS factor) and support practices (P factor), followed by the Cover parameter (C factor). The research showed that in these areas, as a result of uncontrolled irrigation with long furrows, the fertile soil layer is washed away and discharged into the collectors. Thus, in the Shirvan plain, appropriate measures should be taken to prevent the washing of the crop layer and its discharge into the collectors during furrow irrigation. This study shows that Remote Sensing and GIS are useful tools in generating spatial and quantitative data for soil erosion study and risk assessment maps.

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SOIL POLLUTION, CAUSES AND EFFECTS

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The presence of toxic chemicals in soil in sufficiently high concentrations that pose a threat to human health or the ecosystem leads to soil pollution. All soils contain a variety of naturally occurring compounds (pollutants). Such contaminants include metals, salts, inorganic ions, and many organic compounds. These compounds are mostly created by soil microbial activity and decomposition of organisms. Also, various compounds enter the soil from the atmosphere. These are rainwater, wind activity, surface water bodies, etc. Pollution occurs when the amount of pollutants in the soil exceeds the natural level. There are two main factors of soil pollution: anthropogenic factor and natural factors.

Keywords: *Soil Pollution, Environment, Health, Anthropogenic, Ecosystem*

INTRODUCTION

Soil pollution changes the course of the soil cultivation process (often stops it), reduces productivity, plant pollutants enter the human body directly from the plant or indirectly (via plant or animal nutrients). Finally, soil contamination creates fear of disease and microbiological contamination.

Soil pollution is a part of land degradation. Pollution occurs in the natural soil environment, usually as a result of industrial activity, agricultural chemicals, or improper disposal of waste. The most common chemicals are petroleum hydrocarbons, polynuclear aromatic hydrocarbons, pesticides, lead and other heavy metals. Pollution is associated with the degree and intensity of industrialization of the chemical. Soil pollution causes many problems; health risks, vapors from pollutants, direct contact with contaminated soil, as well as secondary contamination of groundwater and underground water supplies. It is important to understand that all soils contain compounds that are harmful/toxic to humans and other living organisms. In uncontaminated soils, the concentration of such substances is very low and does not pose any threat to the ecosystem. Soil is considered contaminated when the concentration of one or more such toxic substances is high enough to harm living organisms. Soil pollution is often caused by one of the following: excessive or improper use of pesticides, excessive industrial activity, poor waste management or inefficient disposal, population growth, etc.

Anthropogenic pollution of the biosphere is mainly caused by industry, energy and vehicles. Their participation is as follows:

- industry - 38%;
- energy - 22%;
- vehicles - 16%;
- agriculture - 14%;
- household waste - 7%;

other sources - 3% [1]

Problems encountered during land reclamation. The problems encountered during land reclamation are closely related to the extent of soil contamination. The greater the contamination, the greater the need for resources for remediation. [2]

One of the most dangerous soil pollutants is xenobiotics. Xenobiotics are substances that do not exist in nature and are synthesized by humans. Also, the presence of heavy metals in the soil can be very harmful for people. Arsenic (As), Mercury (Hg), Lead (Pb), Zinc (Zn), Nickel (Ni), Cadmium (Cd), Selenium (Se), Chromium (Cr) and Copper (Cu) etc.

Their discharge into the soil can result in soil pollution. Some common soil pollutants that can become industrial wastes are: 1) Chlorinated industrial solvents, 2) Dioxins from pesticide production and waste incineration, 3) Plasticizers/dispersants, 4) Polychlorinated biphenyls (PCBs). The petroleum industry produces many petroleum hydrocarbon wastes, such as benzene and methylbenzene, which are known to be carcinogenic in nature. [7] Heavy metal pollution reduces soil fertility. Microbes living in the soil also have a negative effect on the population. In one study, heavy metal contamination in plant roots was found to have a negative effect on vesicular arbascular mycorrhizae. [4]

Pesticides are substances (or mixtures of substances) used to kill or inhibit the growth of pests. Common types of pesticides used in agriculture include: 1) Herbicides are used to kill/control weeds and other unwanted plants 2) Insecticides are used to kill insects 3) Fungicides are used to kill or inhibit the growth of parasitic fungi

These chemicals are dangerous for human health. Pesticides cause central nervous system disorders, immune system disorders, cancer, and birth defects.

Soil pollution can be divided into two categories: 1) Natural soil pollution 2) Anthropogenic soil pollution (as a result of human activity).

Soil contamination by natural means

An example of natural soil pollution is the accumulation of compounds containing perchlorate anion ($ClO4^-$) in some dry, arid ecosystems. Another way of natural soil pollution is through the transport of soil pollutants by rainwater. It is important to note that some pollutants can form naturally in soil under the influence of certain environmental conditions: during a storm, perchlorates can form in soils containing chlorine and certain metals.

Anthropogenic soil pollution

Soil pollution is almost anthropogenic. However, let us take a look at some of the causes of soil pollution:

Accidental spills, industrial accidents, industrial accidents (such as the Chernobyl nuclear disaster) can contaminate the soil with toxins or other substances (such as radiation).

Acid rain - has high levels of hydrogen ions. When this rain seeps into the soil, it can negatively alter soil chemistry. This means that acid rain can negatively affect plants and essential microbes in the food chain.

The discharge of sewage, untreated and released back into the environment, can result in the leaching of pollutants into the soil and the leaching of these pollutants into water sources, causing water-borne diseases.

Nuclear waste is extremely dangerous for human health. This type of waste can make an area uninhabitable if not disposed of properly.

Oil spills usually occur in the marine environment and sometimes on land. Such a situation can affect soil chemistry and negatively affect plant and animal life.

Oil pollution - The development of industrial production is accompanied by an increase in the production and consumption of hydrocarbons in the modern world. This type of pollution is caused by oil extraction, transportation, storage, processing, fueling of cars, leaks and accidents that occur as a result of pumping water reservoirs at gas stations. [6]

Fertilizer pollution - The use of fertilizers and other chemical agents has an active effect on the natural environment. The presence of various toxic compounds in mineral fertilizers, their low quality, as well as non-compliance with the technology of use can have serious negative consequences. Currently, in industrially developed countries and in some of our regions, mineral fertilizers are used at a high rate, which has a negative impact on the natural environment. dangerous character and global scale. The main causes of pollution of the natural environment with fertilizers, the ways of its loss and inefficient use occur due to the following:

•defects in the technology of transporting, storing, mixing and giving fertilizers;

• Violation of agrotechnologies in their rotation and transfer to different crops;

• soil water and wind (deflation) erosion;

•defects in the quality of properties of mineral fertilizers;

• lack of regular and strict control of their chemical composition when various industrial, urban and household wastes are intensively used as fertilizers; [3]

Health effects

Direct contact with contaminated or contaminated soil or direct exposure to human health through inhalation of vaporized soil pollutants pose major threats. The health consequences of exposure to soil contamination vary greatly depending on the type of contaminant, the route of attack, and the susceptibility of the exposed population.

Chronic exposure to chromium, lead and other metals, oil, solvents, and many pesticides and herbicides can be carcinogenic. It can cause congenital and chronic diseases.

Soil pollutants can be decomposed into harmless compounds by both chemicals and microorganisms living in the soil, and these decomposed compounds can leach from the soil solution and pass into the groundwater and pollute the soil and water. This poses a threat to environmental health and life. [5]

Industrial or man-made concentrations of natural substances such as nitrates and ammonia associated with cattle manure are also health hazards in soil and groundwater. Mercury and cyclodienes are known to cause kidney damage and a higher incidence of certain chronic diseases. Many chlorinated solvents cause liver changes, kidney changes, and central nervous system depression. High doses of soil contaminants can cause death by inhalation or ingestion through direct contact with soil-contaminated groundwater.

Ecosystem effects

It is not surprising that soil contaminants can have serious detrimental effects on ecosystems. Even low concentrations of pollutant species can cause profound changes in soil chemistry. These changes can be manifested in the metabolism of endemic microorganisms and arthropods living in a certain soil environment. The result may be the virtual destruction of some of the original food chain. Even if the chemical impact on lower life forms is small, the lower pyramidal levels of the food chain may receive foreign chemicals that are normally more concentrated for each level of consumption in the food chain.

THE RESULT

Soil pollution is a physical, chemical, biological or radiological modification of the surface layer of the earth's crust by the accumulation of large amounts of natural materials or the formation of new synthetic materials. It disables the ecological system and soil purification process (self-purification). The consequences of soil pollution depend on the type, quantity and dynamics of disposal of harmful materials, as well as the composition, structure, and physical-chemical properties of the soil.

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ENVIRONMENTAL CONDITIONS AND PROBLEMS OF AZERBAIJAN'S WINTER PASTURES IN THE CONDITIONS OF GLOBAL CLIMATE CHANGE

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In the Republic of Azerbaijan, taking into account that pastures and hayfields play an important role in the development of animal husbandry as a natural fodder base, as well as in the preservation of the environment, their effective use, restoration and strengthening of the protection of such land areas that have become useless are the main tasks facing the state. In the Republic of Azerbaijan, the lack of soils suitable for agriculture, including natural pastures and hayfields, as well as highly nutritious concentrates produced by industrial methods in the structure of feed used in animal husbandry, leads to overload natural forage areas, as a result of their uncontrolled exploitation, soil erosion and salinization, the country causes serious damage to the forest fund, water resources and the environment as a whole. It is important to carry out scientific-research works in order to increase productivity by developing animal husbandry in the country in more advanced ways, to strengthen the protection of summer and winter pastures and hayfields, to increase the efficiency of their use and to ensure the preservation of biodiversity. From this point of view, the research work dedicated to the investigation of changes in the ecological condition of Azerbaijan's winter pastures under the conditions of global climate change stands out for its relevance. Winter pastures of our republic taken as a research object are 1460 thousand hectares, and summer pastures are 589.5 hectares. During research, cartographic,, mathematical-statistical, systematic analysis, comparison, etc. research methods were used, collected materials were summarized, grouped and systematically analyzed. Since a large part of our summer pastures of the republic has been occupied for 30 years, the overloading of winter pastures has resulted in soil erosion, salinization, humus, etc. leaching of nutrients from the productive layer of the soil, deterioration of its physical and mechanical properties occurred. During the years 1975-2000, 743.3 thousand ha of winter pastures of Azerbaijan, including 218.3 thousand ha of winter pastures in the Kur-Araz lowland, were subjected to varying degrees of desertification. Since the 90s, the intensity of the desertification process in winter pastures has increased 2-3 times. In this regard, it is necessary to implement complex measures to effectively use the winter pastures of the republic and to prevent desertification and bring them to a productive state.

Keywords: *Kur-Araz lowland, Desertification, Winter pastures, Climate change, Soil degradation, Salinization*

INTRODUCTION

In the territory of Azerbaijan, since ancient times, the development of cattle breeding has developed in parallel with agriculture. Favorable climate in the territory of Azerbaijan, vegetation of natural pastures throughout the year, favorable terrain and climatic conditions have given impetus to the development of animal husbandry. Our republic ranks first among the Transcaucasian republics in terms of the area of natural fodder sources. Its total area was 3 million hectares.

67% of natural meadows and pastures are located in lowland areas, including Gobustan, Jeyranchol, Shirvan, Ajinohur, Mil-Karabagh, Mugan-Salyan plains, Kur-Araz lowland, these areas consist of semi-deserts and steppes. 33% of pastures are in the Greater and Lesser Caucasus, in the Talish zone. Despite having such a large natural fodder area, 58.8% of sheep breeding farms in our republic are provided with winter pastures and 37.5% with summer pastures. Feeding cattle on pastures is the main condition for raising healthy animals. Also, pastures have a very good effect on the health of animals. Valuable forages containing sufficient mineral salts, easily digestible proteins and vitamins have historically been abundant in the area. Animals fed on pastures give birth easily. As a rule, healthy and relatively many puppies are bought.

Historically, and especially during the former Soviet era, Azerbaijan, as well as neighboring countries, was used as a fodder base. In the winter months, the large horned cattle kept in the plain areas of the Republic, mainly in the Kur-Araz lowland, and especially the small horned cattle, were taken to favorable mountain pastures in the summer months, which ensured that the cattle were provided with fodder throughout the year. For many years, the small-horned cattle of the neighboring Republics of Georgia, Dagestan and Armenia were brought to the summer pastures of Azerbaijan and were provided with fodder for several months. Regarding the importance of pastures and meadows in the mountain regions of the republic, it is known that the mountains of the Lesser Caucasus can be considered more favorable here. Tovuz, Gadabey, Gazakh, Kalbajar, Lachin, the mountainous part of Karabakh, Gubadli, Zangilan and other regions of the Lesser Caucasus, which are famous for their mild climate, not too high altitude, and their picturesque appearance, functioned and will continue to function as summer pastures.

MATERIAL AND METHODS

Natural fodder areas in our republic are 3396.4 thousand hectares, which is 39.3% of the territory of the republic. Of this, 113.4 thousand hectares are hayfields, 1460 thousand hectares are winter pastures, 589.5 hectares are summer pastures, and 1233.4 thousand hectares are rural meadows. During research, mapping, mathematical-statistical, systematic analysis, comparison, etc. research methods were used, collected materials were summarized, grouped and systematically analyzed.

RESULTS AND DİSCUSSİON

The semi-desert winter pastures in our republic are located mainly in the Kur-Araz lowland, including Mil, Mugan, Karabakh, Shirvan, Salyan, Jeyranchol, Ajinohur, Chakhmag, Gobustan, and Kur-Araz hayfields. The average yield of semi-desert winter pastures varies from 3 to 6 centners per hectare, and from 1.5 to 2.5 centners per fodder unit (The annual set of indicators of the State Statistics Committee of Azerbaijan, 2000-2022). The hot and dry climate in the semi-desert regions, the annual increase in the number of cattle per area unit, the unsystematic use of pastures and other factors are the main reasons that reduce their productivity. Since the current condition of the semi-desert winter pastures does not meet the growing demand of animal husbandry, their superficial and partly fundamental improvement should be solved without delay. In the autumn months, cattle go to winter pastures, that is, mainly to the Kur-Araz lowland, Ajinohur, Jeyranchol, Gobustan-Absheron, Mil-Mugan plains, etc. was returned to pastures (Hajiyev & Gasimov, 1987).

Currently, the creation of individual farms in semi-desert winter pastures involved in irrigation farming in the areas of fertile summer pastures in most of the Aran regions changes the structure of natural complexes both locally and in large massifs, and creates anthropogenic areas within them. At the same time, land privatization has increased the process of anthropogenization of the natural landscapes of unused rivers, river valleys, collectors, and eroded slopes in mountainous and foothill regions. Starting from 1987, as a result of the beginning of the Azerbaijan-Armenia conflict around Upper Karabakh, almost most of our summer pastures were occupied by Armenian invaders. As a result, our republic lost most of the most favorable summer pastures. With this, it became very difficult to bring cattle to the summer pastures not only from the neighboring countries, but also from our own republic. In such a situation, the development of cattle breeding could be in plain areas (Kur-Araz Plain) or by finding new fodder bases. The main force began to fall on the plains and the newly acquired foothills, which were not considered very favorable in the past. The difficulty of such a social demand is also related to the settlement of our refugee and displaced population in our new territories. First of all, the living of mountain people in the plains, especially in hot places, in tent towns, in railway carriages, in big cities and on their outskirts, had to face great socio-cultural, social-political, sanitary-epidemiological and ecological tension. At the same time, this situation caused a change in the eco-geographical conditions in the entire region.

In the Patriotic War, which started on September 27, 2020 and lasted only 44 days, our victorious army led by our honorable president, Mr. Ilham Aliyev, took our occupied lands from the hands of Armenian vandals. Now, major restoration and improvement works are being carried out in those areas.

Due to the lack of moisture in the arid climate, it was difficult to graze and provide fodder for cattle throughout the year in the Kur-Araz Plain. The role of climatic factors in the development of animal husbandry is great. For this purpose, when talking about climate resources in the area, it is necessary to include climate resources of animal husbandry and information on their use. Currently, the climatic conditions of summer pastures and the beginning, end and duration of the grassland period in the Greater Caucasus are 196 days at an altitude of 1500 meters, and 42 days at an altitude of 2000 m. In the Lesser Caucasus, the length of the grassland season is 10-12 days longer than in the Greater Caucasus. In the mountainous regions of Azerbaijan, the length of the period of use of pastures is mainly determined by temperature conditions and the height of grass plants. Azerbaijani winter areas mainly cover plains and foothill zones.

The first and main reason for the use of these zones as winter pastures is that the winters are mild and therefore the vegetation of semi-desert and dry desert zone plants continues. In this zone, the normal use of pastures is prevented by the occasional increase in the height of the snow cover up to 20-25 cm. At this time, grazing of small ungulates is stopped. However, the number of snow-covered days in the winter areas is 10-12 days, and less than 10 days in the Caspian coastal zone.

On July 16, 1996, the Law of the Republic of Azerbaijan "On Land Reform" submitted for discussion by the Milli Majlis was adopted. According to this law, three forms of ownership of land that are kept in state ownership, municipal ownership and private ownership are defined based on the unified land fund of the Republic of Azerbaijan. According to the land reform, the lands kept in state ownership include summer and winter pastures (1231400 ha), forest fund lands (1038638 ha), water fund lands, lands intended for the needs of seed, breeding, variety-experimental farming (41 farms), reserve fund lands (Mammadov, 2001). Initially, 4,000 hectares of summer and winter pastures were allocated to meet and develop livestock breeding, which is an important area of agriculture, which is 22.3% of the total land fund of the Republic. Summer and winter grazing areas are leased to municipal-owned enterprises for the development of animal husbandry in the republic, and to legal and natural persons only (Orudzhov & Iskenderov, 1990).

According to the adopted rules, summer and winter pastures are not allowed to be planted. Vegetation, water sources, migration routes, cattle camps should be preserved in summer and winter grazing areas, and veterinary and sanitary rules should be observed. Shepherd's houses, beds, other cultural-domestic and industrial buildings can be built in summer and winter grazing areas according to demand. It is strictly forbidden to carry out major constructions in the summer and winter grazing areas.

In recent years, in our republic, a number of important measures aimed at the development of animal husbandry and especially the strengthening of its new resources have been defined and are gradually being implemented. It is impossible to develop an agrometeorological forecasting method of the productivity of pasture plants if the main decisive indicators of climatic conditions in pastures are not taken into account. Therefore, it is of great importance to accurately determine the climate indicator, which plays the main decisive role in pasture productivity in any area.

According to the data of Hajiyev and Najafov (1985), 20% guarantee of the amount of autumn precipitation that determines productivity in winter pastures, 100-120 mm in the Mil-Mugan plains and Jeyranchol, 140-160 mm in the Salyan-Shirvan plains and Ajinohur, early and in spring, it fluctuates between 60-80 mm in Salyan-Mil Plain, Jeyranchol and Ajinohur, and 80-90 mm in Shirvan-Mugan plains. In general, 20% of the amount of spring precipitation in winter pastures is not continuous and can be repeated 2 times in 10 years or every 5 years, and in 80% of the supply, the indicators are continuous and can be repeated 8 times in 10 years or almost every year.

Based on the data of a special zooclimatic expedition, the categories of meteorological elements that determine the weather conditions in which it is impossible for sheep to graze in the winter pastures of the Republic of Azerbaijan have been determined by scientists, and on the basis of this, the meteorological conditions of the weather conditions that create grazing for small-horned animals have been determined. Thus, 62% of the total number of days during which it is not possible to graze sheep are covered by snowy weather, 24% by snowy-blizzard-hazy-foggy weather, 9% by low-temperature-windy weather, and 6% by rainy weather (Eyyubov & Orudzhov, 1990). The average and maximum number of full and partial non-grazing days of sheep in the cold season of the year were determined, their provision was calculated and maps were drawn up. According to the information of those scientists (Hajiyev & Najafov, 1990), the average number of non-grazed days in winter pastures ranges from 1-40, partially non-grazed from 2-20, maximum non-grazed from 20-80, which requires additional fodder reserves for sheep during the winter period. Due to the 70% guarantee of winter pastures being ready for grazing, the most optimal times of early spring and summer fertilization have been determined and mapped.

In comparison, the region of Jeyranchol, which is considered a large area of winter pastures, differs significantly from the Ajinohur arid-denudation lowland, which is the westernmost section of the arid-denudation lowland of Azerbaijan, in terms of the features of its natural complexes, and therefore it is distinguished by its originality as a free natural-geographical territorial unit.

The length of Jeyranchol from northwest to southeast is 140 km, and its width from north to south is 15-30 km. Its area is about 4600 km^2 (Mikayilov & Asgarova, 2003). Jeyranchol has been used as a winter pasture for centuries. Hundreds of thousands of ungulates were kept in the western regions of Azerbaijan from October to May. But before, animal husbandry was developed here in very difficult conditions. Even the lack of water showed itself sometimes in the winter months. During the former Soviet period, large events were also carried out in Jeyranchol's winter areas. Water pipelines with a total length of more than 500 km were laid on the waterless plains of Jeyranchol, and the water problem, which seriously hindered the development of animal husbandry, was solved once and for all. At the same time, several highways leading to Jeyranchol connected it with the right bank regions, and the transportation has been significantly improved. These measures eliminated the backlog in the utilization of Jeyranchol wintering grounds, and this area has become one of the most active areas in agricultural production (Garibov et al., 1998). But it is certain that the development of settlements, vehicles, and animal husbandry in the areas where it has been used on a larger scale may cause certain changes in the structure of the landscape in the near future.

Farmers paid almost no attention to this area. For this reason, some negative consequences of human activity in Jeyranchol have started to appear in areas that have just begun to be assimilated (erosion, especially irrigation erosion, etc.). The climate here is a mild semi-desert and dry desert with dry winters. This area has a great amount of solar heat. According to calculations, the annual number of sunny hours here reaches 2200-2500. Maximum sunshine in the area is observed in June, July and August, and minimum in January (Ayyubov & Hajiyev, 1984). Here winter is short and spring starts early. At the beginning of March, some trees bloom, and sometimes the frosts that occur in March-April delay the beginning of spring, destroy the flowers of the trees and cause serious damage to agriculture. For comparison, let us note that Eminov (1985) determined that the total temperature between the beginning of vegetation and the readiness for normal grazing of ephemeral and various grasses in the Jeyranchol pastures (up to 800 m altitude) was equal to 120^0C, and to collect this temperature, it took 25-35 days.

The earliest period of greening of pastures occurs in dry and hot summer, that is, two decades earlier than the average period, which coincides with the second decade of May, and the latest period of grazing is 7-8 days, approximately one month later than the previous one, that is, June coincides with the second decade of the month. Calculating the length of time that ephemerals are green is very important in planning the period of grazing animals in the winter-spring season. The length of such a period should be adapted to the time of grazing (greening) of the area with ephemerals and the recovery of vegetation, which is completely related to meteorological conditions (Ismayilov, 2003).

Conventionally, taking the time until the temperature of about 120^0C for grazing is taken as a condition, and subtracting from it the end of the actual development time of the ephemeral vegetation, it is possible to calculate the period during which the ephemerals and various grasses will be green for a long time. It is known that in the years when the summer is cold, this period is shortened to 20 days, and in the years when the summer is hot, this period is even longer. Another example for comparison with Kur-Araz lowland, according to the data of Bagirov and Ayvazov (1990), in the

Ajinohur steppe, which is another winter pasture complex of the republic, as soil washing increased, humus and absorbed bases decreased, as a result of which the productivity of agricultural plants decreased. It was determined that if the amount of humus, nitrogen and absorption capacity in the strongly eroded parts of gray-brown (chestnut) soils in the 0-20 cm layer is 31.5 t/ha, 0.075 t/ha, 32.42 meq. if there was, in moderately eroded soils, these indicators were 110.8 t/ha, 5.5 t/ha, 27.79 meq., respectively, and in non-eroded soils, these indicators were 174.0 t/ha, 5.8 t/ ha and reached 35.75 meq.

In order to increase productivity from cattle breeding, it is necessary to use the land used for grazing efficiently. It is known that the feed unit used by each animal in the pastures depends on the age, actual weight and productivity of the cattle. According to the calculations, each sheep weighing 50-60 kg consumed 1.40 feed units of grass (Khalilov, 2006). Based on this, the number of cattle in Ajinohur pastures was calculated separately for each type of phytocenosis by Mammadov and Ayvazov (1990). It has been found that increasing the load received on pastures not only leads to deterioration of its condition, but also is harmful from the zootechnical point of view and leads to the disease of animals. In addition, the increase in load (pressure) leads to a decrease in the daily demand for each commodity and thus to a decrease in the productivity of animals (meat, milk, wool). Different parameters of the soil affect the productivity of the pasture cover in different ways and affect the diversity of the soil cover. When carrying out this bonitation work, it shows itself in the fertility of the soil and the bonity score.

As we mentioned, today 1,931.4 thousand (Mammadov, 2001) hectares of land have been allocated to meet the needs of animal husbandry, and the scientific-theoretical and experimental bases of their protection and improvement should be worked out. In pastures, vegetation grows naturally and provides high-nutrition, inexpensive forage. Although people do not participate in the creation of natural ecosystems, they sometimes exploit nature to an unfair degree and inflict irreparable wounds on it. That is why natural ecosystems management methods should be developed. In order to solve this problem, the most optimal and extensive method should be modeled in modern times, by means of which the ways of protection and efficient use of the ecological resources of pastures are clearly defined. So, at the beginning of the work, the main indicators that indicate the state of the ecosystem and reflect the processes taking place within the system are selected and clarified. The model consists of the following blocks: agroecology, evaluation, soil composition, soil properties, soil regime, crop technology, etc. (Goychaily et al., 2003).

The biggest problems when drawing up models of ecological fertility of pasture lands are the selection of standard soils, which Hasanova (2002) associated with soil-ecological zoning and evaluation. When dividing the soil ecological regions within the pastureland, within the relatively homogenous climate-relief conditions of the territory, according to the indicators of soil fertility, phytocenoses were taken as leading signs. For example, steppe grass formations spread over dark gray-brown (chestnut) soil led to the separation of the area as a steppe-soil ecological region, and within this region the ecological fertility model of dark mountain gray-brown (chestnut) soils was established, etc. The ecological fertility model of grassland soils is a new complex approach to solving problems such as studying, using, protecting and managing the grassland ecosystem as a whole. The soil and plant blocks of the fertility model of the mountain-steppe soil-ecological region of Jeyranchol winter pastures compiled by Hasanova (2002) are presented below (Table 1, 2).

Table 1.

Soil block of the mountain-steppe soil-ecological region fertility model

Indicators	Level of ecological fertility model			
	High	M	Medium	M
Soil composition block				
1. Soil profile thickness, cm	100-130	120	50-93	80
2. Physical clay content (<0.01 mm)	51-74	62	36-49	42
3. Density, g/cm^3	1,18-1,20	1,13	1,18-1,20	1,18
4. Total porosity, %	55-60	58	55-47	53
5. Amount of waterproof aggregates, %	30-53	44	26-47	43
6. Hygroscopic moisture, %	5,2-9,4	7,3	3,6-6,1	5,6

7. Water capacity, %	13,8-24,7	18,0	9,6-16,1	12,0
Soil properties block				
8. Humus, %	2,33-4,90	3,72	2,29-2,67	2,51
9. Reserve of humus, t/ha,	55-74	64	54-63	59
10. Nitrogen, %,	0,10-0,21	0,15	0,14-0,16	0,14
11. Reserve of nitrogen, t/ha,	2,4-4,9	3,5	3,3-3,8	3,5
12. Phosphorus, %,	0,14-0,21	0,18	0,20-0,21	0,20
13. Reserve of phosphorus, t/ha,	3,3-4,9	4,1	3,3-43,9	4,34
14. Sum of adsorbed bases, meq	18,8-32,6	31,9	19,2-26,3	25,1
15. pH	7,0-8,8	7,5	7,6-8,0	7,9
16. P_2O_5, mg/kg	19-21	20	20-21	20
17. K_2O, mg/kg	192-342	265	249-323	260
18. $N/NH_4 + N/NO_3$, mg/kg	53-69	64	61-68	64

Table 2.

Plant block of mountain-steppe soil-ecological region fertility model

Grassland types	Pasture type structure, %	Productivity, cent/ha	Feed unit, kg/ha	Digestible protein, kg/ha
1. Wormwood– Ferula	0,48	1,5	48	5
2. Wormwood- couch grass	8,08	2,7-2,9	120 -123	9-11
3. Couch grass	2,84	3,2-3,5	170-175	21
4. Wormwood - yellow bluestem	43,46	2,8-3,6	100	85
5. Bushy-wormwood yellow bluestem	15,74	2,8-3,7	100	85
6. yellow bluestem	11,29	2,8-3,7	100	85
7. Feather grass- yellow bluestem	16,62	2,1-2,8	81-108	8-11
8. Bushy - Feather grass	0,53	2,8-3,0	53,66	5-6
9. Feather grass	0,96	2,7-2,9	92	9

The aerospace observations conducted in the Republic revealed that the areas most affected by desertification are winter grazing areas (21). Aerospace shooting was carried out in the visible (λ=0.4-0.7 μm.), near-infrared UV (λ=0.8-3.0 μm) and thermal UV (λ=4-15 μm) spectra of the electromagnetic spectrum.

In order to monitor the dynamics of the desertification process in winter pastures, three main issues were considered: 1. Depending on the region where the winter pastures are located, its natural characteristics and the intensity of its use. 2. Periodicity of observations of grassland dynamics as a result of human economic activity. 3. Monitoring of the phenological characteristics of vegetation in the territory of the wintering areas by means of a plane and a helicopter.

The basis of the desertification process in winter pastures is the disproportion between the amount of grazing animals (quantitatively and qualitatively) and the amount of biomass in the pasture area (seasonal, annual).

The optical and radiation effect of desertification in winter pastures manifests itself in the reduction of the area of vegetation, the height of plants, the deterioration of the composition of plants and the disintegration of the humus layer of the soil. In order to classify the results of the study, the authors took the unused winter pasture area as a benchmark and compared the used pastures with it. Experimental results show that while the brightness coefficient of vegetation in the reference area varies from 0.12 to 0.15, the value of the spectral-brightness coefficient increased from 0.16 to 0.35 in the specified range depending on the characteristics of economic activity in the used pastures. The establishment and prediction of the dynamics of the desertification process depending on the area of winter pastures is based on the mutual comparison of aerial photographs taken simultaneously in different years and finally on the mutual comparison of the results of the measurements carried out in different ranges of the spectrum. Tracking the desertification process covers the years 1975-2000 (Table 3).

Table 3.

Intensity of desertification in the winter pastures of Azerbaijan (Azizov & Mehdiyev, 2003)

Names of winter pastures	Number of fed sheep per project (thous. head)	Average area per animal (ha)	Desertified areas during a certain period (ha)			Area (thous.ha)	Note
			1975-1980	1980-1990	1990-2000		
Jeyranchol	430,0	0,455	382	442	1250	196,9	Areas where vegetation has been destroyed by 80-90% are taken as desertified areas.
Gobustan	453,0	0,456	415	603	1870	207,3	
Southeast Shirvan	431,0	0,361	280	245	415	156,1	
Southern Mugan	130,0	0,476	44	40	180	62,2	
Total			1286	1510	4029	743,3	

Since 1982, systematic aerial photographs have been carried out seasonally in the indicated wintering grounds. Table 3 shows that during the years 1975-2000, 743.3 thousand ha of Azerbaijan's winter pastures, including 218.3 thousand ha in the southeastern Shirvan and South Mugan plains of the Kur-Araz lowland, were distinguished by the intensity of desertification. The intensity of desertification has increased rapidly since the 1990s.

The conducted studies show that the ecological conditions of the winter pastures in the territory of Azerbaijan are not satisfactory, and the summer pastures do not meet modern requirements. Adoption of various regions of the Kur-Araz Plain, which is one of the largest natural complexes of our republic, as pasture all year round is straining the ecological conditions. As a result, productive grasses and ephemerals cannot turn green again and again, productivity decreases, the area becomes bare, water erosion and wind erosion begin to accelerate, irrigation canals and pumping stations are worn out and out of order, and the water supply of grazing areas deteriorates from time to time, the pasture area is overloaded. As a result, due to lack of food among animals, especially high-quality food, animals lose weight, their weight, milk, meat, and wool yield decreases. Their immunity against diseases weakens, their environmental conditions are strained, animals suffer from various diseases, even if they are massive (Akhmedov, 2003; Mammadov et al., 2005). As we have already mentioned, the mountain slopes of the Lesser Caucasus, the mountainous part of Karabakh, which are considered the most favorable summer pastures of Azerbaijan, as well as most of the lands of the Kalbajar, Lachin, Gubadli, Zangilan, Jabrayil regions, Barda, Terter, Aghdam, Fizuli and Goranboy regions were occupied until September 2020.

At present, our lands have been released and our possibilities of use have increased. As a result of the temporary occupation, all the power fell on the winter pastures (with the exception of the south-eastern slopes of the Greater Caucasus, Gobustan-Absheron, and Khizi pastures). This has led to the reduction of cultivated areas and sometimes to grazing during the occupation period, violations of grazing norms and regime.

Selecting drought and salinity-resistant fodder plants is important in improving semi-desert winter pastures of the Kur-Araz lowland, which is known as the winter pasture base of our republic. Herbs grown in semi-desert conditions can also be used as mowing. Sowing on winter pastures should be carried out in autumn under rainfed and irrigated conditions. In connection with the removal of water to winter pastures, it is time to plant new plants in irrigated areas. In arid semi-deserts, irrigation of pastures and hayfields is beneficial (Babayev& Gurbanov, 2002). Determining the period of their grazing is of great importance in the efficient use of winter pastures.

In connection with the change in the form of ownership, the reduction of cattle in some regions as a result of their distribution to rural workers, along with the fact of the reduction of large herds, the process of grazing animals in small, small herds is taking place. 1.93 million ha of state-owned summer and winter pastures should be used efficiently and carefully in order to prevent fragmentation, improve the fodder base of pastures, improve the ecological conditions of pastures in general, and solve the problems facing them (Annual reports of the Ministry of Ecology and Natural Resources of the Republic of Azerbaijan, 2002). We need to increase the species diversity of pasture plants, identify new pasture areas, and expand the artificial planting of high-quality, highly productive grasses and ephemerals. Prevention of erosion (especially irrigation and wind erosion) processes, improvement of water supply to pastures, ensuring rotational grazing there, restoration of soil protective forest strips on the edges of pastures, creation of a new veterinary system in the entire territory of the Republic. Efficient use of water reservoirs, irrigation canals, and at the same time focusing on environmental protection in all these works, taking into account environmental crises that may occur in the future, etc. It is recommended. It is possible to solve the problems of ecogeographical conditions in a very important region for the Republic, such as the Kur-Araz lowland, as a result of the comprehensive implementation of the indicated system of measures.

CONCLUSION

Reworking of the scientific-theoretical and experimental bases in the direction of protection and improvement of 1931.4 thousand hectares of summer and winter pastures allocated for the development and meeting the demand of animal husbandry in our republic is relevant to the goal. Since most of our summer pastures have been under occupation for 30 years, winter pastures are overburdened. It is necessary to implement complex measures to bring the winter pastures to a productive state, especially in the Kur-Araz lowland. During the years 1975-2000, 743.3 thousand ha of winter pastures of Azerbaijan, including 218.3 thousand ha of winter pastures in the Kur-Araz lowland, were subjected to varying degrees of desertification. Since the 90s, the intensity of the desertification process in winter pastures has increased 2-3 times.

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BASICS OF EFFICIENT USE OF LANDS OF SHABRAN-KHACHMAZ CADASTRAL REGION

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The study of the ecogeographic characteristics of the land is of particular importance due to the fact that the area is highly exploited from the point of view of agriculture and is subject to man-made influences in some areas. The relief of the territory of Azerbaijan, including the territory of the Shabran-Khachmaz cadastral district, is very complex. Therefore, the ecogeographical processes taking place in the country and in the research area also attract attention due to their complexity. Studying the ecogeographical problems of cadastral district lands, ecogeographical assessment based on GIS is quite relevant both theoretically and empirically. The result of these scientific studies will be a great support for increasing the fertility and management of the soils of the research area. It is considered an important condition to implement a number of measures in the direction of agrochemical analysis of soils, creation of drought-resistant varieties, expansion of the application of advanced irrigation technologies. In Azerbaijan, as in the whole world, the use of modern technologies should be expanded in order to reduce the negative effects of climate change on the agricultural sector, to use the existing land and water resources more efficiently. Human economic activity has accelerated exogenous processes in Shabran-Khachmaz cadastral district as well as in all areas. As a result of the consistent policy implemented by the state, the sustainable development of the agricultural sector is constantly increasing. However, in order to achieve sustainable development in this field, it is important to evaluate the current trends in the world and to establish the production of agricultural products according to today's challenges. The government of Azerbaijan, in turn, supports the development of climate-friendly agricultural systems. All these are important conditions for the efficient use of land and thereby increasing the fertility of land.

Keywords: *Ecogeographic characteristics, Agricultural sector, Cadastre,Efficient use of land.*

INTRODUCTION

An important condition for the objective assessment of land is accurate accounting of natural and economic factors. The variability of soil-climate, relief and other factors within the borders of our republic, especially in mountainous areas, has a strong impact on agricultural production, including the productivity of land plots and fertility indicators of soil cover. Climate is the greatest natural factor affecting the productivity and efficiency of production of agricultural crops in large areas. Climate affects the zonation of the land cover, the variability of its fertility indicators within the area. However, if soil fertility indicators are changed and improved through agrotechnical, melioration and other measures, climate indicators are uncontrollable.

In the study of the natural ecological and geographical conditions of the Shabran-Khachmaz cadastral region, which is our research area, the application of efficient use is carried out taking into account the natural properties of the soil. Studying the ecogeographical problems of cadastral district lands, ecogeographical assessment based on GIS is quite relevant both theoretically and empirically. The result of these scientific studies will be a great support for increasing the fertility and management of the soils of the research area.There are a number of features of the soil and environment (climate, relief, vegetation, fauna, hydrography and hydrogeology, etc.) that are important to study and take into account when carrying out a number of works. Thus, the air temperature affects the species composition, density and regularity of the distribution of vegetation on the earth's surface. When using soils, the average annual temperature of the temperature regime, the average monthly temperature of the hot and cold period, and the maximum and minimum temperature indicators are taken into account.

Water resources affect the type and volume of production, especially in arid and humid climates, water supply and soil drainage costs, and different combinations of these characteristics create a variety of natural complexes. The study of the ecogeographic characteristics of the land is of particular importance due to the fact that the area is highly exploited from the point of view of agriculture and is subject to man-made effects in some areas.

Diagram 1. Use of irrigated land in Shabran-Khachmaz cadastral region by region

There are also features of the area that are studied through complex research. These are erosion, landscape, recreation, etc. Studying the properties of the land is a necessary condition for efficient land use. It enables efficient use of both land resources and other resources, nature protection, and efficient organization of production.

MATERIAL AND METHODS

If we look at the importance and content of soil research, we will see that soil research is considered one of the important jobs in the field of agriculture. The entire soil fund should be provided with large-scale soil research materials. Land survey materials include land maps, cartograms of various contents, as well as reports characterizing the lands of all land uses and making recommendations for their use, improvement, and conservation. For this reason, at the beginning of our research, we first compiled a land map of our territory (Shabran-Khachmaz cadastral district). Complex use of them is one of the main directions in improving the use of land resources. Human economic activity accelerated exogenous processes in Shabran-Khachmaz cadastral district as well as in all areas. As a result of the consistent policy implemented by the state, the sustainable development of the agricultural sector is constantly increasing. However, in order to achieve sustainable development in this field, it is important to evaluate the current trends in the world and to establish the production of agricultural products according to today's challenges. In recent years, a number of important measures have been implemented in the field of improving the planning of efficient use of the unified land fund in our Republic. Accordingly, scientific and technical forecasts of long-term use of land resources at different structural levels have been prepared. When analyzing the level of use of land resources, it is of great importance to determine the main directions of their improvement.

Organizational, agro-technological, technical, reclamation, biological-ecological, socio-economic measures are the directions of land use improvement. Here, each direction group includes a system of measures aimed at increasing the efficiency of land use. On the basis of planning, a proportional and mutual connection of the development of production in various fields of the economy is obtained on scientific basis. Prospective planning of the use of land resources should be carried out in the directions of the country's economy and individual sectors of the economy. The important condition of land use planning at the level of the country's economy is the comprehensive accounting of the characteristics of land relations in society and their use in a legal form. The main role in solving these issues should be given to the planning and forecasting of the efficient use of land resources. Forecasting of the use of land resources is carried out in the main schemes of the use of land resources, as well as in the schemes of the republic, administrative district and intra-farm land use.

Appropriate separation of land for agricultural and non-agricultural needs with maximum protection of the fertility of the main scheme of the use of land resources of the republic and administrative regions in accordance with the perspective plan of the development of individual sectors of the country's economy, recultivation of lands disturbed during the exploitation of natural resources and construction works, intra-farm constructions During this period, by effectively locating production centers and residential areas, as well as inter-farm facilities, maximum land protection, melioration in agricultural production, concentration and specialization of production, and efficient use of land are carried out by creating optimal structures for agriculture.

It should be noted that a number of proposals for increasing the productivity of agricultural lands and applying farming systems, intensification of agricultural production, assimilation and use of lands suitable for rural economy were developed and applied to the research area (Shabran-Khachmaz cadastral district).

Due to a number of reasons, in the land use of modern agricultural enterprises, there are often spatial and economic deficiencies that have a negative impact on economic activity and production efficiency. Spatial conditions can lead to additional investment in the construction of production and household facilities, water facilities, roads and other facilities in order to reduce annual production costs. Economically, deficiencies have a negative impact on the quality and quantity of agricultural products, the cost and income of various agricultural fields. This is done primarily through the elimination of spatial and economic disadvantages. Therefore, it is necessary to comprehensively implement theoretical and practical knowledge on the restoration and protection of soil fertility, especially issues related to soil ecology. Undoubtedly, meeting the growing demand of the population for agricultural products in all periods was primarily reflected in the solution of the problem of restoring and protecting the fertility of the lands used for this purpose. This fact gave impetus to the development of new socio-economic relations in the agrarian section of the country. In mountainous areas, not only plants, but also the disruption of the natural structure of the soil cover creates a threat to the washing away of erosion materials for flood processes. In this regard, the development of scientific and practical methods for efficient and sustainable use of the environment, its protection and improvement is one of the actual scientific and practical problems of the modern era. Optimizing the relationship between society and nature should be based on sound scientific theories. In the development of such a theory, fields of science in the ecological direction, especially soil science, can play an important role. The damage caused by wind erosion to agriculture is no less than the damage caused by water erosion. Human economic activities, especially irrigation, deforestation, grazing, and cultivation have a great impact on erosion processes. Therefore, it is important to consider the degree of soil erosion as an effect of anthropogenic factors during soil evaluation.

In general, as in other regions of the republic, there is a serious need to develop and implement a comprehensive program of measures against the erosion processes occurring in the soil cover in Shabran-Khachmaz cadastral region. From this point of view, it is of great importance that the State program envisages the expansion of the area of irrigated land in the region and the implementation of a number of restoration and reconstruction works to increase the carrying capacity of the Samur-Absheron canal in order to improve their sustainable water supply. In addition, in order to improve the water supply of irrigated lands in individual districts of the region, cleaning and restoration works should be carried out in the irrigation and drainage networks.

RESULTS AND DISCUSSION

It should be noted that from 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 new production areas, at the same time, the rapid increase in the population, the surrounding ecological environment and the country's natural resources, especially the use of land resources, did not remain unaffected. Starting from that period, the extensive expansion of arable land and also the allocation of arable land for non-agricultural purposes, the gradual decrease of fertile land resources in the country due to various natural and anthropogenic effects, improper use of land for its intended purpose, instead of restoring, increasing and improving its natural fertility. caused damage. For this reason, the correct use of land areas according to their purpose, the application of the rotational cropping system, and the observance of melioration and agronomic rules are the basis for the efficient use of land.

All this tells us that human activity has become a strong ecological factor in the process of soil cultivation. Only by studying this effect in detail, it is possible to increase the productive capacity of the soil, the productivity of plants, and at the same time to restore the biological function of the soil.

It is also clear from these analyzes that it is necessary to prevent long-lasting destructive natural and anthropogenic effects on the soil cover of the regions that make up the unified soil fund of the republic, or to substantially limit these effects, to ensure the natural fertility of the soil (sustainable and sustainable), and to restore and protect it. These measures to be implemented in the field will ensure sustainable and sustainable development of the population's socio-economic və as well as the general ecological situation of the regions.

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PROBLEMS OF PROTECTION OF ERODED BROWN MOUNTAIN-FOREST SOILS ON THE TERRITORY OF GOYGOL DISTRICT

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Soil erosion in our republic's ecological problem is sure to attract attention. Erosion is a Latin word (erosio) which means destruction by water or wind. According to the United Nations Environment Programme, 20 million hectares of land become unproductive or less economically efficient each year as a result of erosion and erosion-related degradation. Slope length and slope shape have a great influence on the progress of severe erosion. Studies show that a decrease in slope slope from 3^0 to 2^0 soil seepage per hectare from 6-19 m^3 to 12 $m^{3.}$

The Goygol area where we surveyed consists mainly of mountainous areas, so it is necessary to carry out forest reclamation measures mainly against erosion. As you know, forests are very important in the fight against erosion, as water regulators and as soil protectors against erosion. In forests, the soil structure is improved by the influence of the root systems of trees and shrubs. Increases dehydration capacity. Surface runoff becomes subsurface runoff, reducing water flow and flow. As a result, erosion is weakened and the amount of turbidity flowing into the river channel is reduced.

However, in the areas we studied, steep slope forests were deliberately cleared, weakening the role of forests in controlling erosion. The population should be aware that deforestation on steep slopes and river basins with the formation of erosion processes will dry up springs and disrupt the water balance of rivers.

Key words: *Ecoetic, Erosion, Fertility, Forested Soil, Research.*

INTRODUCTION

The ever-increasing anthropogenic changes in the environment put forward a solution to echoetic problems in the world, and its study aroused the interest of all mankind. The people and nature of a number of regions of our planet have fallen into crisis. And the way out of this situation is the abolition of atomic weapons, the work of a system of measures by specialists to prevent environmental pollution in general, and the establishment of international control over the state of this global business (A.H. Babayev, 2012).

The total land fund of the Republic of Azerbaijan is 8.6 million hectares. Of this, 4.35million 3.2 million hectares of agricultural land The hectare is suitable for irrigation. Currently, about 1.45 million irrigated lands The hectare is irrigated. It occupies 1.3 million ha of different degrees of salinity, 733.2 thousand ha of stony and gravel areas, and 0.5 thousand ha of wetlands. 510,2 thousand ha of erosion-hazardous areas (Q.Sh. 2007). From this point of view, the erosion of soils among the ecological problems of our republic cannot but attract attention. Erosion is a Latin word (erosio), which means destruction by means of water and wind.

As a result of erosion and erosion-induced degradation, according to the United Nations Environmental Program, the productivity of 20 million ha of land annually approaches zero or lowers its economic efficiency (Anonymous, 1991).

Analogues and explanations of the terms erosion in Azerbaijani and English are presented in Table 1 (Morgan 2005).

Table 1.

Erosion Terms

Terms	In English	Açıqlaması
Eroziya	Erosion	Soil loss, soil weathering
Landslide	Erosion	Soil loss, soil weathering
Geological eroziya	Geological erosion	Natural / normal soil loss
Natural, normal, harmless erosion	Geological erosion	Natural / normal soil loss
Accelerated erosion	Erosion	Soil loss, soil weathering
Harmful erosion	Erosion	Soil loss, soil weathering
Sedimentary, deep, linear erosion	Sediment	Destroyed soil, displaced soil
Degradation	Degradation	Soil quality deterioration

To realize the horror of this process, one should look back at the 1935 decree of the US Congress, issued back in 1935 on April 27. The decree indicates that soil erosion is a "national misfortune" of the people.

Soil erosion is a complex process, the formation and development of which is greatly influenced by natural and historical factors, as well as factors of improper economic activity of human (Q.Sh. 2006).

The slope length and shape of the slopes have a great influence on the violent course of erosion. Studies show that when slope slope decreases from 3^0 to 2^0, the leaching of soil from each hectare area decreases from 6-19 m^3 to 12 m^3. Soils for the preparation of measures to combat erosion are divided into certain categories:

I Category -areas that have not been exposed to wind and water erosion. Measures against erosion are not carried out in such areas.

II Category -areas poorly exposed to the erosion process. It is advisable to take simple agrotechnical measures here. That is, transverse deep plowing on the slope and planting of inter-row cultivated plants, etc.

III Category-areas moderately exposed to the erosion process. The slopes should be plowed and cultivated transversely, alternating planting systems should be applied.

IV Category-areas severely exposed to the erosion process. To restore the top fertile layer of this category of soils, it is necessary to carry out surface softening (10-12 cm), clean the fields from stones and gravel, sow seeds of perennial forage pastures, etc.

V Category-areas with very severe water and wind erosion For soil protection, it is recommended to apply alternating sowing, in which 1-2 fields are cereals and 2-3 fields are perennial grasses. Such plots are subsequently used as pastures and hayfields.

VI–VII Categories: these include swamps, ravines, and gobies. Unsuitable for alternating sowing. It should carry out superficial improvements in favorable places and be used as a mower and pasture.

VIII Category—unsuitable for agriculture—can only be suitable for a certain amount of forest.

IX Category : These areas consist of ravines,Gorges, cliffs, etc., which are not used for agriculture or other purposes consists of Q.Sh. (2009).

Due to the fact that the Goygol region, where we conducted the research, consists mainly of mountainous areas, forest reclamation measures should be carried out here, mainly against erosion. As we know, in the fight against erosion, the forest is of great importance as a factor that regulates water and protects the soil from erosion. In the forest, the structure of the soil improves due to the influence of the root system of trees and shrubs. The ability to dehydrate increases. Surface runoff turns into subsoil runoff, reducing the amount and speed of running water. As a result of this, the erosion process is weakened and the amount of turbid flow that flows into the course of rivers decreases.

However, it should be noted that over the past 15 years, the temporary settlement of some of the internally displaced people in this region has exposed the brown mountain-forest lands, which are considered the Golden fund of our republic, to severe erosion. So, as a result of the merciless chopping and use of forests, huge disasters-landslides began.

As we know, the forested area affects the water regime because of the high humidity in the lowland region. Therefore, forests in our mountainous regions are of great reclamation importance. In forests, the umbrella of trees, the trunk, the root system, and the forest floor on the surface of the soil also streamline the water regime of the soil.

The water regime under the forest umbrella is always different from the water regime under herbaceous plants. When rain falls on the forest, it first wets the surface of the leaves, branches, and stems, and part of the rain remains there. Studies have shown that the amount of precipitation that reaches the soil surface in the forest is 20–25% less than that that reaches the grass or field. So, trees with well-developed umbrellas retain 15% of precipitation (Q.Sh. 2002)

And the remaining 85%, as soon as they fall on the surface of the soil, are immediately absorbed into the soil, and the formation of the erosion process of superficial runoff is not observed. Observations conducted in the Goygol region show that 75–85 tons of soil were washed out of each hectare of open areas, although there was no washing in the forests during the rain.

In the forest, the erosion process and the water regime are affected by the umbrella and trunk of forest trees, as well as the root system. Thus, the root system of forest trees improves the structure of the soil, increases its resistance to erosion, and improves soil water absorption capacity (Q.Sh. 2002). Our studies show that the aggregates larger than 1 mm and resistant to water in brown mountain forest soils under the oak forests of the region are 75–80%, while in those lands under the forest they are 40–45%. Along with the root systems of trees, the forest floor, plant remains, and insects in the soil play a great role in improving the structure of the soil in the forest.

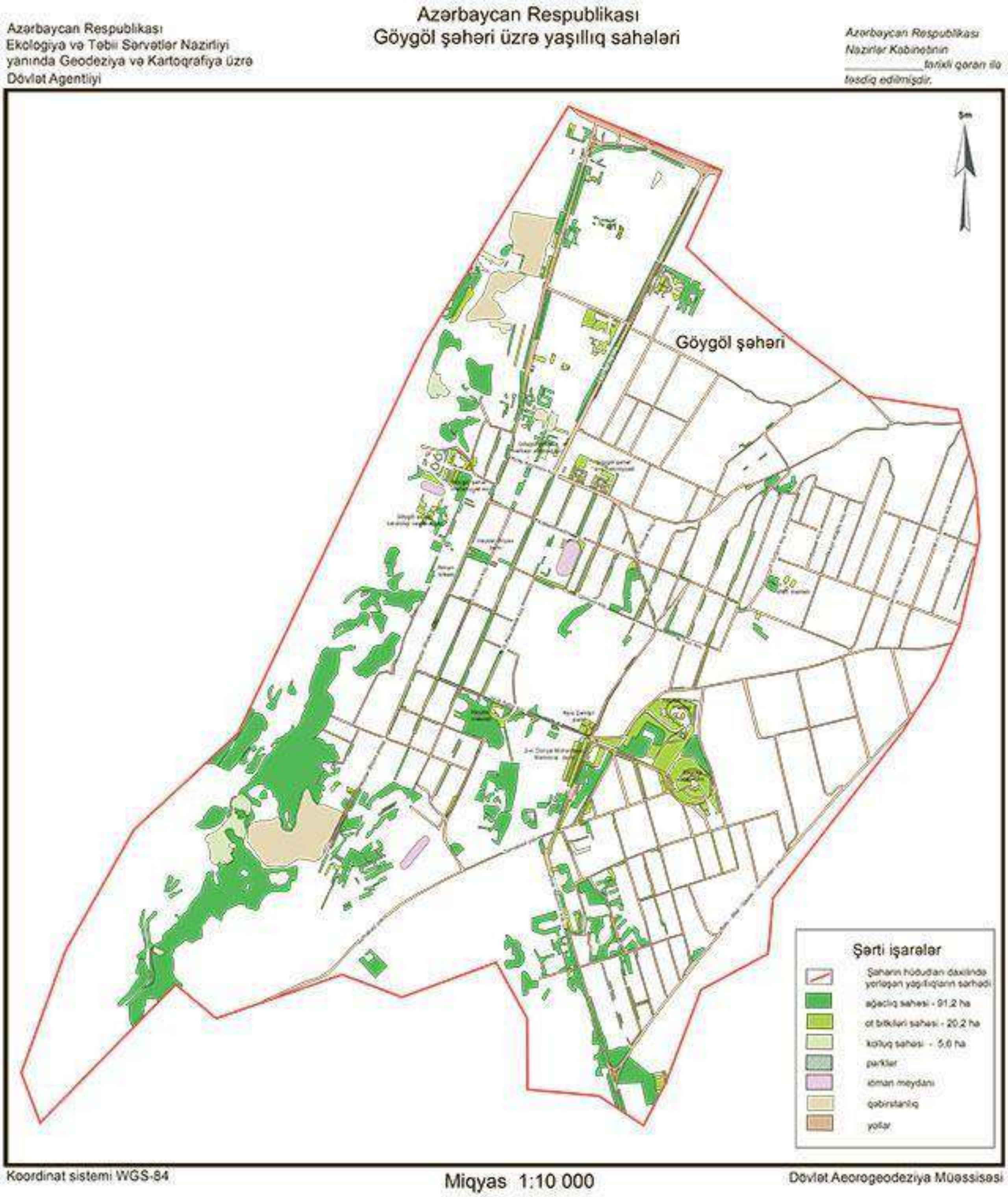
The waterlogging capacity of the forest floor is so great that rainwater, no matter how much, is all absorbed into its mass and seeps into the soil. Therefore, the process of erosion in the forest is not observed.

However, in the areas where we conducted research, forests on steep slopes were systematically broken down, as a result of which the forest's role in combating erosion was weakened. The population should know that when deforestation occurs on steep slopes in the basins of rivers, along with the formation of the erosion process, there is a drying up of springs and a violation of the water regime of rivers.

Table 2.

Fertility indicators of forested lands in the Goygol region

Topic of analysis	Results	Unit	Results of analysis	Standarts
pH	7.1		Saturation	6.5-7.5
EC_{25}	0.65	Ms/sm	Saturation	0.5-1
Carbonation ($CaCO_3$)	12	%	Calciometr	5-15
Humus	1.9	%	Walkey-Black	2-4
Nitrogenium (N)	0.2	%	Keldal	0.09-0.17
Phosporium (P_2O_5) mq/kq	78	ppm	In sodium bicarbonate	60-90
Potassium (K_2O) mq/kq	474	Kq/ha	1 N amonium acetate	250-500
Calsium Ca mq/kq	3920	ppm	1 N amonium acetate	1431-2860
Magnezium Mg mq/kq	402	ppm	1 N amonium acetate	55-114
Sodium Na mq/kq	428	ppm	1 N amonium acetate	
Iron Fe mq/kq	4	ppm	DTP solution	2.5-4.5
Copper Cu mq/kq	0.5	ppm	DTP solution	0.2>
Zink Zn mq/kq	0.2	ppm	DTP solution	0.7-2.4
Manganese Mn mq/kq	16	ppm	DTP solution	14-50



When trees and shrubs break in the forest, the forest floor collapses, the structure of the topsoil is disturbed, it solidifies, and precipitation seeps badly into the soil. When precipitation falls in such places, superficial runoff is formed and the soil is washed out. Natural growth in such places goes quite badly as the soil hardens and dries. For example, in the area where we conducted the research, the natural growth of plants in these areas does not go away since the soil in the area that was deforested 15 years ago has undergone erosion and has been washed away.

In general, it is required to take the following complex agrotechnical measures to prevent erosion processes and their consequences, which have become a very serious ecological problem for the soil cover of Goygol District: reduce their intensity and reduce their natural limits; increase the fertility of the soils affected by erosion; restore their biological potential and initial ecological parameters (Q.Sh. 2007).

Plowing in the transverse direction of the slope, plowing in the transverse direction of the slope with a cut-stem plow or soil dredger, circular plowing in the ridge, cultivating the soil with flat tools, plowing with a layer attached to the first and third stems, plowing with a layer removed from one or two layers, plowing with a layer attached to the remaining stems, circular and stepped plowing with furrow opening, deep plowing with slot opening, plowing by burrowing and burrowing, plowing with a plow with an extended layer, opening of crevices in plant plantings from end to end, furrowing between rows and filling of plant bottoms, etc.

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ENVIRONMENTAL ASSESSMENT OF SOILS UNDER THE VINEYARDS OF THE GANJA-GAZAKH REGION OF AZERBAIJAN

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Azerbaijan is one of the ancient countries involved in the cultivation of grapes and its processing. The viticulture and wine-making agrarian industry occupies a special place, is becoming important for the country's economy in terms of economic rationality and the creation of additional value. Research in the direction of soil compliance with the environmental requirements of the grape plant was carried out by us in the Ganja-Gazakh region. In accordance with the purpose of the research, a mathematical and statistical analysis of indicators of soils, climate and relief was carried out, and bonitet points were determined based on soil fertility indicators of the territory by collecting materials from the latest research. On the basis of methodological guidelines for the environmental assessment of soils, special assessment scales were prepared according to the severity of individual signs of the ecological need of a grape plant; according to these scales, an ecological assessment of several types and subtypes of soils suitable for grapes in the study area was carried out. Based on the research, it was found that the study area has a high prospect for the development of viticulture and winemaking. As a result of the research, the main limiting factors were identified: for the foothill soils of the Ganja-Gazakh zone - slope steepness, erosion processes, leaching; for the soils of the plain zone - the aridity of the climate, heavy granulometric composition and soil salinity. The most favorable conditions for growing grapes are in the low-mountain and foothill zone of the Ganja-Gazakh region of the republic, the best soils for growing wine grapes are mountain gray-brown dark (92 points) and gray-brown dark (94 points) soils. It was determined that the main limiting factors for the cultivation of grapes on the soils of the foothill zone of Ganja-Gazakh region are the clay content of the soil, the lack of the sum of active temperatures and the low amount of carbonates; for the soils of the plain zone are the lack of precipitation, dry climate, soil salinity, heavy texture of soils and low soil fertility.

Keywords: *Evaluation scales, Fertility, Grapes, Limiting factors, Soil assessment.*

INTRODUCTION

The aggravation of agro-ecological problems of nature management and environmental quality has led to the actualization of methodological issues of assessing soil quality, their compliance with modern and future requirements of society, the level of development of science and technological capabilities of practice, in this direction specialists have carried out interdisciplinary and numerous studies (Comerford et al., 2013; Ziaei, 2014; Harms et al., 2015; Orvar & Brynhildur, 2016; Ji et al., 2018; Kovaleva & Yakovlev, 2018; Legese & Gelanew, 2019; Vlasenko et al., 2019; Huo et al., 2020; Inoue et al., 2020; Rostami et al., 2021; Strock et al., 2022; Tashpınar et al., 2022).

Latysheva (2017) carried out a comprehensive agro-ecological assessment of agricultural lands in the dry steppe zone of the Kulundinsky district of the Altai Territory and determined their agro-ecological state, taking into account the degree of soil deflation and the dynamics of soil-agro-climatic indicators of effective fertility. Irmulatov (2016) in the Republic of Kazakhstan carried out agrolandscape zoning, agroecological grouping and typification of soils in the Pavlodar region, identified agroecological groups and types of soils. formed, assessed methods of tillage and adaptation of cultivated plants to carbonate black loamy and dark chestnut soils. Miller (2013) was the first to apply an integrated assessment-soil-ecological approach to assess the soil cover of the forest-steppe zone of Prisalair, combining factors of soil fertility and landscape-climatic conditions of soil cultivation. Saprin (2017) conducted an assessment of the environmental sustainability of agrolandscapes in the Voronezh region of the Russian Federation, for this he developed a new methodology for a comprehensive assessment of the sustainability of agrolandscapes. Zoning of agrolandscapes in the Voronezh region was carried out on the basis of the manifestation of natural factors and conditions (orography, hydrology, climate, soils, etc.), landscape and ecological state, physical and geographical processes, predicted changes in the sum of active temperatures.

Ezeaku (2015) found that long-term cultivation of crops in the Akwang region in Nigeria leads to a deterioration in the physical, chemical and biological quality of soils. This study was carried out to assess the physico-chemical parameters (based on the soil assessment approach) and biological parameters (based on the agroecological approach) of the soil for the sustainable management of cereals, crop areas and plantations. Kapustyanchik (2013) conducted comprehensive studies in the forest-steppe of the Ob region of Novosibirsk, revealed patterns in the distribution of agroecological factors - moisture, nitrate nitrogen and agrocenosis pollution, and conducted an agroecological assessment. Morev (2017) conducted research in the agroecosystems of the Central region of Russia on soddy-podzolic, brown forest and forest-steppe chernozems subject to long-term anthropogenic impact, determined that the following limiting agroecological factors exist for the soils of the region: 1) meso- and microrelief; 2) lack of essential nutrients, incl. lack of potassium and phosphorus; 3) soil compaction. Kutkina (2021) carried out an agroecological assessment of the chernozems of the foothills of Khakassia by calculating the soil-ecological index according to the method of Karmanov. Studies were carried out by Ghimire et al. (2018) to assess the quality of various soils in the Chure region of central Nepal. The soil quality index was determined based on the physicochemical parameters of the soil. Lee et al. (2020) proposed a multi-criteria system for assessing the resources of arable soils by combining an integral indicator of soil productivity with an indicator of soil cleanliness (by the amount of heavy metals).

MATERIAL AND METHODS

The soils of the Ganja-Gazakh zone were taken as the object of study, the total area of which is approximately 400,000 ha. In accordance with the purpose of the research, reference points were selected and 36 soil samples were taken from under the vineyards. Physical and chemical analyzes of the taken soil samples were carried out according to the following methods: granulometric composition - by pipetting method according to Kachynsky; total humus and nitrogen - according to the method of Tyurin; total phosphorus and total potassium - by X-ray spectral method; hygroscopic moisture - thermal method; total mass of water - according to the method of Ivanov; absorbed Ca and Mg - according to the method of Ivanov; carbonization - calcimeter; the reaction of the pH is determined by the potentiometer (Arinushkina, 1970). Based on field and laboratory studies, materials from the cartographic fund of the Institute of Soil Science and Agrochemistry of ANAS, map “The ecological assessment of soils of the Ganja-Gazakh zone” were compiled on a scale of 1: 100,000.

The ecological assessment of the soils cultivated under vineyards in the Ganja-Gazakh zone was carried out on the basis of the methodological recommendations of Mammadov (1988), Bulgakov (2002), Mammadova (2006) and “Map of ecological assessment of soils in Azerbaijan and its significance” (1992).

RESULTS AND DİSCUSSİON

The Ganja-Gazakh zone is located in the western part of Azerbaijan along the northern foothill plains of the mountainous province of the Lesser Caucasus. Altitude decreases from 500-600 m above sea level in the northwest to 100-200 m in the southeast. This region is considered one of the main wine-growing zones of the republic and includes the foothill and plain parts of the Khanlar, Ganja, Shamkir, Tovuz, Agstafa and Gazakh administrative regions. Vineyards are mainly planted along the right bank of the Kur River; the surface of the plain is slightly inclined to the northeast: 1-5° and is cut by many branches of the Kur River: Aghstafachay, Tovuzchay, Shamkirchay, Goshgarchay, Ganjachay, etc. In the Ganja-Gazakh zone, groundwater is located deep and does not directly participate in the process of tillage (Yusifova & Nuriyeva, 2016). The Ganja-Gazakh zone is located in the central subtropical dry steppe climatic zone and has a hot arid climate (Shikhlinsky, 1968). The average annual air temperature is 11.5-13.3^{0}C, the amplitude is -24.5^{0}C, the temperature of the hottest month is 25.1^{0}C, the maximum temperature is 38.4^{0}C, the temperature of the coldest month (January) is 8.5^{0}C. The amount of annual precipitation varies between 280-450 mm. The sum of active temperatures is 3500-4500^{0}C. The number of frost-free days is 240. During the growing season of grapes, the relative humidity in the zone is 45-55%. The temperature above 10^{0}C, which is necessary for the beginning of the growing season of grapes, is formed in the first decade of April.

Most of the vineyards in the zone are irrigated, as the amount of annual precipitation does not ensure the grapes need for water during the growing season. For irrigation, tributaries Kur, ground water, and kahrizy are used. The natural vegetation of the Ganja-Gazakh zone was preserved in limited places and was mainly represented by wormwood and saltwort-wormwood plant formations. In the upper foothills, it is replaced by fescue-feather grass dry steppe plants and shrubs. The main part of the land of the zone is plowed and used for agricultural crops.

The soil cover of the Ganja-Gazakh zone was studied by Zakharov, Akimtsev (1928), Hasanov (1972), Salayev (1966) and other researchers (Hasanov et al., 2013; Mammadov, 2013; Aliyeva, 2015, 2016; Abbasova, 2018; Huseynova, 2018). Salayev (1966) determined the bioclimatic conditions of the mountainous region of the Lesser Caucasus, carried out the natural zoning of the province. According to Salayev (1966), the zonal soil types of the Ganja-Gazakh region are steppe mountain-brown and gray-brown soils. In the region, there are gaja, solonetsous and long-term irrigated subtypes of gray-brown soils. The modern soil-ecological characteristics of gray-brown soils are given below.

Gray-brown soils are most common in the dry subtropical steppe zone of Azerbaijan, on the foothill plains of the Lesser Caucasus, in the Ganja-Gazakh massif, in the Arazboyu strip at an altitude of 100-500 m above sea level. It is composed of quaternary alluvial gravels and granular sands rich in chloride-sulfate salts. According to their characteristics, these soils are divided into light, dark and dark gray-brown soils.

Dark gray-brown soils were formed mainly on weathered carbonate deposits. These soils are thick and medium thick, in the flat parts of the relief the top layer of the soil is usually less carbonate and increases with depth, and on the slopes, carbonates appear from the top layer. Dark gray-brown soils are characterized by weak profile differentiation, the presence of a humus layer of 30-40 cm, and the leaching of easily soluble salts from the upper layer. The vegetation is composed of wormwood-cereal formations. The amount of humus in dark gray-brown soils is moderate and ranges from 2.88-4.58% in the upper layer, and gradually decreases towards the lower layers and ranges from 1.35-2.04% (Table 1). The humus resource is 230-260 t/ha in a meter layer, the nitrogen reserve is 9-10 t/ha in a layer of 0-50 cm, the phosphorus reserve is 10-12 t/ha. The amount of total nitrogen in the upper layer ranges from 0.18-0.25%, and the amount of total phosphorus ranges from 0.15-0.27% (Report on the soil cover of Goygol region, 2013).

Table 1.

The fertility indicators of gray-brown soils under the vineyards of the Ganja-Gazakh zone

Indicators	Soils				
	Dark gray-brown	Ordinary gray-brown	Light gray-brown	Meadow gray-brown	Gray-brown gaja
Granulometric composition,%, 0-100cm					
<0,01 mm	42,92-56,68	42,8-59,48	52,04-60,20	47,2-61,43	37,56-52,08
<0,001 mm	18,36-24,91	19,4-26,28	20,56-29,18	21,92-27,80	15,76-21,84
Humus, %					
0-20 cm	2,88-4,58	2,19-3,51	1,45-2,36	2,75-3,89	2,07-3,24
0-50cm	2,19-3,23	1,87-2,95	1,30-2,11	2,19-3,08	1,27-2,30
0-100cm	1,35-2,04	1,13-1,77	0,92-1,46	1,23-1,94	1,04-1,48
Nitrogen, %					
0-20 cm	0,18-0,25	0,15-0,20	0,10-0,17	0,13-0,18	0,15-0,25
0-50 cm	0,12-0,20	0,10-0,17	0,08-0,13	0,10-0,15	0,13-0,19
Phosphorus, %					

0-20 cm	0,15-0,27	0,17-0,23	0,15-0,20	0,15-0,22	0,14-0,25
0-50 cm	0,15-0,24	0,14-0,20	0,12-0,17	0,12-0,18	0,12-0,21
Sum of adsorbed bases, meq					
0-20 cm	25,20-36,83	22,68-30,27	23,19-27,47	26,38-33,46	21,93-27,80
0-50cm	22,26-36,40	21,94-31,50	22,05-28,02	23,16-31,71	20,88-26,51
pH, 0-100cm	7,2-8,2	7,5-8,2	8,0-8,4	7,9-8,4	7,8-8,1
$CaCO_3$, %,	7,57-14,05	8,16-18,91	8,5-22,84	5,46-15,52	4,3-8,55
Hygroscopic humidity, %	3,5-5,1	3,2-4,9	3,2-4,0	4,0-5,5	3,5-4,2
Dry residue, %	0,08-0,12	0,10-0,18	0,10-0,22	0,12-0,29	0,12-0,20

Dark gray-brown soils are well supplied with absorbed bases: their amount ranges from 22.26 to 36.40 meq per 0-50 cm. The mechanical composition of dark gray-brown soils is light clayey and heavy loamy and ranges from 42.92 -56.68% in the layer 0-100 cm, in the middle part of the profile there are signs of claying, in the plow and subplow layer is well aggregated. The reaction of the soil solution is neutral in places, slightly alkaline and alkaline in places, and varies within pH 7.2-8.2 (Table 1). The presence of dry residue in the amount of 0.08-0.12% in 0-100 cm indicates that the soil is not saline, only the amount of salt increases in the deep layers.

Ordinary gray-brown soils occupy areas along the foothills of the Lesser Caucasus. Ordinary gray-brown soils were formed on soft deluvial carbonate, sometimes solonchak loams, where wormwood -ephemeral cenoses develop. According to their morphological characteristics and physicochemical properties, these soils are very close to dark gray-brown ones. The color of the soil layer is slightly light, which is associated with a relatively low humus content, the amount of humus in the upper layer is 2.19-3.51%, a gradual decrease is observed towards the lower layers: 1.13-1.77% (Soil research materials of Goygol Regional Center of Agrarian Services Agency, 2022). The amount of total nitrogen and total phosphorus varies in a half-meter layer as follows: 0.10-0.17% and 0.14-0.20%. The absorption capacity of ordinary gray-brown soils is correspondingly lower than that of dark soils: 22.68-30.27 meq in the 0-20 cm layer and gradually decreases towards the lower layers - 21.94-31.50 meq. The granulometric composition of ordinary gray-brown soils ranges from 42.8 to 59.48%, depending on the parent rocks. The middle part of the profile is characterized by a significant increase in dust fractions; the amount of dusty particles ranges from 19.40 to 26.28%. These soils are alkaline, pH ranges from 7.5-8.2. The amount of easily soluble salts in the upper layer of ordinary gray-brown soils ranges from 0.10-0.18%, which indicates signs of weak salinization in the lower layers.

Ecological assessment of soils under the vineyards of the Ganja-Gazakh zone

Mammadov (1988), when conducting an environmental assessment of agricultural and forest lands in Azerbaijan, compiled special rating scales and assessed the variability of the selected indicators with such conditional expressions as “good”, “average”, “sufficient”. Professor Mammadova (2006) improved the methodology of academician Mamedov, where the main scientific innovation was the use of calculated environmental scores, rather than expressions, in the environmental assessment of soils.

Studies on the environmental assessment of soils under the vineyards of the Ganja-Gazakh zone were carried out according to the method of Mammadova (2014):

1. First of all, environmental factors that affect the productivity of grapes cultivated on the soils of the Ganja-Gazakh zone are identified and characterized.

2. A qualitative assessment of soils favorable for grapes in the Ganja-Gazakh zone was carried out, and the quality scores of soil subtypes were determined.

3. Taking into account the ecological needs of the grape plant to the soils of the Ganja-Gazakh zone, special evaluation scales have been developed according to the degree of manifestation of the individual characteristics of the soil.

4. An ecological assessment of soils suitable for growing grapes in the Ganja-Gazakh zone was carried out and a map was drawn up.

Based on the methodology, we have compiled scales that allow us to assess the compatibility of soils in the Ganja-Gazakh zone with the environmental requirements of a grape plant (Table 2).

Ecological score of soils under the vineyards of the Ganja-Gazakh zone were calculated for three groups of indicators:

1. Environmental factors (height (m), sum of active temperatures (^{0}C), precipitation (mm), humidity index (Md));

2. Soil quality scores calculated on the basis of such indicators as the stock of humus, nitrogen, phosphorus (t/ha) and the sum of absorbed bases (meq);

3. Indicators of other soil properties that are not reflected in the quality score (pH, mechanical composition, amount of dry residue, amount of carbonates, etc.).

Based on the above three groups of indicators, environmental scores were calculated in accordance with the environmental requirements of grapes cultivated on the soils of the Ganja-Gazakh zone (Table 3). As can be seen from Table. 3, there are 12 types and subtypes of soils in the region, of which dark gray-brown (94 points), gray-brown and brown-meadow (92 points) soils received the highest ecological scores. The main limiting factors for the cultivation of grapes for the soils of the foothill zone of the study area are the amount of clay particles (80 points), lack of precipitation (90 points), lack of carbonates for dark mountain-brown and steppe mountain-brown soils (90 points) and the level of soil fertility below optimal (score 74-82). However, the complex influence of soil-climatic indicators led to an increase in the ecological score of soils in the steppe zone compared to the quality score.

Table 2.

Scales for a special assessment of soils according to the degree of manifestation of their individual characteristics

According to the pH index

Indicators	Evaluation, score
6,0-6,5	70
6,5-7,0	90
7,0-7,5	100
7,5-8,0	100
8,0-8,5	100
8,5-9,0	80

According to the degree of salinity

Indicators	Evaluation, score
<0,10	100
0,10-0,25	80
0,25-0,50	70
0,50-1,00	40
1,00-2,00	< 20

According to the amount of waterproof aggregates

Indicators	Evaluation, score
70-80	100
60-70	95
50-60	90
40-50	70
30-40	60
20-30	40

According to the granulometric composition

Indicators	Evaluation, score
20-30	70
30-40	90
40-50	100
50-60	80

According to the amount of $CaCO_3$

Indicators	Evaluation, score
5-10	70
10-15	90
15-20	100
20-25	100
25-30	95

According to the altitude of the area

Indicators	Evaluation, score
1000-1500	40
500-1000	80
200-500	100
>28-200	100

According to the amount of precipitation

Indicators	Evaluation, score
<200	<50
200-300	80
300-500	90
500-700	100
700-1200	60

According to the Md index

Indicators	Evaluation, score
<0,10	<30
0,10-0,25	70
0,15-0,25	90
0,25-0,35	100
0,35-0,45	80

The soils of the plain zone have the widest distribution area and include 8 soil types and subtypes. There are dark gray-brown soils with the highest environmental rating in the region (94 points). If we look at the fertility indicators, we will see that the soils of this zone have an average fertility (63-78 bonitet points), with the exception of dark gray-brown soils. Among the environmental factors for growing grapes in this area, we see a lack of precipitation (70-80 points), dryness of the climate (Md index - 80 points) and a sum of active temperatures somewhat less than optimal (95 points), among soil factors as the main limiting factor can be name the process of salinization (80 points) and the heavy mechanical composition of soils (90 points).

The lack of carbonates is manifested only in gray-brown meadow soils (80 points). It should be noted that gray (63 points) and gray-brown gaja (64 points) soils with a low level of fertility received high environmental scores (86 and 88 points, respectively), this is explained by the fact that indicators such as the height of the area, the amount of $CaCO_3$ and the pH index were optimal for these soils (100 points).

Table 3.

Ecological assessment of soils under the vineyards of the Ganja-Gazakh zone

Soils	Hight, m	$\sum T > 10^0C$	Precipitation, mm	Md indicator	Bonitet score of soil	pH	<0,01 mm,%	$CaCO_3$,%	Dry residue, %	Ecological score
Steppe mountain-brown	300-400 / 100	3500-3800 / 95	400-500 / 90	0,25-0.30 / 100	80	7,8-8,3 / 100	45,28-60,40 / 80	11,86-16,93 / 90	---	91
Dark mountain-gray-brown	300-400 / 100	3500-3800 / 95	400-500 / 90	0,25-0.30 / 100	82	7,5-8,1 / 100	43,86-61,48 / 80	8,92-13,75 / 90	---	92
Ordinary mountain-gray-brown	200-400 / 100	3800-4000 / 95	400-450 / 90	0,20-0.25 / 90	79	7,8-8,3 / 100	44,68-62,72 / 80	12,52-22,08 / 100	---	91
Light mountain-gray-brown	200-300 / 100	3800-4200 / 95	350-400 / 90	0,15-0,25 / 90	74	8,0-8,6 / 90	44,40-64,80 / 80	16,76-23,48 / 100	---	90
Gray-meadow	200-400 / 90	4000-4300 / 95	300-400 / 100	0,15-0,20 / 90	81	7,7-8,1 / 100	43,26-61,12 / 90	11,23-17,89 / 100	0,10-0,15 / 90	92
Dark gray-brown	200-300 / 90	4000-4500 / 95	300-400 / 100	0,15-0,20 / 90	90	8,0-8,3 / 100	43,96-61,36 / 90	10,39-18,10 / 100	0,08-0,18 / 90	94
Ordinary gray-brown	200-300 / 90	4200-4500 / 95	300-400 / 100	0,15-0,20 / 90	74	8,0-8,3 / 100	45,24-63,76 / 90	10,80-20,41 / 100	0,10-0,38 / 80	91
Light gray-brown	200-250 / 90	4300-4700 / 95	250-300 / 80	0,10-0,15 / 80	66	8,0-8,4 / 100	46,68-66,08 / 90	13,50-24,63 / 100	0,17-0,53 / 80	87
Gray-brown gaja	200-250 / 90	4200-4500 / 95	250-300 / 80	0,10-0,15 / 80	64	8,0-8,3 / 100	42,71-60,38 / 90	12,55-21,17 / 100	0,15-0,25 / 90	88
Gray-brown meadow	100-200 / 100	4300-4700 / 95	250-300 / 80	0,10-0,15 / 80	78	7,9-8,4 / 100	47,20-61,43 / 90	5,46-15,52 / 80	0,12-0,29 / 90	88
Gray	50-100 / 100	4500-4800 / 95	150-250 / 70	0,10-0,15 / 80	63	8,0-8,5 / 100	47,18-65,10 / 90	10,93-23,26 / 100	0,18-0,45 / 80	86
Light meadow-gray	50-100 / 100	4500-4800 / 95	150-250 / 70	0,10-0,15 / 80	68	7,9-8,5 / 100	48,25-59,12 / 90	11,54-19,03 / 100	0,18-0,32 / 80	87

CONCLUSION

1. Taking into account the soil-climatic-relief conditions of the Ganja-Gazakh zone, environmental factors influencing the productivity of a grape plant were identified and characterized; for this, scales for a special assessment of soils favorable for the cultivation of grapes according to the degree of manifestation of their individual characteristics have been developed. The ecological scores of the soils of the Ganja-Gazakh zone are calculated according to the ecological requirements of the grape plant. The highest ecological scores were obtained by dark gray-brown (94 points), gray-brown and brown-meadow (92 points) soils. Gray soils have the lowest ecological score - 86 points.
2. It was determined that the main limiting factors for the cultivation of grapes on the soils of the foothill zone of the study area are soil clay content, the sum of active temperatures is less than optimal, and the lack of carbonates; for the soils of the plain zone are the lack of precipitation, dry climate, salinity of the soil, heavy mechanical composition of the soil and the level of soil fertility below the optimum.

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CONTRIBUTION TO HEALTH OF THE ENVIRONMENT AND THE USE OF ORGANIC WASTE TO INCREASE SOIL FERTILITY IN AZERBAIJAN

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The use of organic waste in the form of biofertilizers for various crops in Azerbaijan is very relevant. At the same time, the problem of maintaining soil fertility is solved, taking into account environmental protection, when waste from the source of its pollution is converted into fertilizer valuable for plants. One such biofertilizer is manure. Under natural conditions, manure decomposes into humus, water, carbon dioxide, nitrogen, methane and ammonia. Gas is released into the atmosphere, and part of the water, under the influence of gravity, goes into the soil along with helminths and pathogens. At any time, the activity of pathogenic flora may increase, which will infect nearby plants. That is why it is impossible to throw away fresh manure without processing, which will direct the chemical processes in the right direction. Use as organic fertilizers - manure, safe in hygienic and veterinary and sanitary terms. It should be free of pathogens, weed seeds, heavy metals and pesticides in excess of the norm. After 8–12 months after formation, it loses its dangerous qualities. This property is used for natural disinfection. Manure storage facilities should be organized in such a way that harmful substances do not enter the soil and rivers, so that gas emissions into the atmosphere are minimal. During storage, manure goes through several stages and, depending on this, has different properties: fresh - inhibits the growth of crops, damages the roots, since it contains weed seeds, fungal spores, helminth eggs; semi-rotted - can only be used in the form of an aqueous solution, for example, during autumn digging; well-rotted - loose and light, suitable for fertilizing the soil in spring during digging; humus is the most useful organic fertilizer, which is used as a mulch and as a component of soil mixtures. Mulch is covering the soil between plants with sawdust, straw, small stones, fallen leaves. In its functions, it resembles the forest floor, which overheats and becomes humus.

Key words: *fertility, environmental protection, biofertilizers, manure, soil mix, mulch, vermicompost, earthworms.*

INTRODUCTION

Increasing the yield of all agricultural crops depends on the degree of soil fertility, which in turn depends on the potential of humus and nitrogen. Humus serves as a source of nutrients (nitrogen, phosphorus, potassium, sulfur, etc.) for agricultural crops and at the same time affects the physical, water-physical and agrochemical properties of the soil. One should first of all pay special attention to providing the soil with organic matter when evaluating soil fertility. The decisive importance of organic matter is confirmed by the fact that without its application for several years there is a significant reduction in yields. Therefore, in order to preserve soil fertility and obtain high yields of cultivated crops, it is necessary to use organic fertilizers. Manure is the main organic fertilizer. With the systematic introduction of manure, approximately 75% of this fertilizer is completely mineralized, 25% replenishes humus reserves in the soil [1, pp.43-47, 134-135, 2, p.520].

However, at present, the limited amount of manure in Azerbaijan (only 2.5-3 tons per 1 hectare at a rate of 10-12 tons) does not make up for all the soil's need for organic matter. Therefore, it became necessary to use organic waste, which can replace and even surpass the traditional fertilizer - manure. In Azerbaijan, a large amount of such waste has been identified, which, accumulating in many places and remaining unused, pollute the environment. These include: urban household waste - 1 million 400 thousand tons, tops and remains of agricultural plants - 720 thousand tons, forest litter (including litter from urban greening) - 180 thousand tons, waste from industrial processing of agricultural products and chemical factories - 320 thousand tons, waste from tea and vineyards - 117 thousand tons, sewage sludge - 500 thousand tons, sewage sludge - 1 million 200 thousand tons, etc. (table).

Analyzes revealed in the composition of all wastes the content of about 209 thousand tons of pure nitrogen, 110 thousand tons of pure phosphorus, 240 thousand tons of pure potassium, 6 million tons of organic matter and 5 million tons of ash, a significant amount of trace elements and beneficial microorganisms [2 , pr.520].

Therefore, the use of these wastes is considered appropriate to maintain soil fertility and partially solve environmental pollution.

Bio-Maks is an extract from the waste products of worms and soil microorganisms. It contains a certain amount of free amino acids. The content of humic acids in the working solution is less than 5 g/l. Humic substances are extracted from vermicomposts. The preparation "BİOMAKS" differs from other similar preparations in that the concentration of humic substances is increased by 10 times, a number of macroelements (N,P,K) and microelements (Mg, S, Fe, B, Mn, Cu, Mo, Zn). The drug contains the components of vermicompost in a dissolved and physiologically active state. The bactericidal and fungicidal properties of the drug are due to the presence of bacteriostatic proteins secreted by the tissues of the worm sprinkling itself, and antibiotics secreted by the saprophytic microflora of the earthworm intestine during the process of vermicom-building. With foliar treatment, the productivity of cultivated plants increases, which can be explained by the many influences of humic substances on the physiological and biochemical processes of agricultural crops.

In connection with the foregoing, in this work, we set the goal of studying the effectiveness of organic waste and the BİOMAKS preparation on soil fertility, productivity and quality indicators of soils in Azerbaijan.

MATERIALS AND METHODS

Based on the available stocks of organic waste in various zones of the Republic, biofertilizers were prepared by biological conversion, named according to the zone of their preparation. The mechanical and chemical composition of biofertilizers has been studied, studies are being carried out to identify their effectiveness for various agricultural crops in various soil and climatic conditions of Azerbaijan [3, pp.43-44].

Table 1

Organic wastes common in the Republic of Azerbaijan and the content of nutrients necessary for plants in them

№	Waste names	Amount of waste (thousand tons)	The content of waste mineral nutrients (NPK) in pure form (thousand tons)				
			N	P	K	Total content of mineral elements	Organic matter
1	Manure	9000	62,1	27,0	90,0	179,1	2160,0
2	Municipal waste	5600	28,0	21,3	43,7	93,0	1792,0
3	Peat	119	9,0	0,5	1,2	10,7	70,0
4	Plant residues	837	10,8	4,2	24,3	39,3	293,0
5	Industrial waste	476,5	5,3	5,7	13,3	24,3	133,4
6	Sewage sludge	1200	8,4	4,8	30,0	43,2	432,0
7	Forest litter, including litter from urban greening	170	3,7	1,0	4,6	9,3	61,2
8	Silts of freshwater reservoirs	4400	48,4	10,1	4,4	62,9	1408,0
9	Green manure crops	20	0,12	0,026	0,082	0,228	7,4
Total 21822,5			175,82	74,6	211,6	462,0	6357,0

Our research with the laying of field experiments was carried out in three zones of the Republic - Shirvan (the effect of the compost "Shirvan" was tested on meadow-forest soil under cotton), Lankaran (the effect of compost "Lankaran" on yellow earth-podzolic soil under a tea plantation) and

Absheron (effect of Absheron compost on gray-brown soil under almond culture). The chemical composition of composts was determined according to generally accepted methods in laboratory conditions. In the soil samples selected for analysis, the content of humus was determined by the Tyurin method, ammonium nitrogen-photocolorimetric method with Nessler's reagent, mobile phosphorus - according to Machigin and Kirsanov, exchangeable potassium - according to Maslova [4, pp.512].

Shirvan compost, which included manure (60%), cannery waste (10%), tops of agricultural crops (10%), bird droppings (10%), forest litter (6%), simple superphosphate (2%), ammonium sulfate (2%) with the chemical composition: N-1.30, P_2O_5 -0.82, K_2O-1.02, organic matter -41% was tested at a dose of 30 t/ha on gray-meadow soil under cotton [5, pp. 139-143]. It was found that during the period of mass budding of cotton, there is an increase in the content of forms of basic microelements available to plants and a slight increase in humus in the arable soil layer. Thus, the amount of ammonia nitrogen increased by 8.1 (in control 16.5), mobile phosphorus - by 7.5 (in control 22.0), exchangeable potassium - by 125.0 (in control 275.0) mg/kg soil. The increase in humus was 0.09% (2.0 in the control).

Lankaran compost, which included manure (50%), waste from a tea plantation and vegetable crops (38%), bird droppings (10%), simple superphosphate (1%), ammonium sulfate (0.5%), complex organo-mineral microfertilizer (0.5%) with the chemical composition: N-1.36, P_2O_5- 0,65, K_2O-1,34, organic matter-27.7% was tested at a dose of 30 t/ha on yellow earth-podzolic soil under tea culture The results of the experiment revealed an increase in the amount of ammonia nitrogen, mobile phosphorus and exchangeable potassium in the arable soil layer in the middle of the tea plant growing season by 35.0, 79.1 and 24 mg/kg of soil, respectively.

BİOMAX "Absheron", which included solid household waste (40%), sewage sludge (30%), manure (10%), crop residues (15%), ash (3%), complex organo-mineral microfertilizer: N -1.95, P_2O_5 -1.37, K_2O-1.63, organic matter -24.0%, tested at a dose of 30 t/ha on gray-brown soil under almonds [1, pp.43-47, 134 -135]. Studies have shown that in the growth phase of almond fruits, there is an increase in the content of forms of basic microelements available to plants and a slight increase in humus in the arable soil layer. Thus, the amount of ammonia nitrogen increased by 10.4 (in control 24.5), mobile phosphorus - by 8.8 (in control 20.0), exchangeable potassium - by 125.0 (in control 280.0) mg/kg soil. the increase in humus was 0.12% (in the control 1.31%).

The preparation of bio-fertilizer from organic waste and their use in various zones of Azerbaijan for agricultural crops in order to maintain and increase soil fertility has yielded positive results. An increase in the content of forms of basic microelements (NPK) and humus available to plants in the soil was revealed. At the same time, the efficient use of organic waste undoubtedly makes a significant contribution to the improvement of the environment.

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LAND RECLAMATION OF TECHNOGENEOUSLY POLLUTED MELIORATED AGRICULTURAL LANDSCAPES IN BELARUS

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The article presents the results of research on the reclamation of technogenically polluted lands. The influence of irrigation on the ecological state of reclaimed agricultural landscapes is shown. The equation for predicting groundwater pollution is given, the design of a gravitational-biological sump for water purification in a hydrographic network is described.

Keywords. *Land reclamation, technogenic pollution, agro-landscape, removal of nutrients, water quality, gravitational-biological sump.*

INTRODUCTION

Rational and careful use of lands, preservation and increase of their fertility largely determine the solution of the global problem - provision of the population with food. Reclaimed lands in the Republic of Belarus make a significant contribution to the production of crops and strengthening the fodder base of livestock. A significant part of these lands is located in the zone of intense technogenic impact. The analysis of literature showed that in order to increase the environmental sustainability of reclaimed agro landscapes and to create conditions for obtaining environmentally friendly crop products in conditions of technogenic pollution, it is necessary to use land reclamation technologies [1, 2, 3]. Therefore, land reclamation measures are based on the assessment of the level of loss of the quality of the ecological system, due to the productivity decrease and deterioration of the product quality. In [2], it is recommended to distinguish the following levels of functioning of agro landscapes: normal, acceptable, critical.

The normal level is characterized by the content of ecotoxicants not exceeding background concentrations. At the same time, in order to obtain the planned crop yields of good quality, it is necessary to develop science-based fertilization systems aimed at increasing the fertility of reclaimed lands. To increase the humus content, or at least to reduce the negative balance of organic matter, it is necessary to use local fertilizers (manure, straw, composts, etc.). At the same time, reclamation measures should be carried out in the system of adapted crop rotations, and to provide for the regulation of the water regime of soils, taking into account the biological characteristics of crops.

The need to regulate the water regime is due to the fact that an increase in the concentration of heavy metals (HM) in plants with an increase in the degree of soil hydromorphism is explained by an increase in acidity, deterioration of other properties. This ultimately leads to a decrease in the productivity of plants, affects the processes of absorption of toxicants by them [4].

RESEARCH METHODOLOGY AND MATERIALS

The methodological basis for conducting research and subsequent analysis of the results was the consideration of the processes in the "soil - water - plants" system as a result of anthropogenic activity.

The study of the behavior of pollutants in the "soil - water - plants" system was carried out using physical modeling methods in the field. Field, production experiments and work on implementation were carried out on large irrigation systems of the Republican Unitary Enterprise of "Zadneprovsky" and the agricultural complex "Yubileiny" of the Orsha district of the Vitebsk region. Laboratory experiments, as well as analytical studies, were carried out according to standard methods. Processing of experimental data was carried out using the methods of pair and multiple correlation, analysis of variance using computer technology.

RESULTS AND DISCUSSIONS

The reclamation system, through which the management of the water regime is carried out, should include elements that ensure the discharge of excess water, as well as the supply of the additional amount of it during dry periods. For this purpose, drainage and irrigation systems with the use of sprinkling are most suitable. The latter affect the water regime of the upper 0.5-meter soil layer, provided that irrigation is carried out without violating the technological regulations. A mandatory element of the reclamation system should also include special water protection structures. First of all, they should be aimed at the purification of waste polluted waters.

At the acceptable level of the ecosystem functioning, the toxic effect of trace elements and heavy metals is manifested. Signs of this are a decrease in crop yields and deterioration in product quality. The level of soil pollution is approaching a critical value, and the content of ecotoxicants in plants reaches the maximum permissible concentrations. In this situation, first of all, it is necessary to identify sources of pollution and develop a system of measures to restore disturbed soil fertility. The main measures to reduce or prevent pollution should be based primarily on the improvement of production technology, the creation of closed technological systems. When cultivating crops in agricultural landscapes with an acceptable level of pollution, it is necessary to organize control over the content of heavy metals in products. Since mobile HM forms are the most dangerous, it is necessary to use techniques that can convert their soluble forms into hardly soluble and inaccessible to plants. In this case, various methods can be applied, adapted both to specific pollutant elements and soil conditions.

So, for example, in the neutral environment, copper and nickel become practically harmless. With a decrease in the acidity of the soil solution, the solubility and mobility of cadmium and lead decrease, and their consumption by plants decreases. The same is true about zinc and arsenic [1,5].

The interaction of salts of heavy metals with soil organic matter contributes to the formation of salts of humic acids and the involvement of metals in complex compounds that are inaccessible to plants. Agronomic measures carried out on contaminated lands should increase the humus content. Therefore, the application of manure, composts based on the solid fraction of wastewater is of fundamental importance. For this purpose compost preparation technology can be recommended. It should be noted that the components of the compost are a good substrate for the development of the California worm. Therefore, when implementing this method, it is possible to obtain biohumus - a valuable organic fertilizer with high environmental characteristics. A good effect was obtained in our experiments with the introduction of straw on the background of irrigation with wastewater from a pig-breeding complex.

The production experiment was carried out on the area of 90 hectares. In the course of the experiment, it was found out that the introduction of straw contributed to the decrease in the mobility of the studied heavy metals. Moreover, the degree of mobility depended on the dose of the applied straw, and the greatest efficiency took place in the third year after the introduction.

One of the methods that ensure the production of environmentally friendly products on contaminated lands is the application of biological methods. At the acceptable level of ecosystem functioning, tolerant varieties and crops should be grown. At the same time, it should be taken into account that the roots are the most contaminated, then the leaves, stems, and the seeds. Contaminated areas should be used only for growing seeds, cultivating technical, as well as crops that will be processed.

The removal of pollutants with plant products contributes to its self-purification. The experimental data of simulated soil pollution, as well as the results of studies [6], indicate that with an increase of soil pollution with heavy metals, their removal by the crop also increases. That's why, methods of soil phytosanation can be recommended. They are based on the ability of some plants to absorb significant amounts of ecotoxicants from the soil. At the same time, it should be noted that when obtaining the dependence of the total removal of HMs on the degree of soil contamination, it is necessary to link the calculated periods for determining the removal by crops with the calculated periods for determining the removal by lysimetric waters. It is also possible to use separate dependences of HM removal by lysimetric waters and yield using the following equation:

$$N = \frac{\kappa(в - a)^2}{\kappa\int_a^в f(x)dx + \int_a^в f_1(x)dx} \quad (1)$$

where Y=f(x) is an equation characterizing the removal of HMs from the soil by lysimetric waters; Y=f1(x) equation of HM removal from soil by crop; K - the ratio of the duration of the settlement periods used in obtaining equations of the form Y \u003d f (x) and Y \u003d f1 (x).

The parameter N in the above equation represents the number of periods required to reduce soil pollution from the value of в to a.

Thus, knowing the duration of periods N and their average annual distribution, it is possible to determine the time required to reduce soil pollution to the required value.

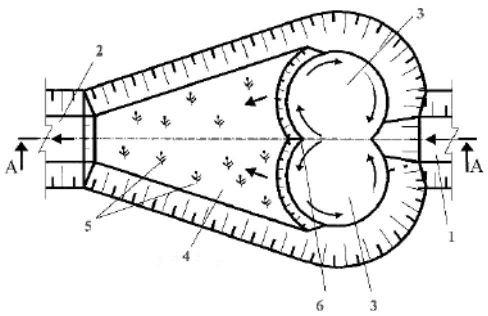
At the critical level of the agro landscape functioning, the crop yields drop sharply up to complete failure. In this case the content of heavy metals exceeds the maximum allowable concentrations. From the standpoint of environmental safety, it is legitimate to speak of agricultural use of such lands without radical recultivation.

The most effective way to eliminate the consequences of pollution is the removal of metals from the root layer of the soil. In this case, two main technologies are possible: mechanical removal of the contaminated soil layer and displacement of the contaminated layer into the soil horizons underlying the root layer. The latter technique is used most often and is carried out by deep plowing with plantation plows.

As noted above, conservation measures should be carried out on reclaimed landscapes. Land reclamation systems should contain environmental structures aimed primarily at treating polluted waters, surface and drainage runoff. This runoff is polluted as a result of applying fertilizers, herbicides, etc. to the field, which are partially washed out of the soil and washed off its surface. As a result, contamination of not only the reclaimed area, but also the water intake and adjacent territories is possible.

For post-treatment of return water, various facilities are used - bio-sites, filter ponds, bio-channels, biological sedimentation tanks, etc.

The sump can have various design features. The figure schematically shows the design of a gravitational-biological sump. It is arranged on the channel and consists of two sections.



Schematic diagram of a symmetrical gravitational-biological sump:
1 – inlet part; 2 - output part; 3 - the first section (gravitational cleaning); 4 - the second section (biological treatment); 5 - macrophytes; 6 - jet separating face.

The principle of sump performance is as follows. Polluted effluent from the canal enters the first section of the sump. Due to a sharp increase in the area of the flow cross section, the speed of water movement decreases, and suspended solids fall to the bottom. Moreover, during the movement of water along the first section of the sump, the flow is deflected to the sides by the jet separating face. There is a slow circular motion of water. The path of its passage through the first section of the settler is significantly increased, which contributes to a more complete precipitation of suspended particles.

As the first section is filled, the upper (most purified) layer of water overflows through the jet-separating edge and enters the second section with macrophytes, where biological water purification takes place.

The area F occupied by macrophytes is determined from the ratio

$$F = \frac{W \times (C_i - ПДК_i)}{V_i}, \quad (2)$$

where W is the volume of treated water, m^3; C_i is the concentration of the i-th pollutant in the treated water, g/м^3; $ПДК_i$ – maximum allowable concentration of the i-th element, g/m^3; Vi is the cleaning ability of macrophytes to remove the i-th pollutant in the treated water, g/m^2.

Calculations are carried out for all pollutants whose concentrations exceed the $ПДК_i$. The largest is taken as the calculated area.

Tests of a biological sedimentation tank as part of the reclamation system in Belarus and in the Ryazan region of the Russian Federation showed a high degree of purification of polluted waters, which averaged 70.0-88.2%.

Conclusion. The recommended technologies make it possible to control the process of migration of pollutant elements in the soil-plant-groundwater system and significantly improve the ecological situation in reclaimed agricultural landscapes.

To increase the environmental sustainability of reclaimed agrolandscapes under the conditions of technogenic pollution, it is necessary to construct special water circulation reclamation systems. They should be used to monitor studies to identify sources of pollution and types of pollutants.

With a normal level of soil pollution, the system of measures should first of all contribute to reducing the impact of pollution sources and the use of a scientifically based fertilizer system aimed at increasing soil fertility and crop yields.

At an acceptable level, in order to reduce the HM mobility, it is recommended to carry out liming of the soil, as well as the introduction of manure or composts based on it.

At a critical level of soil pollution of the agrolandscape, the system of measures should include deep plowing of the upper soil horizon, liming of the soil, as well as the introduction of manure or composts based on it.

When organizing fertigation with runoff, the area must be carefully planned to prevent the accumulation of irrigation fluid in micro depressions in order to exclude waterlogging of the soil, which affects the behavior of ecotoxicants. It is recommended to carry out reclamation treatment of the turf to prevent surface runoff,

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APPLICATION FEATURES OF GIS TECHNOLOGIES IN ECOLOGICAL MAPPING

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During the last decades, the active industrial activity in the world has made the ecological situation even more complicated, and therefore the monitoring of the state of the natural environment should be carried out with more and more sophisticated methods. The need of human society to monitor the ecological state of the environment led to the development of a new field of thematic cartography - ecological mapping. The diversity of the thematic content of ecological maps is related to their field of practical application (biological, geological, medical, social sciences, etc.). In ecological maps, the Earth's crust plays an important role, as objects located on the Earth's surface are the main environmental elements. The Earth's crust is a complex multicomponent system, a factor that determines the shape and state of other components, because the objects here interact with each other. Therefore, ecological mapping is one of the main means of establishing relationships between natural elements and graphic modeling of the natural environment to solve the problems of regulated nature use. In modern times, geographical information systems are one of the widely used tools of mapping.

Keywords: *ecology, environment, geoinformation, modeling, GIS, information*

INTRODUCTION

Currently, the methodology and principles of creating ecological-geographical maps have not yet been fully developed. Therefore, it is one of the urgent issues to analyze and revise such issues. There are different approaches to the consistency of the content of ecological-geographical maps: the cartographer is obliged to pay attention not only to the features of the object, but also to the relationship between the object (or objects) and the environment. Any processes occurring on the surface of the earth can be presented as a complex of interactions of various elements of the environment. Therefore, the most accurate and detailed analysis requires simultaneous observation of many parameters. This means environmental mapping with the ability to display several parameters on the maps at the same time. The difficulty lies in finding the correct systems selected from all possible ecological relationships.

The recent ecological situation creates new problems for cartography. To solve them, modern geoinformation support is required, which allows to quickly react to any changes in the environment.

The first maps based on CIS technologies were compiled in the 90s of the XX century. During that period, significant work was started on the conversion of similar data from general geographic, topographic and thematic maps into digital form. At the same time, original computer maps were developed and created in geoinformation centers, as well as in relevant specialized organizations and departments. These are computer thematic maps that accompany many environmental studies, programs, and projects. In the last decade, geoinformation systems with environmental content are developing rapidly. Most of them have a practical orientation, combining several mutually agreed maps and multidisciplinary databases. This allows for quick analysis of the environmental situation and prompt and effective decision-making.

Ecological GIS is prepared both for administrative-territorial units (regions, large industrial centers, administrative districts) and for local objects that are environmentally problematic (mining and oil and gas production enterprises). This type of CIS includes:

- automated cartographic systems;
- cartographic databases;
- analytical and modeling blocks.

In general, the following can be attributed to the main features of geoinformation mapping:

- automation;
- sequence;

- goal orientation;
- effectiveness;
- multivariate.

Geoinformation mapping is distinguished primarily by the systematic, consistent creation and use of maps aimed at specific management tasks. The structure, content and plots of maps in GIS are diverse. The software used in their design reflects the objectivity of knowledge about the mapped object and the technical capabilities of the working specialist.

The use of GIS is especially effective in ecological and geographical mapping of cities. Because the city is a special ecological system that differs not only by the concentration and composition of pollution, but also by many parameters. This requires the creation of a unified system of all types of pollution and their impact on society. GIS is increasingly used to monitor the environmental condition of cities, which allows creating a dynamic system that can process large volumes of spatial and attributive data and present it in the form required by the end user. GIS can be used to develop science-based recommendations for ecologically oriented nature management:

- environmental protection measures, including limiting and stopping certain impacts on the urban environment and population.
- according to the environmental expertise of the construction of various objects and development projects of the city area;
- for making decisions in the management activity of city and district environmental structures;
- for the planning and implementation of various economic, medical, sanitary, environmental measures, as well as for solving scientific and educational problems.

At the modern stage of development, geoinformation ecological maps are systems that can be used for both the production of printed atlases and the creation of GIS aimed at monitoring the environmental situation and timely warning of problems. An example of this is the map "Pollution situation of the Absheron Peninsula" (Figure 1).

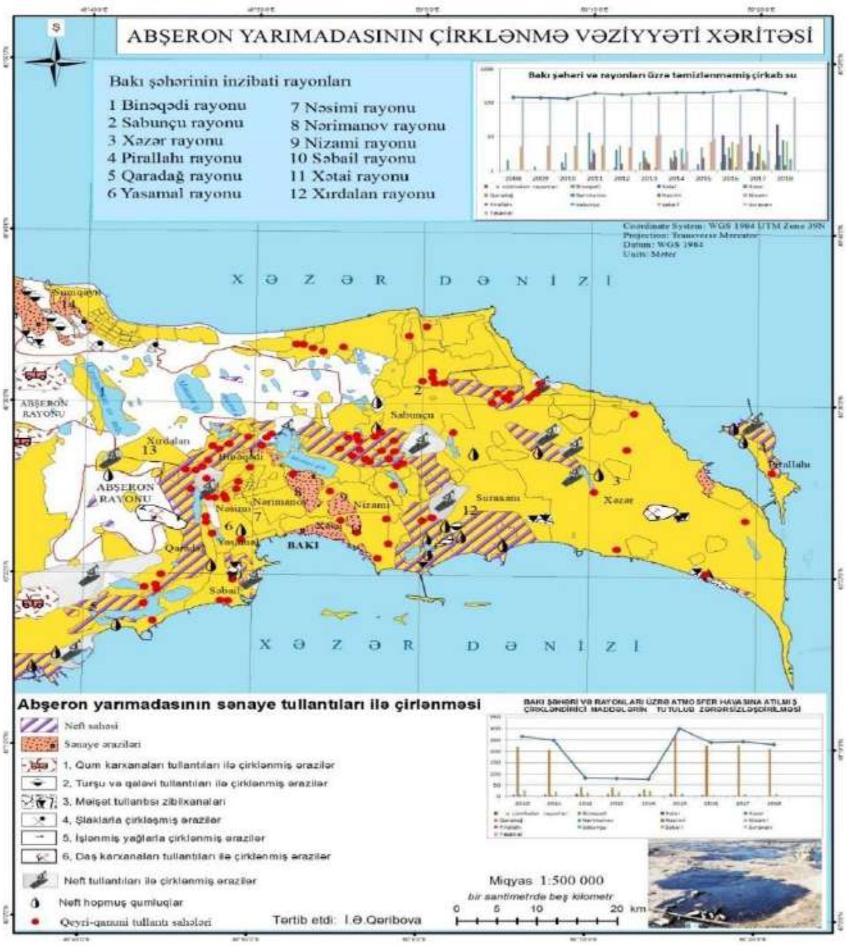

Figure 1. Absheron Peninsula pollution status map.

Within its framework, more than 10 thematic layers were created, such as the state of the natural environment, air pollution, the state of surface water bodies, the state of radiation, social-hygienic monitoring, and medical-ecological monitoring. During mapping, the framework part of the territory - geographical content, mathematical basis and other information was compiled based on Google Map, Go Map, stock materials, as well as images and data received from Landsat and other satellites. As a whole, the map was created with the application of GIS technologies (using ArcGIS 10.8 package-program produced by Esri (USA)) with modern mapping methods.

At the first stage, a cartographic base is prepared. It is a set of thematic layers, which firstly represent the initial data for modeling (location of pollution sources, topography, landscape), and secondly, the data necessary to analyze the results and obtain the final pollution map. At this stage, the dimensions of the area corresponding to the task are determined. A database on pollution sources is being prepared. The data is transferred to the map.

The second stage includes direct preparation for modeling. Because data on meteorological fields, topography, and subsurface properties are spatially inhomogeneous quantities, this type of spatially continuous data is discretized for numerical pollution simulations, usually performed on a regular grid. For this, the necessary information obtained as a result of the processing of the initial vector layers is presented in the form of a network - topics (grid). At this stage of data preparation, modern GIS tools are used to automate the processes of transformation and generalization of primary data on the map.

The third and final stage includes the calculation of the model. The calculated pollutant areas are presented in the form of certain conventional signs and areas. At this stage, the final processing of the results and the acquisition of maps for the assessment or prediction of pollution are carried out. Schematically, all these stages can be presented in the form of diagrams (Figure 2).

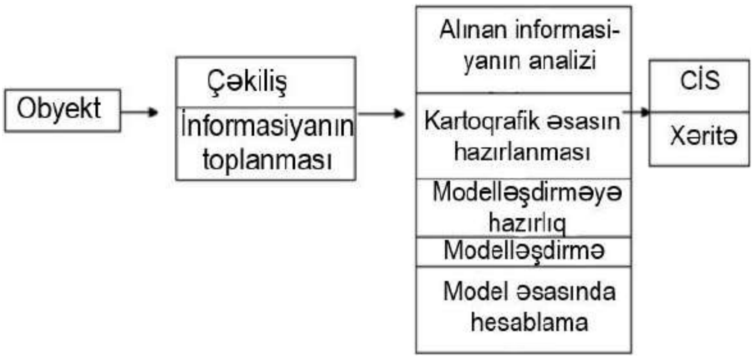

Figure 2. Stages of creating a geoinformation ecological map

The range of software products used for environmental mapping is very wide: Arc FM, Arc Info, ArcView (ESRI, Inc.), MapInfo Professional (MapInfo Corp.), MicroStation (Bentley Systems, Inc.), etc. According to the scale of application, they can be divided into general (multifunctional) and private, global, and local aimed at solving specific (single-functional) tasks. Currently, the leaders in the global GIS field are the products of two companies - the ArcGIS system of the American company ESRI and MapInfo of the INTERGRAPH corporation. In addition, many companies dealing with land ownership or land use issues are creating their own application GIS.

ArcView was developed by the Environmental Systems Research Institute (ESRI), maker of ARC/INFO, the leading geographic information systems (GIS) software. ArcView is rich with useful, ready-to-use databases.

MapInfo Professional is a full-featured geographic information system (a professional tool for creating, editing, and analyzing cartographic and spatial data). It integrates as a client into distributed information systems based on servers: MS SQL, Oracle, Informix, DB2, Sybase, etc. Map Basic programming language is used to develop specialized programs. It is used for land, forest and real estate cadasters, urban planning and architecture, telecommunications, oil and gas production and transportation, power grids, ecology, geology and geophysics, railway and road transport, banking, education, management purposes.

CONCLUSION

At the current stage of development of society for humans, it is vitally important to constantly monitor the environment, especially in ecologically unfavorable areas. Monitoring, drawing up the development dynamics of pollution, controlling the change of pollution areas, all this is carried out with the help of ecological mapping.

In the course of the work, the concept of "ecological mapping" was considered; different methods of mapping the state of the environment are considered; the software used for environmental mapping is briefly introduced; determined the areas of application of ecological mapping; Development ways and prospects of this industry are suggested using GIS.

Ecological mapping is a broad and promising field with a wide range of applications, especially in integration with GIS technologies. In the future, it is planned to apply the skills acquired during the research in the mapping of the ecological situation in Azerbaijan.

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BORON STATUS OF AGRICULTURAL SOILS IN ADIYAMAN-SAMSAT DISTRICT OF TURKIYE

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The aim of this study, which was carried out in the Samsat District of Adıyaman, Turkey, is to determine the available B content of agricultural soils and to investigate their relationship with other soil properties. For this purpose, 263 soil samples (0-20 cm) were taken from and analyzed. The available B content of the study area was 0.76 mg/kg on average, whereas the mod value was 0.83 mg/kg. As a result of the study, it was determined that there was a positive correlation between the available B results of the region's soils and organic matter, silt, available K-Fe-Cu-Zn and Mn, and a negative correlation with clay. It was determined that the B content available from the region's soils was less than 1 mg/kg in 87.08%. According to the determined results, no toxicity risk was observed in terms of boron element in soil samples.

Keywords: *Adıyaman province, Boron, Micro element, Soil Properties.*

INTRODUCTION

Bor has been stated that among the microelements, it is a non-metal, a neutral molecule that does not exist in the form of ions within wide pH limits, and is a micro nutrient in the form of H_3BO_3 and, slightly anion $B(OH)^-$ in the soil solution (Epstein and Blom, 2005). Boron is an essential element for plants, plays an important role in many metabolic events such as sugar transport, cell wall synthesis, lignification, carbohydrate metabolism, RNA metabolism, respiration, indole acetic acid synthesis (Parr and Loughman, 1983). Boron (B) is an element that is required by plants in trace amounts, and its deficiency and toxicity limits are very close to each other (Brown et al., 2002). Boron (B) is one of the eight essential plant micronutrients, also called trace elements, necessary for the normal growth of most plants (Weisany et al., 2013). Boron is an important micronutrient for its normal functions in many plants (Hussain et al., 2017). It increases the growth and yield of plants as it stimulates cell division and elongation and the development of cell walls. Boron plays an important role in carbohydrate and protein metabolism (Goldbach and Wimmer, 2007; Miwa et al. 2007). Boron also plays an important role in cell wall synthesis, sugar transport, cell division, cell differentiation, cell membrane functioning, root elongation, regulation of plant hormone levels, and generative growth of plants (Marschner, 1995). Boron management is difficult as the optimum B level is narrow (Gupta 1993) and optimum B application rates may differ from one soil to another (Gupta 1993; Marschner 1995). Both excess and deficiency of boron in the soil can adversely affect plant growth (Papadakis et al., 2004a). In general, plants absorb B mainly from the soil through roots in the form of boric acid. Boron then moves through the xylem to be distributed to different tissues or organs for use (Marschner et al., 1996; Takano et al., 2008). Boron deficiency can be triggered by poor soil conditions such as high pH and low organic matter content, and environmental factors such as drought, high temperature and light (Atique-ur-Rehman et al., 2018).

As it is known, boron is a plant nutrient element defined by Warington in 1923 (Marschner, 1995). Boundary ranges in soil and plant are very narrow. The toxic concentration, which may be harmful to plants, and the optimum value are very close to each other (Rashid and Ryan, 2004; Yau and Ryan, 2008). When the boron content in the soil is lower than 1 mg kg-1, there is a toxic effect for plants due to boron deficiency and when it exceeds 5 mg kg^{-1}, due to excess boron (Kelling, 2010). Therefore, boron deficiency and excess of plant nutrients can cause problems in plant production. Türkiye is the country with the largest boron reserves in the world. 66% of the world's total reserves are located in Turkey (Demirtaş, 2006). For this reason, the B content of the country's soils gains even more importance.

MATERIAL AND METHODS

The study area was conducted in the southeast region of Turkey. The material of the research consists of 263 soil samples taken from 0-20 cm depth in Adıyaman-Samsat (Figure 1).

Soil samples were air-dried and passed through 2 mm sieve. pH was measured in (1:2.5 soil: water) extract and soil salinity (EC, dS m^{-1}) was measured in 1:2.5 soil:water extracts. Organic matter (C_{org}) was determined with the use of Modified Walkler-Black method (Jackson, 1973). Lime was determined by the Scheibler calcimeter by volumetric (Schlichting and Blume, 1966). The grain size distribution of the soils was determined by the hydrometer method (Bouyoucos, 1962). The total nitrogen amounts of the soil samples are obtained by applying the Modified Macro Kjeldahl Method (Bremner, 1965). Available phosphorus was determined in accordance with Olsen method (Olsen and Dean, 1965). Soil available Na, K and Ca concentration were determined with the use of 1 N ammonium acetate extraction (NH4OAc, pH=7) (Pratt, 1965). Available Soil Fe, Cu, Zn and Mn were determined through the extractions with DTPA solution (Lindsay and Norvell, 1978) Contents of boron in soil samples were determined in filtration obtained with 0.05 M Mannitol + 0.01 M $CaCl_2$ solution (Cartwright, B. et al., 1983).

RESULTS AND DISCUSSION

When soil properties are examined according to the coefficients of variation, the most variability is seen in the available Na values (Table 1). Although high pH values are sometimes encountered in the region, the soils are generally slightly alkaline. When the available B is examined, it is seen that it varies between 0.13 and 1.85 mg kg^{-1} and is 0.76 mg kg^{-1} on average. Most of the soil samples (83.65%) contain between 0.4 and 1.0 mg kg^{-1} of B. Soils containing less than 0.4 mg kg^{-1} of B are 5.2%. The boron element concentration in soil samples differed according to the values (1.01-4.92) stated by Tepecik (2016), and it can be said that this is due to the soil properties. As a result of the study, it was determined that there was a positive correlation between the available B results of the region's soils and organic matter, silt, available K-Fe-Cu-Zn and Mn, and a negative correlation with clay (Table 2). It is stated that more B can be found in surface soils and organic matter applications can increase the amount of B and even cause phytotoxicity (Havlin et al., 2017). Budak and Günal (2015) found a negative significant correlation between available B and organic matter in their study. This situation is thought to be due to the unusual characteristics of the field they work in. It is reported that B availability decreases as pH> 6.5 increases and as Ca increases in the medium (Havlin et al., 2017). Considering that the soil reaction in the study area is alkaline and rich in Ca, the low available B values are considered to be compatible with each other. High sand content in soil samples may also be effective in lower available B values (Figure 2). B adsorption is expected less in coarse textured and well-drained soils.

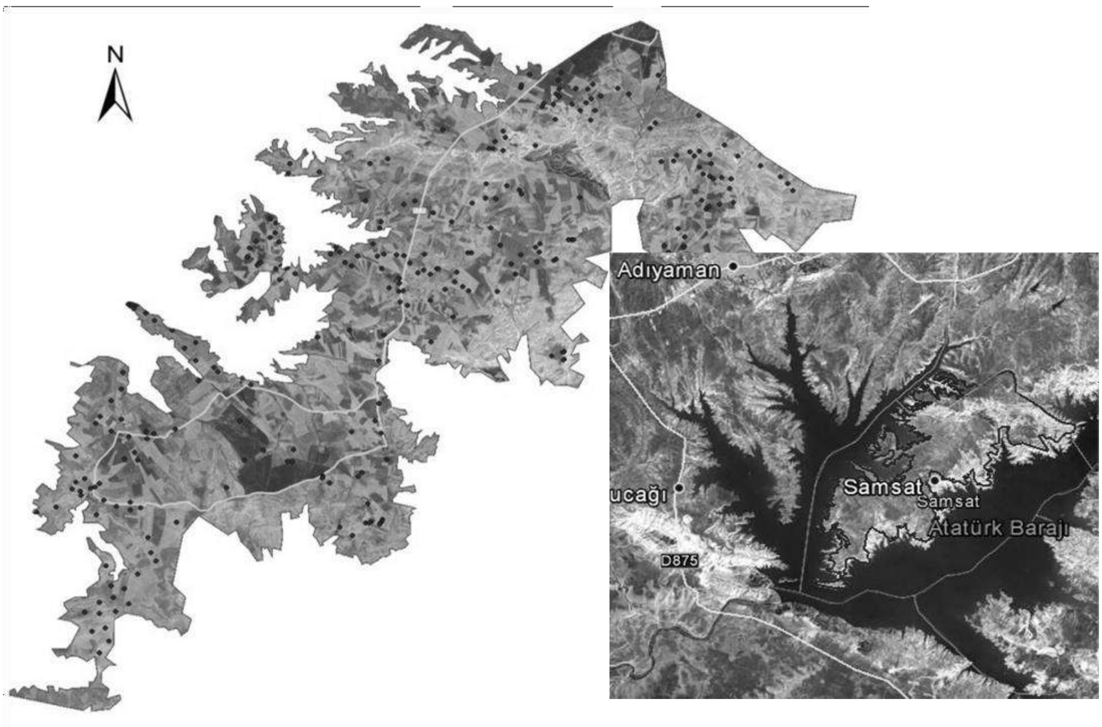

Figure 1. Locations where soil samples were taken.

Table 1.

Descriptive statistical results of soil properties.

n=263	pH	EC dS m^{-1}	$CaCO_3$ %	OM %	Sand %	Silt %	Clay %
minimum	5.78	0.37	2.09	0.09	22.24	7.28	7.76
maximum	7.96	2.88	81.45	4.21	76.24	62.00	44.32
mean	7.50	0.88	30.94	1.58	45.12	31.16	23.72
skewness	-5.31	2.16	0.84	0.86	0.20	0.17	0.45
kurtosis	53.52	12.65	0.34	1.36	0.69	1.33	0.04
sd	0.16	0.28	17.26	0.66	8.83	7.10	6.90
CV	2.13	31.79	55.79	41.92	19.56	22.79	29.09
median	7.51	0.88	27.37	1.52	45.68	30.72	23.04
mode	7.54	0.76	24.75	1.07	50.24	34.00	21.04

	Total-N %	Available P mg kg^{-1}	Available K mg kg^{-1}	Available Ca mg kg^{-1}	Available Mg mg kg^{-1}	Available Na mg kg^{-1}
minimum	0.028	0.94	39.60	3832.89	92.40	7.90
maximum	0.218	172.40	1250.40	15964.66	3626.00	588.75
mean	0.089	12.24	320.08	7665.61	444.68	25.73
skewness	1.41	7.08	1.46	0.60	5.20	10.13
kurtosis	3.53	69.61	5.13	0.85	52.99	118.13
sd	0.03	14.16	162.56	1973.74	291.82	43.69
CV	31.86	115.67	50.79	25.75	65.63	169.81
median	0.085	9.00	313.80	7530.50	398.30	19.41
mode	0.073	6.28	524.70	7229.28	286.40	19.41

	Available Fe mg kg^{-1}	Available Cu mg kg^{-1}	Available Zn mg kg^{-1}	Available Mn mg kg^{-1}	Available B mg kg^{-1}
minimum	0.71	0.21	0.18	0.91	0.13
maximum	27.82	6.72	1.77	104.20	1.85
mean	8.19	1.32	0.57	21.41	0.76
skewness	0.93	2.42	1.63	1.37	0.56
kurtosis	1.42	11.94	4.86	1.58	1.74
sd	4.74	0.73	0.21	20.78	0.23
CV	57.90	55.50	36.72	97.05	30.76
median	7.86	1.15	0.54	14.82	0.76
mode	10.66	0.97	0.51	29.80	0.83

sd: standart deviation; CV: coefficient of variation; OM: organic matter

Table 2.

Relationships between available B and soil properties.

	pH	EC	$CaCO_3$	OM.	Sand	Silt
B	-0,030ns	0,108ns	0,046ns	0,189**	0,001ns	0,187**
	Clay	N	P	K	Ca	Mg
B	-0,193**	0,265**	0,093öd	0,351**	-0,026ns	0,067ns
	Na	Fe	Cu	Zn	Mn	
B	0,066ns	0,256**	0,163**	0,215**	0,189**	

** P<0,01 *P<0.05

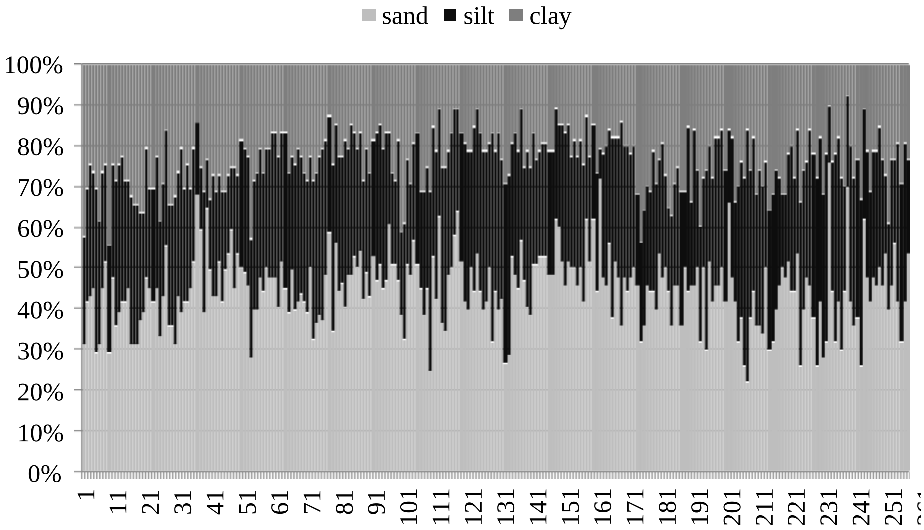

Figure 2. Soil particle size distrubution

CONCLUSION

In this study, it was determined that the available B content of the samples taken from the soils of the region was less than 1 mg kg^{-1} in 88.85%. Soil available B concentration (B) levels were below the toxicity limit values and the risk of B toxicity in the soils of the region is quite low. However, the possibility of B deficiency in plants should be evaluated by plant analysis. Since B is held more strongly in the soil than other compounds, it is very difficult to reduce it to a harmless level. For this reason, agricultural practices and especially the selection of irrigation water to be used should be done carefully and boron fertilizer applications should be made according to soil and plant analysis.

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THE EFFECTS OF FOREST FIRES AND POST-FIRE MANAGEMENT ON SOIL AS A BASE FOR POST-FIRE VEGETATION DEVELOPMENTS

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Forest fire is recognized as an important feature in the dynamics of soil and vegetation in fire-sensitive areas. It is known that fire sensitive areas are gradually expanding in the world. Depending on the change of vegetation and soil characteristics by the fire, the hydrological regime of the burned area and the sediment transport dynamics can also be changed. In this study, it is aimed to assess the soil vegetation development after fire by reviewing the effects of forest fire on the soil. It is also focused that this relationship will provide basic information on the content of post-fire forestry management activities. The most important fire characteristics affecting soil and vegetation proporties are fire intensity, heat transfer, fire duration, flame depth etc. The physical, chemical and biological properties of the soil are directly affected by the consumption of organic matter during a fire, and soil water repellency, runoff and sediment yield and erosion are also increased after the fire. Soil-vegetation interactions continue after fire under extreme conditions that affect vegetation growth rates and species composition. The first years after fires are more important to increase the nutrient capacity of the soil and the development of vegetation. It should be an important goal to improve the vegetation succession rate and increase the primary C source going underground from belowground to restore the soil flora and fauna, ensure sustainable vegetation dynamic after the fire. Therefore, post fire forest management activities after the fire to be carefully planned.

Keywords: *Forest Fires, Soil and Vegetation Properties, Post Fire Management*

INTRODUCTION

Soil and vegetation have a mutual dynamic relationship. It is generally known, that soil has many functions, such as promoting plant growth, providing nutrients to plants, retaining water, and maintaining plant roots. Furthermore, forest vegetation of various sizes and densities provides functions to prevent soil degradation and desertification, such as ensuring soil retention, continuity of water and nutrient cycle, and reducing water and wind erosion. In fire-sensitive areas, forest fires have effects that will change the relationship between soil and vegetation. Today, fire-sensitive areas tend to expand gradually (Ferreira et al. 2020) due to climate change (Whitman et al. 2022) and increasing human mobility in natural areas (Sjoström and Granström, 2023). It has become a matter of debate that increases in fire frequency will endanger the natural regeneration capacity of ecosystems in the future (Mouillot et al. 2002). In this context, post-fire monitoring has already become a priority for vegetation recovery, forest management, and control of flash floods and soil erosion (Bastos et al. 2011). Changes in the quantity and characteristics of goods and services such as grazing from natural resources, food product supply, quality drinking water supply, recreation and tourism, wood raw material production are inevitable in areas where the fire regime has begun to change. Fire not only changes plant composition and diversity in the forests, but can also affect many physical, chemical and biological properties of soil such as texture, colour, bulk weight, pH, porosity, amount of organic matter, available nutrients and soil organisms (González-Pérez et al. 2004: Certini, 2005). Those effects on the soil also directly affect the development of forest vegetation after the fire. In addition, the type and severity of post-fire management activities can also leave negative permanent traces on vegetation re-covering (Tavşanoğlu and Pausas, 2022: Yıldız et al. 2023). The aim of this study is to assess the results about the natural development of soil and vegetation after the fire, based on the effects of forest fires on the soil. In addition, it is to consider the impact of post-fire forestry management activities for forest recovering.

MATERIAL AND METHODS

In this study, the effect of forest fires on the soil and its results on vegetation development will be obtained by compiling the results obtained from different publications. In the first stage, it will be focused on which characteristics of forest fires affect the soil. Afterwards, the effects of fires on the biological, chemical and physical properties of the soil will be discussed. In the next step, it will be discussed how soil properties affect plant growth after fire. Finally, the effects of post-fire forest management activities on future forest dynamics would be evaluated.

RESULTS AND DISCUSSION

Fire Characteristics Affecting Soil and Vegetation Properties

In order to take into account the possible effects of fire on vegetation and soil, the importance of four folowing main factors emerges (McArthur and Cheney, 2015). Fire intensity and frequency (Keeley, 2009), heat intensity and its duration (Certini, 2005), fuel bed characteristics (McArthur and Cheney, 2015), soil (Neary et al. 2008) and vegetation characteristics (Tavşanoğlu and Gürkan, 2014). Fire intensity is an integral part of fire severity as it indicates the rate of thermal energy generation in the fire regime depending on the fuel-climatic environment (DeBano et al. 1998). The intensity and frequency of forest fires are the main fire characteristics that have a direct effect on the soil (Certini, 2005). Fire intensity refers to the energy released at various stages of the fire. It gives the rate of energy output per meter of fire front. The energy released during combustion first reaches the surface dead-cover and then the underlying mineral soil surface (Yıldız, 2023). The continuous existence of different types of available fuels in the horizontal and vertical spread of forest ecosystems causes changes in fire characteristics such as flame height, flame depth, depth of burning and scorch height (Neary et al. 2008: McArthur and Cheney, 2015). Changes in fireline intensity determined by these characteristics cause different effects on the physical, chemical and biological properties of the soil where the fire progresses. In the fireline, a sudden increase in temperatures on the soil surface occurs, as well as smoldering burns that affect the heating time (Keeley, 2009). Flame depth is the width of the continuously burning area behind the fire front. The grade of flame depth in the fireline is important because flame exposure time and heat burning time in a given area can affect the combustion of soil organic matter sources (Yıldız, 2023) and plant communities (Kavgacı et al. 2016). The duration of fire is an another integral part of fire severity and is a component of fire severity that causes the greatest underground damage (Certini, 2005). The duration of the flaming combustion on the unit area of the fireline has a very important effect on the damage to living vegetation and heat input to the soil. The duration of a fire depends on the rate at which the fire spreads, the amount of fuel available for combustion, and the rate at which the fuel is burned. Flame persistence in a fire is an important fuel characteristic related largely to fuel particle size (McArthur and Cheney, 2015). In addition to fire intensity, age of forest stands or succession period of plant communities, differences in topography and post fire management activities play an important role in stabilizing soil improvement, furthermore actual direction and rate of vegetation recovery after a fire (Viedma vd. 1997: Ganatsas et al. 2004: Caon et al. 2014: Kavgacı et al. 2016).

Effects of Fires on the Physical, Chemical and Biological Properties

Forest fires directly affect the mineral and organic components of the soil, soil microbiota and their habitats. The most important of these effects is the burning of the O horizon on the surface (Organic matter - OM) and the organic matter in the soil (SOM), which is the fuel for the fire (Yıldız, 2023). Organic matter acts as the primary reservoir for most of the available phosphorus (P), sulfur (S) and various nutrients such as available nitrogen (N) and is therefore the source of nearly all of them. The role of SOM in N storage is particularly important for forest ecosystems, as the sustained high productivity of forests is largely dependent on the N available. Nutrients stored in the SOM are released slowly during decomposition, providing an efficient, stable nutrient supply that keeps leachate losses low (DeBano, 1991: Certini, 2005). After the fire, the O horizon on the surface is partially or completely lost, depending on the intensity of the fire, and the organic matter in the mineral soil is partially lost (Yıldız, 2023). Fire dramatically changes OM at or near the soil surface by rapidly burning it. Changes in OM, in order, affect different chemical, physical and microbiological properties of the underlying soil. The heat transfer from the top of the soil down is increased by the evaporation and movement of water and organic compounds. Although some nutrients are lost in the meantime, most nutrients are made available by more rapid mineralization. Fire works like a rapid mineralizing factor that instantly releases nutrients, unlike natural decomposition processes that can take years or in some cases decades (DeBano, 1991). In low to moderate fires that spread quickly, the temperature can reach a depth of 3-5 cm, and the soil temperature can return to pre-fire levels in a few minutes or hours. However, in severe and long-lasting fires, the temperature increases towards the depth of the soil and it may take one or a few days to return to its former level. In slow fires that last longer in the field, the temperature often exceeds 700 °C on the soil surface, it drops to 200 °C in a few cm of the soil, and the temperature decreases to the normal level at a depth of 15-30 cm in the soil (DeBano et al. 1998). The temperature changes described above are caused by the heat generated by the burning of the litter layer on the soil surface, the evaporation of organic matter, and their then reaching the colder underlying soil layers, where they condense. That is, the combination of combustion and heat transfer produces steep temperature gradients up to the surface layers of the mineral soil, and the temperature moves downward in the soil. Heat transfer from the top of the soil down is enhanced by the evaporation and movement of water and organic compounds in the lower layers (DeBano, 2000: Jiménez-Pinilla et al. 2016). The water repellency starts to increase with the transmission of the heat generated during the fire to different soil depths. The downward movement of hydrophobic substances from the litter layer in the soil occurs mainly during fire. After the flaming portion of the fire has passed, the continued downward heat movement through the soil can re-evaporate some hydrophobic materials, causing the water-repellent soil layer to thicken or the hydrophobic materials to be fixed in place. As a result, a water-repellent layer remains below and parallel to the soil surface in the burned area. The amount and type of organic matter (DeBano, 2000), soil texture (Jiménez-Pinilla et al. 2016), soil water content (DeBano, 2000), mineralogical composition (Jiménez-Pinilla et al. 2016), ash (Larsen et al. 2009: Bodi et al. 2012) and soil-plant environment (differentiate between trees, shrubs and herbaceous plants) (Doerr et al. 2000) affect the property and thickness of the water-repellent layer (DeBano, 2000: Larsen et al. 2009). A hydrophilic ash layer a few millimeters to several decimeters thick is formed after a severe fire in forests and shrublands. This layer is effective in reducing runoff and surface erosion (Woods and Balfour, 2008: Larsen et al.2009). Depending on the ash porosity and depth, the effect of the ash on the flow increases proportionally. The role of the ash layer in decrasing erosion occurs through flow reduction and also reduces the rate of rain splash detachment (Woods and Balfour, 2008). The problems of infiltration, runoff, and erosion following wildfires require an understanding of the mechanisms responsible for producing fire-induced water repellency (DeBano, 2000). Soil sealing, runoff and erosion are another problems that arise after rains following forest fires. Surface sealing is due to compression and reduction of pore size by the droplet movement during precipitation. The initial soil moisture content just before the fire starts affects the initial severity of the water-repellent condition. Soil sealing refers to the formation of a thin (0.1–1.0 mm), dense soil layer on the mineral soil surface. The hydraulic conductivity of this layer can be several times lower than that of the underlying soil. In the formation of a sealed soil cover contribute to the raindrops in following processes: destruction of soil aggregates, compaction of soil and realignment of surface particles, and pore clogging by physical movement of fine particles or chemical dispersion of clays. (Larsen et al. 2009). The main hydrological effects of soil water repellency are reported in the literature, following as (Doer et al. 2000): (i) decreased infiltration capacity, (ii) increased land runoff, (iii) spatially localized infiltration and/or infiltration, usually fingered runoff development, (iv) effects on the three dimensional distribution and dynamics of soil moisture, (v) enhanced streamflow responses to rainstorms and (vi) enhanced total streamflow. It is also argued that slope washing, sometimes creek and gutter formation, can be promoted due to increased erosiveness of the soil as a result of increased land runoff and water repellency. The effect of fire on microorganisms is greatest in the organic horizons and in the upper 1-2 cm of soil, where populations of microorganisms are most abundant (Caon et al. 2014). The effects of fire on biological organisms occur directly or indirectly. Direct effects are short-term changes that occur when organisms are directly exposed to flames, bright combustion, hot gases, or by transferring sufficient heat to the organism's immediate environment, being trapped in other environments enough to kill or seriously injure the organism. Indirect effects are generally related to longer-term changes in the living environment of biological organisms after the fire has occurred. These may include habitat, food supply, competition, and other more nuanced changes that affect the regeneration and succession of plants and animals after a fire (Busse and DeBano, 2008). The negative effect of fire on microorganisms results loses of the N cycle (Caon et al. 2014).

Effects of Soil Properties on Plant Growth

Soil-vegetation interactions continue in post-fire environments under extreme conditions that affect vegetation growth rates and species composition. Growth patterns and regenerative strategies have been recognized as key features in determining the vegetation fitness to fire and resource utilization capacity in post-fire environments (Fernandez-Garcia et al. 2021). The processes that directly affect plant growth after forest fires can be generalised as changing the nutrients and the water holding capacity of the soil, which is related to site productivity and vegetation dynamics. Soils provide a nutrient and hydrological reservoir crucial to the survival of both underground and aboveground organisms. Many soil processes help determine above-ground ecosystem structure and function (Neary et al. 1999). While high intensity fires tend to decrease site productivity, low intensity fires can increase site productivity. Fire alters quantitative and qualitativ proporties of nutrients and increases or decreases their availability in the ecosystem. The persistence of ash accumulation on the soil surface is considered to be one of the most important factors in the formation of soil nutrient content, both immediately after the fire and in the long term. The nutrient-rich ash materials left after a fire can be taken off-site or redistributed into a burned area by convection or surface wind in a smoke column. For the restoration of burnt habitats, it is important to know the content and spatial distribution of nutrients in the soil, because in this way factors limiting the recovery of vegetation can be reduced. The amounts of carbon and nitrogen in the soil are predicted as the basis for vegetation recovery after a fire. To encourage the accumulation and retention of nutrients in the soil after a fire, it is important to stabilize the burned area by implementing post-fire measures that limit soil erosion, runoff, and wind loss of ash. SOM is an another important component for under- and belowground ecosystem dynamics because it provides the ion-exchange capacity, its ability to interact with clay minerals, form soil aggregates, absorb and release plant nutrients, and retain water (Caon et al. 2014). In determining the soil-vegetation relationship after the fire, it is necessary to monitor the soil and vegetation changes that have occurred in the years of 2-5 after the fire. Depending on the increase in the time passed after the fire, significant changes occur in the horizontal and vertical structures and species composition of the plant communities (Trabaud, 1997). It is known that soil-vegetation relationship are more important in the very short term (1-2 years) than in the short term (3-4 years) after fires (Jiménez-Pinilla et al. 2016: Fernandez-Garcia et al. 2021). Fernandez-Garcia et al. (2021) showed in Mediterranean ecosystems that the effects of fire on available phosphorus, enzymatic activities, and microbial biomass C in the soil decreased insignificant or highly softened 5-6 years after the fire, and differences in vegetation recovery caused by fire also decreased in the short term. Organic P forms in litter are more readily available to plants. Therefore, the effect of complete litter burning on the P cycle may be more severe. Furthermore, P in soils with high Ca levels can complexed into non available forms which have detrimental consequences for ecosystem productivity (Neary et al. 1998). However, as the microbial activities in the field begin to increase, phosphorus begins to accumulate again over time (Yıldız, 2023). Immediately after the fires, abundant increases are observed in plant species diversity (Kavgacı and Tavşanoğlu, 2010). Trees and hard-leaved shrubs growing in the Mediterranean climate zone, which are adapted to fire in fire-sensitive areas, are increasing in height, degree of coverage and biomass. However, over time, the importance of some plants in the community decreases and annual species are replaced by perennial plants (Viedma et al.

1997). After fires, resprouter shrubs regenerate more rapidly than seed-propagating trees (Fernandez-Garcia et al. 2021).

Post-Fire Forest Management Activities for Forest Regeneration

The techniques and methods preferred in post-fire forest regeneration directly affect the future management purpose of forests and the quality and amount of ecosystem services provided from them (Marcolin et al. 2019). Determination of tree deaths in forest areas with different fire intensity (Kwon et al. 2021) should be seen as an important sustainable forestry management base for ensuring post-fire reforestation (Tepley et al. 2018). It takes a certain amount of time to understand the recovery and regeneration dynamics after forest fire. It is important for post-fire management activities to leave the trees whose upper top is still alive to the next vegetation period and to monitor whether the shoot and seed giving characteristics continue or not with terrestrial and remote sensing. For this purpose, spectral analyzes based on time series that determine the post-fire recovery and regeneration dynamics are recommended (Gibson et al. 2022). Trees that are partially or completely protected from crown burning and still have the ability to produce shoots and seeds are often found in areas where cover fires with low burnt ratio are more developed (Tepley et al. 2018). Improving the vegetative succession rate after fire and increasing the primary C source going underground from belowground the primary key to the recovery and sustainability of th soil flora and fauna (Neary et al. 1998). In forest fires, water repellent does not occur equally in the entire fire area. Having patchy soil water repellent distribution in a fire affected area could contribute to an heterogeneous water redistribution on the soil superficial layer, and affect to the vegetation recovery (Jiménez-Pinilla et al. 2016). These areas should not be exposed to intensive post-fire forest management activities such as salvage logging and road construction, which causes soil compaction, leading to a decrease in soil water holding capacity and a delay in vegetation recovery (Yıldız et al. 2023). Intensive post-fire management activities are required only in areas where fire intervals are much shorter or resilience has been reduced by previous land uses. Rather than aggressive response, sustainable post-fire management, natural regeneration, biodiversity and ecosystem function should be considered (Tavşanoğlu and Pausas, 2022).

CONCLUSION

The intensity of forest fires gives the ratio of energy output per meter of fire front. The energy released during combustion first reaches the surface litter and then the underlying mineral soil surface. The continuous presence of different types of fuels in the horizontal and vertical spread of forest ecosystems causes changes in fire characteristics. The fire characteristics do not cause uniform effects on the physical, chemical and biological properties of the soil. After the fire, the O horizon is partially or completely lost depending on the severity of the fire, and the organic matter in the mineral soil is partially lost. Forest fires directly affect most of the various nutrients available, such as P, S, and N, by burning the surface O horizon and soil organic matter. Changes in OM, in turn, affect different chemical, physical and microbiological properties of the underlying soil. Heat transfer from the top of the soil to the bottom is enhanced by evaporation and movement of water and organic compounds. While some nutrients are lost meanwhile, most nutrients become available with faster mineralization. The temperature released by the combination of combustion and heat transfer moves up to the surface layers of the mineral soil. Heat transfer from the top of the soil to the bottom is enhanced by the evaporation and movement of water and organic compounds in the lower layers. Water repellency begins to increase as the heat generated during the fire is transmitted to different soil depths. The downward movement of hydrophobic substances in the soil occurs during a fire. Continued downward heat movement through the soil can re-evaporate some hydrophobic materials, causing a thickening of the water-repellent soil layer or fixing the hydrophobic materials in place. This layer provides an understanding of the mechanisms responsible for water infiltration, runoff and erosion problems. Improving the rate of vegetative succession after fire and increasing the primary source of C going underground is the primary key to the recovery and sustainability of soil flora and fauna. Having a patchy soil water repellent distribution in a fire affected area can contribute to a heterogeneous water redistribution in the superficial layer of the soil and affect vegetation recovery. These areas should not be exposed to intensive post-fire forest management activities such as salvage logging and road construction that cause soil compaction, reduce soil water holding capacity and delay vegetation recovery.

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