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EFFECT OF AGROMELIORATIVE MEASURES ON HYDRO-PHYSICAL PROPERTIES AND REGIMES OF GREY-BROWN SOILS IN THE ASHBERON PENINSULA

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ABSTRACT

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The dissertation work was carried out in the experimental area of the Agricultural Research Institute of the Republic of Azerbaijan.

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İNTRODUCTION

The actuality and study level of the topic. The natural climatic condition, soil and vegetation of the Absheron Peninsula play an important role in providing the population of Baku and its settlements with agricultural products. Along with grains, vegetables, melons and fodder crops, olives, pistachios, almonds, figs, grapes and other rare fruit and berry trees grow and are cultivated here. The climate of the Absheron Peninsula is very dry, and the soils are poorly supplied with nutrients. The amount of precipitation during the year does not exceed 130-244 mm, and the amount of evaporation is 947-1262 mm. The soils of the peninsula are mainly sandy, loamy and light clayey, with low moisture capacity and poor water holding capacity. Underground and surface freshwater resources are very limited. It is required to implement complex agro-technical, agrochemical and reclamation measures for meeting the needs of plants in the area for water and nutrients, to obtain high and sustainable yields from cultivated plants. Conducted experiments show that the implemented agro-ameliorative measures affect the environment, including soils and hydrogeological conditions. For example, improper use of irrigation techniques and technologies leads to re-salinization and salinization of soils, and the application of excessive fertilizers to the soil leads to the accumulation of harmful and toxic substances in the soil and plant products.

In both cases, the hydro-physical and physico-chemical properties of soils are subject to significant changes. Therefore, preparation of preventive measures to obtain sustainable productivity from soils and the study of hydro-physical properties of soils used under cultivation for a long time, the changing tendency and reqularity of food regime is of especial scientific and practical importance.

Hydro-physical properties of the lands of the Absheron Peninsula have been researched in different years in order to implement various reclamation (mainly irrigation) agro-technical and agrochemical measures. In the conducted researches, the regularities of change of hydro-physical properties of soils of the peninsula under the influence of implemented and carried out agro-ameliorative measures have not been studied systematically.

Predmet of the research. Hydro-physical and thermal properties of gray-brown soils of Absheron peninsula, research of the impact of agro-ameliorative measures on the regime of these properties.

The goal of the research. The main goal of the research is to determine the impact of agro-ameliorative measures on the hydro-physical properties and regime of gray-brown soils used under cultivation in the Absheron Peninsula for a long time and to prepare appropriate measures. The following issues have been resolved to achieve the goal:

1. Study and analysis of the current situation of natural and soil conditions of the Absheron Peninsula.

2. To determine the impact of agro-ameliorative measures on the hydro-physical properties of the gray-brown soils of the Absheron Peninsula, where they are researched, and their changing tendency and reqularities;

3. Preparation of relevant measures to improve the hydro-physical properties of soils;

Object of the research. Research on the impact of agro-ameliorative measures on the gray-brown soils of the Absheron Peninsula on the properties and regimes of these soils was carried out in the Northern Absheron zone and in the experimental area of the Agricultural Research Institute.

Research method. Tested and generally accepted methods were used to solve the problems - the principle of "field-nature experiments-laboratory analysis-cameral processing". The methods of conducting individual experiments and analyzes and processing the obtained results are described in detail in the "Research Methodology" section of the dissertation and in the text of the work. The accuracy of the obtained results was checked using the appropriate methods of mathematical statistics.

Scientific innovations of the work:

1. For the first time, the specific surface of the soils of the peninsula was studied and its changing tendency was determined.

2. The impact of agro-ameliorative measures on the hydro-physical properties and regime of the lands of the Absheron Peninsula, their changing tendency and regularities have been identified.

3. Appropriate measures have been prepared to improve the hydro-physical properties of the lands used under cultivation in the Absheron Peninsula and to increase their productivity.

4. Natural-historical conditions of the Absheron Peninsula (geomorphology, climate, hydrography, geological structure, tectonics, hydrography, vegetation) and modern situation were studied, analyzed and systematized.

The main provisions of the defense:

1. Changing tendency of hydro-physical properties and regime of lands of Absheron peninsula under the influence of agro-ameliorative measures and formation regularities.
2. Scientific-practical bases of measures on restoration, improvement of hydro-physical properties and increase of productivity of irrigated lands used under cultivation in Absheron peninsula.

Practical significance of the work. The results of the dissertation can be used to solve practical problems, including the restoration and improvement of hydro-physical properties and productivity ability of soils, the establishment of irrigation norms and regimes, the design of advanced irrigation techniques and technologies, and other issues. Methodological and scientific provisions of the work can be used as a methodological aid in the lessons on soil science and land reclamation, reclamation and land protection in higher and secondary institutions. The information provided and systematized in the dissertation can be a useful resource for researchers, doctoral students, bachelors, masters, specialists working in the agrarian sector and related fields.

Approbation of the work. The results of the research and the main provisions of the work were presented at international and national scientific-practical conferences, congresses of soil scientists, methodological councils: 8th International Scientific-Practical Conference "International cooperation in the development of agricultural science, food security and environmental protection" (Ganja, 2016), Proceedings of the III International Scientific and Practical Conference “The goals of the World Science 2017” (Dubai, 2017), Western Siberian Scientific Center, International Cooperation: Experience, Problems and Prospects (Kemerovo, 2020).

The dissertation work was carried out based on the program on training of scientific personnel and doctoral studies of the Azerbaijan State Agrarian University in 2014-2017.

Published works. 5 scientific articles and 3 theses on the dissertation, including 1 article and 2 theses were published in foreign journals and collections of scientific works.

Volume and structure of the dissertation. The dissertation consists of 172 computer printed pages, 5 chapters, 323816 characters, results, proposals for production, list of 169 titles and appendices. The work includes 32 tables and 18 figures.

The first chapter is devoted to the natural-historical conditions of the Absheron Peninsula. Geomorphology, geology, relief, climate, hydrography, soil and vegetation of the peninsula were studied, analyzed and systematized based on literature sources, observations and field research.

The second chapter describes the state of study of the soils of the Absheron Peninsula, distribution reqularities, morphometric and morphological features, quality indicators and formation condition of soil cover.

The third chapter describes the methods for determining the hydro-physical properties of the soil.

The fourth chapter explains and systematizes the composition, purpose and control factors of agro-ameliorative measures, including information on water (moisture), temperature, evaporation, air and food factors, their nature, origin, effects and consequences. This chapter presents the results of research on the impact of agro-ameliorative measures on soil water (moisture) regime, soil maximum field moisture capacity and soil water permeability.

The fifth chapter is devoted to the study of changes in the soil profile along the study of the impact of agro-technical measures on the granulometric composition of the soil during the years of the experiment.

CONTENT OF THE WORK

NATURAL-GEOGRAPHICAL CONDITION OF THE ABSHERON PENINSULA

Geomorphology, relief, climate, hydrogeology, geological structure, soil and vegetation of the Absheron Peninsula differ from other natural-climatic zones of Azerbaijan. The peninsula is divided into four parts - north, south, east and north-west. The north-eastern part includes rocks and mountainous areas located at an altitude of 340-350 m above sea level. The northern part covers areas with undulating relief, represented by sandy and clayey rocks. The southern part includes the Guzdek plateau, which is rich in mud volcanoes and limestone. In the eastern part, relatively flat areas below sea level are widespread. The northern and north-eastern parts have a complex tectonic structure, consisting of anticlinal Middle Cretaceous and younger Paliogen, the eastern part of the Miocene and Poliogocen sediments, and the western part mainly of limestone. Sedimentary rocks of the third period, as well as sediments of anthropogenic origin are widespread in the peninsula. Ancient sediments, including Cretaceous sediments, are also found here.

The climate of the Absheron Peninsula is dry subtropical, winters are mild, summers are hot and dry. The average temperature of the air is 14.4-16.00C, the average amount of precipitation is 130-244 mm, the amount of possible evaporation is 947-1262 mm, the relative moisture varies between 72-87%. Peninsula is the windiest area and the number of windy days with a speed of more than 13 m / s during the year is 65-119 days. The river network of the peninsula is very poor. There are two rivers here, the water of which also dries up in dry years. The depth of groundwater in the Absheron basin varies between 0-31 m. The mineralization degree of groundwater fluctuates in the range of 0.6-100 g / l. In the impact zones of canals and irrigated areas, groundwater is located close to the surface and their mineralization degree varies from 0.5 g / l to 115 g / l. Pressurized waters are widespread throughout the peninsula, except for the Gala galkhimi. Pressurized waters are located at a depth of 20-300 m above the ground and their mineralization degree varies between 0.7-45 g / l.

The vegetation of the peninsula has changed significantly as a result of economic activity. Ancient flora species are on the verge of extinction. However, cultivated vegetation has developed on the peninsula.

LANDS OF THE ASHBERON PENINSULA, THEIR STUDY STATUS AND GENERAL CHARACTERISTICS

The research works of scientists and specialists engaged in the study of the laws of formation reqularities, genesis, development, formation, hydro-physical and other properties of the soils widespread and developed in Azerbaijan have been studied and briefly commented. Classification, diagnose, degradation, ecology, productive capacity, evaluation, agro-industrial grouping, causes of salinization of the soils of Absheron peninsula, soil distribution geography and regularities, soil formation rocks were determined by soil scientists and land reclamation scientists of our country. Based on the research of scientists, studying the agrochemical, agrophysical, hydrophysical, physico-chemical and other properties of soils, mapping of soils, return to ownership of crop rotation of non-productive and degraded (re-salinized and salinized, polluted, lost fertility, eroded, etc.) soils, appropriation, increasing productivity and other practical issues have been resolved. This chapter covers the research work carried out in the lands of the Absheron Peninsula and identifies issues that need to be addressed. For example, despite numerous and varied research activities in the Absheron Peninsula, changing tendency and reqularities of the hydro-physical properties of the peninsula's soils under the influence of agro-ameliorative measures have not been sufficiently studied. The dynamics of changes in the "specific surface of the soil", one of the main indicators of soils of agro-technical, agrochemical and reclamation measures, has not been studied at all. Another fact is that the issues of change and restoration of granulometric (mechanical) composition in the sowing layer under the influence of agro-ameliorative measures were not studied. These issues are of exceptional importance in terms of taking appropriate and preventive measures to improve soils and increase their productivity.

As a result of natural and anthropogenic activity in the Absheron Peninsula, saline-solonetic, irrigated solonetic, poorly developed, underdeveloped and swampy gray-brown soil subtypes were formed. Saline-solonetic and solonetic subtypes are distributed in the western of the peninsula, poorly developed and underdeveloped subtypes in the eastern part of the peninsula, and swampy subtypes in the central, eastern and northern parts of the peninsula. Under the influence of agro-ameliorative measures, lands became civilized. The thickness of the fertile layer in cultivated soils reached 28 cm. The presence of humus in the upper layer and the formation of humus in the deeper layers indicate that the anthropogenic impact on these soils is great. The relatively high humidity and blue spots in the horizons indicate that irrigation and groundwater play an important role in the process of soil formation. The clear and gradual transition of genetic horizons confirms that the soil layers are formed from homogeneous parent rock. Recording of limestone fragments at a depth of 90-120 cm from the earth's surface shows that these soils developed on shellfish limestone sediments.

Despite good quality indicators, most of the soils on the peninsula are saline-solonetic and have a weak structure or unstructured. The salinization and re-salinization of soils, as well as the purification of some soils, related to artificial irrigation and natural factors. The unstructured nature of most soils is explained by the large amount of sand particles in the horizons and the small amount of silt particles.

Raw soils are poorly supplied with humus and the accumulative layer is not clearly selected. In general, the soils of the Absheron Peninsula are poorly supplied with humus and nutrients. The amount of humus in the top layer varies between 0.21-1.60%. The amount of humus in the lower layers of the soil decreases and its value reaches 0.03%. The amount of total nitrogen (N) in the 0-25 cm soil layer is 0.05-0.12%, the amount of total phosphorus (P_2O_5) is 0.1-0.3%, and the amount of potassium (K_2O) is 0.5-1.5%.

The soil profile is well provided with carbonates. The amount of calcium carbonate in the soil layers varies between 4-24%. However, the amount of carbonate in the A1a layer is relatively small and is 4-9%. The high carbonate content of the soils of this peninsula is explained by the fact that the soil-forming rocks are composed of calcareous sediments. The relatively low carbonate content of the topsoil related to cultivation and irrigation. The lands of the Absheron Peninsula have a high absorption capacity. The cost of absorption capacity varies from 8 mg-eq to 100 mg-eq per 100 grams of soil. Sandy and crude soils have a lower absorption capacity, while clayey and poorly saline soils have a higher absorption capacity. The absorption complex is dominated by calcium cation (Ca^{2+}) and its content in the upper layers is 9-29 mg-eq. The amount of magnesium (Mg^{2+}) and sodium (Na^{+}) cations is close to each other, ranging from 2.3 to 4.4 mg-eq in the upper layers and 1.1-3.3 mg-eq in the lower layers.

The amount of harmful salts in the soils of the Absheron Peninsula is small. The amount of harmful salts in the soil layer of 0-90 cm varies between 0.066-0.105%. However, in the lower layers of crude soils - in the layer of 90-165 cm, the amount of salts increases and reaches 1.146%. The amount of salt in irrigated soils increases slightly with depth, and its value varies between 0.07-0.50%. In irrigated soils, the content of hydrocarbonate (HCO_3^-) and calcium (Ca^{2+}) ions is predominant, and their content is 5-10 times higher than the amount of other ions. The presence of carbon (CO_3^{2-}) in salt ions increases the likelihood of water formation in the soils of the peninsula. However, in this case, the possibility of sodium bicarbonate ($NaHCO_3$) salt may occur.

The formation, development and degradation of the soil cover of the peninsula occurs under natural and anthropogenic influences. However, the formation of soil cover is closely related to the primary rocks that form the soil. The soil-forming rocks here are younger and consist of carbonate limestone, clayey clays and alluvial marine sediments. Soil-forming rocks are composed of sand, dust and silt (clay, colloids) fractions due to their mechanical composition. The amount of physical clay (<0.01 mm) varies between 14-42%, the amount of physical sand (> 0.01 mm) 68-84%, and the amount of waterproof aggregates (> 0.25 mm) varies 6-31%. As a result of irrigation, use of mineral, organic and local fertilizers, weak, medium and highly degree civilized soils have been formed on the peninsula. However, strong winds blowing throughout the year cause the topsoil to absorb nutrients and deflate the soil.

Technogenic influences also play an important role in the process of soil formation. Industrial and domestic wastes, produced layer water from oil fields, oil and fuel oil leaking from wells cause soil pollution.

These factors and economic activities also affect the hydro-physical and other properties of soils, leading to the gradual degradation of soil cover, weakening the intensity of the process of soil formation and, ultimately, the decline in soil productivity ability.

Research method. Determination methods of soil moisture and water resources in the soil, determination of maximum field moisture and total moisture capacity, determination of water permeability capacity of soil and filtration coefficient, method of studying soil water regime, determination of soil volume (density) and specific gravity (solid phase density), determination of soil granulometric (mechanical) composition and determining of specific surface area of the soil are described in detail. Assignment methods are systematized.

Influence of agro-ameliorative measures on hydro-physical properties and regime of soil. Based on the research, it was determined that agro-ameliorative measures include more than 18 economic activities. Not all agro-technical measures, but a small part of them, mainly irrigation and cultivation (plowing, discus, mulching, deep loosening, application of organic fertilizers, etc.) directly affect the hydro-physical and other properties of the soil, as well as their regime. The water factor is the primary factor in changing and managing the hydro-physical properties and regime of the soil. The point is that the water factor is one of the three phases that make up the soil - solid, liquid and gas. Soil nutrient, temperature, salt and air regimes are cleaned directly by the water factor. Due to the water factor, the intensity of physical, chemical and biological processes, the rate of erosion of rocks are formed in one direction or another. The vital activity and existence of higher plants is directly related to cultivate the soil, the energy used to cultivate and the quality of agricultural work, the vital activity of microorganisms, decomposition of organic matter in the soil, the nitrification process and other water factors. In general, extensive information on the water factor and its role is explained in more detail in the dissertation.

One of the main elements of agro-ameliorative measures is the cultivation of land, which includes complex agricultural activities. Cultivation regulates hydro-physical and other properties of soil, as well as water, temperature, nutrient, salt and air regimes of soil. Cultivation ensures the water holding, water and air permeability capacities of the soil, the density and porosity of the soil, the physical evaporation from the soil, the maintenance of optimal amounts of nutrients and salts, and allows them to change in favorable directions.

However, experience shows that under the influence of agro-ameliorative measures not only the hydro-physical properties of the soil improve, but also the hydro-physical and other properties of the soil deteriorate as a result of improper agro-technical measures, and even soil fertility and productivity capacity are lost. For example, intensive irrigation and water losses from canals lead to rising groundwater levels and re-salinization of soils. Poor plowing leads to soil compaction, reduced water holding capacity, increased physical evaporation and other complications.

Conducted experiments have shown that the value of the moisture content coefficient (k =A/E) in the Absheron Peninsula is less than 0.7. Therefore, unwashed and exudative water regime types prevail in this zone. The water regime of the soil is formed only due to atmospheric precipitation and is unstable. In non-irrigated soils, there is a constant lack of moisture during the growing season, and the amount of moisture in the soil varies between 5-8%. However, irrigated lands have a stable water regime throughout the year, and its average monthly value fluctuates between 12-15% (Figure 1).

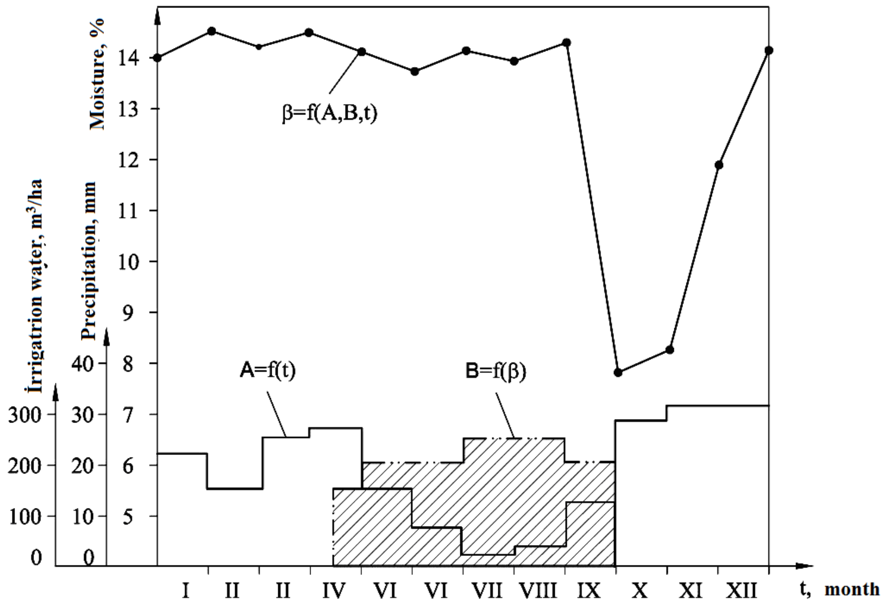

Figure 1. Dynamics of moisture in irrigated soil (soil water regime in 0-50 cm layer): β - moisture, %; A-atmospheric precipitation, mm; Amount of water supplied to B-irrigation, m^3/ha.

However, in the lands of the Absheron Peninsula, the maximum moisture content of the field is very small, and its value in the one-meter layer of soil varies between 19-24% (Figure 2). Therefore, these lands require frequent, but low norms irrigation. The water holding capacity of the soil weakens, the moisture migrates to the lower layers in a short time - 3-4 days, decreasing by 4-5% in the upper layer of the soil.

Agro-ameliorative measures have a significant impact on the water permeability and filtration cofficient of irrigated lands. However, this effect is dynamic and seasonal in the lands used under cultivation. Thus, at the beginning of the growing season, the rate of water absorption into the soil is high in plowed and plowed soils, but at the end of the growing season - after the crop is fully harvested, the rate of water absorption into the soil decreases (Table 1). However, the following year, as a result of cultivating the soil (plowing, harrowing, disking, etc.), the water permeability of the soil is restored.

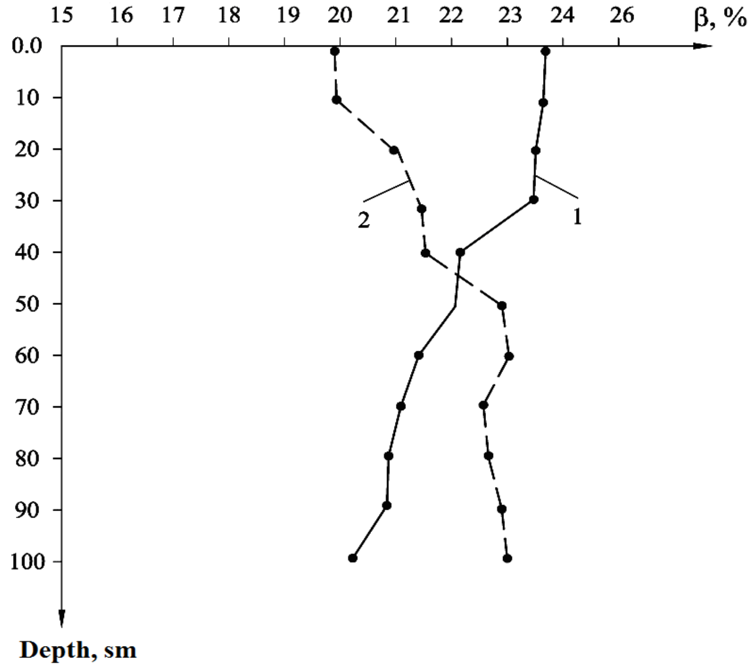

Fig. 2. Change of moisture on the depth:
1-one day after the soil pores are completely saturated with water;
2-three days after the soil pores are completely saturated with water;

According to the experiments carried out over three years, the rate of water infiltration into the soil in the first year of the experiments was 1.40 mm / min, in the second year 1.42 mm / min, in the third year 1.37 mm / min, and at the end of the growing season speeds were 1.15, 1.14 and 1.13 mm / min, respectively (Table 1). The same was observed in the dynamics of soil filtration coefficient. Conducted experiments have shown that the rate of water infiltration into the soil is higher than in unused (crude or rested) soils. In crude soils, the average rate of water absorption into the soil is 0.80 mm / min, while in arable lands its value is 1.37-1.42 mm / min. The decrease in soil water permeability is explained by the combination of dust and sludge particles as a result of pressure from irrigation and agricultural machinery, and the compaction of soil aggregates.

Table 1
Rate of water absorption into the soil in established regime, mm / min

Observation pitches	2015		2016		2017	
	Before vegetation	After vegetation	Before vegetation	After vegetation	Before vegetation l	After vegetation
№ 1	1,50	1,17	1,36	1,15	1,32	1,13
№ 2	1,36	1,16	1,48	1,18	1,43	1,15
№ 3	1,33	1,12	1,42	1,09	1,36	1,12
Average	1,40	1,15	1,42	1,14	1,37	1,13

Influence of agro-ameliorative measures on physical properties of soil. The effect of agro-technical measures on the granulometric composition of the soil has been studied for three years. It was determined that as a result of the implemented agro-ameliorative measures, the granulometric composition of the soil varies in layers of 0-30 cm and 30-40 cm. However, in layers less than 40 cm, the mechanical composition does not change. Physical clay (<0.01 mm), powder (0.05-0.001 mm) and decrease amount of silt (<0.001 mm) fractions, increase in the amount of sand fraction (1-0.05 mm), physical sand (> 0.01 mm) and water-resistant aggregates (> 0.25 mm) in the 0-30 cm soil layer (in 2017) compared to the granulometric composition

Table 2
Amount of mechanical elements,%

Observation pitches	Soil layers on the depth, sm	Fractions			Physical clay (<0,01 mm)	Physical sand (>0,01mm)	Water resistant aggregates (>0,25mm)
		sand	dust	silt			
2015 year							
№-1	0-10	47,72	40,76	11,52	23,96	76,04	12,44
	10-20	56,40	32,80	10,80	22,44	77,56	17,80
	20-30	49,88	46,44	3,68	21,64	78,36	13,38
	30-40	54,89	44,06	1,05	15,43	84,57	19,05
	40-50	60,61	38,15	1,24	14,36	85,64	22,65
	50-60	49,93	47,04	3,03	15,61	84,39	10,59
№-2	0-10	40,12	47,08	12,80	31,60	68,40	16,76
	10-20	46,80	41,60	11,60	28,20	71,80	26,16
	20-30	43,44	53,88	2,68	26,72	73,28	16,62
	30-40	47,40	41,08	11,52	23,64	76,36	32,50
	40-50	46,76	51,84	1,40	16,08	83,92	6,16
	50-60	58,80	25,20	16,00	25,60	74,40	11,55
№-3	0-10	28,16	63,84	8,00	41,20	58,80	6,69
	10-20	33,56	55,84	10,60	41,56	58,44	10,50
	20-30	48,43	39,20	12,37	26,45	73,55	23,16
	30-40	50,89	41,59	7,52	25,60	74,40	26,07
	40-50	52,83	40,23	6,94	22,15	77,85	30,82
	50-60	44,94	43,18	11,88	24,28	75,72	16,93

Continuation of Table 2

2017 year							
№-1	0-10	55,12	39,60	5,28	18,28	81,72	16,72
	10-20	49,20	43,96	6,84	20,52	79,48	13,05
	20-30	36,18	52,59	11,23	29,94	70,06	10,68
	30-40	33,56	55,84	10,60	41,56	58,44	10,50
	40-50	60-61	38,15	1,24	14,36	85,64	22,65
	50-60	49,93	47,04	3,03	15,61	84,39	10,59
№-2	0-10	46,52	43,87	9,61	22,83	77,17	18,40
	10-20	45,72	43,16	11,12	27,72	72,28	19,50
	20-30	44,38	40,12	15,50	30,02	69,98	21,11
	30-40	33,16	48,84	18,00	41,20	58,80	11,69
	40-50	46,76	51,84	1,40	16,08	83,92	5,16
	50-60	58,80	25,20	16,00	25,60	74,40	11,55
№-3	0-10	42,68	47,48	9,84	33,44	66,56	12,02
	10-20	40,56	48,78	10,66	34,56	65,44	13,12
	20-30	47,12	41,88	11,00	27,92	72,08	17,16
	30-40	40,89	46,59	12,52	35,60	64,40	26,07
	40-50	52,83	40,23	6,94	22,15	77,85	30,02
	50-60	44,94	43,18	11,88	24,28	75,72	16,93

determined at the beginning of the experiment (in 2015) were observed. In the 30-40 cm layer of the soil, on the contrary, an increase in the amount of physical clay, dust and silt fractions, a decrease in the amount of sand fraction, physical sand and water-resistant aggregates was recorded (Table 2).

Analysis of the experimental results shows that change of granulometric composition occurs due to irrigation and cultivation and is cyclical. Cultivation - due to the mixing of soil layers by plowing, the movement of mechanical elements occurs and a new granulometric composition is formed. However, due to irrigation, dust and silt particles gradually migrate to under plow layer, create a poorly permeable, dense layer there. This leads to the deterioration of the hydro-physical properties of the soil and, accordingly, water, temperature, food and air regimes.

The effect of agro-ameliorative measures on the volume weight (density) of soil has been studied for three consecutive years. It was found that under the influence of agro-ameliorative measures, the value of the volume weight of soil in the plowed layer increases during the growing season (during the year), and this increase is temporary. The following year, the price of the volume weight is restored due to the cultivation of the land. However, in the 30-40 cm layer of soil - below the plowing layer, an increase in volume weight is observed (Table 3). In the lower layers of the soil, the value of volume weight does not change. During the year, the volume weight increases by 0.15-0.18 g/cm^3, and in the perennial period by 0.049 g/cm^3. The temporary increase in volume weight is due to the formation of subsidence deformation in the porous plowing layer as a result of irrigation and the pressure exerted by agricultural machinery on the soil in the field. The results of experiments conducted on crude soil also prove this. Thus, according to experiments conducted in parallel on crude (rested) soil, no increase or decrease in volume weight was observed for three years. During the vegetation period, as noted, the accumulation of dust, clay and colloidal particles migrating from the plowed layer to the lower layers due to irrigation occurs and causes the formation of a thin dense and dense layer in the under plow layer.

This leads to a temporary deterioration of the hydro-physical properties of the soil.

Table 3

Change of volume weight (density) of soil, g / cm^3

Soil layers, *sm*	2015		2016		2017	
	Before planting	After harvest	Before planting	After harvest	Before planting	After harvest
0-10	1,39	1,40	1,40	1,41	1,38	1,40
10-20	1,40	1,42	1,40	1,41	1,40	1,42
20-30	1,45	1,52	1,46	1,52	1,45	1,53
30-40	1,47	1,65	1,51	1,66	1,53	1,68
40-50	1,51	1,51	1,52	1,53	1,51	1,51

Agro-ameliorative measures carried out for three years did not affect the specific gravity of the soil (density of the solid phase). The average value of specific gravity in one meter of soil layer was 2.61 g / cm3.

Conducted experiments have shown that agro-ameliorative measures have a direct impact on soil porosity. However, this effect is temporary and periodic. Thus, in some years, the cost of porosity in the 0-20 cm soil layer before planting is 45-47%, and 45-46% at the end of the growing season, 44% in the 20-30 cm soil layer before planting, and at the end of the growing season. 41-42%. That is, the cost of porosity in the 0-20 cm soil layer decreased by 1-2%, in the 20-30 cm soil layer by 2-3%. In the 30-40 cm layer of soil, the value of porosity before planting varied between 43%, after harvest - at the end of the growing season - between 36-37%, and the value of porosity decreased by 6-7%. However, although porosity was restored in the 0-30 cm soil layer, porosity was not restored in the 30-40 cm soil layer. The analysis shows that as a result of plowing, disking, harrowing and other agro-technical works carried out before planting each year, the soil structure improves, softens, granulates and the density of the sowing layer is reduced. However, under the influence of irrigation and machinery carried out during the growing season, the processes of subsidence, hardening and compaction occur in the plow layer. The next year, due to the re-cultivation of the soil, the porosity in the plowed layer is restored. As the deeper layers of the soil, mainly the under plow layer, remain intact, the porosity does not change, and the hardened and compacted layer has a negative impact on water, air, temperature and nutrient regimes in the following years.

One of the indicators that embodies the physical properties of soils is the specific surface area of the soil and represents the total surface area of particles that make up 1 gram of soil. The surface of the mechanical elements of the soil is considered its geometric and physical characteristics. The decomposition and dispersion of mineral elements in the soil indicates the transition of the soil to a new active phase. In this case, the surface area of the solid phase in a single mass or volume of soil increases, and thus the energy of the soil surface increases. The price of a particular surface is directly related to the absorption of mineral ash, vapors and gases, the movement of water and air in the soil, the physical and technological properties of the soil. According to sources, the surface of soil particles has a complex micro-relief, and their individual areas are important from an energy point of view. The special surface allows distinguishing the external dispersion of elementary particles, internal blunt microporosity and cracks. The active field is located in the convex part of the particles, and the activity of the surface of the substance characterizes the absorption of heat, surface conductivity and other parameters. With the help of a special surface it is possible to estimate the amount of water and heat absorbed into the soil, the cost of physical evaporation, the speed of water movement in the pores and other indicators. The hydro-physical properties of the soil are directly related to the specific surface.

The effect of agro-ameliorative measures on the specific surface of the soil was determined by geometric method using granulometric composition. The method of determination is described in detail in the dissertation. It was found that under the influence of agro-ameliorative measures the specific surface of the soil changes sharply. Thus, there is a decrease in the specific surface in the 0-20 cm layer of soil, and an increase in the specific surface in the 20-40 cm layer. In the first year of the experiment, the value of the special surface in the 0-10 and 0-20 cm soil layers varied between 3098-3988

cm^2/g, and in the 20-30 and 30-40 cm layers between 1056-3567 cm^2/g. In the fourth year of the experiment, the price of the special surface in the soil layers of 0-10 and 10-20 cm decreased to 1949-3340 cm^2/g, and in the soil layers of 20-30 and 30-40 cm the price of the special surface increased to 3299-5029 cm^2/g and as a result, the rate of a special surface in the soil layer of 30-40 cm increased 3-4 times (Table 4).

Table 4
The total amount of fractions and the average specific surface of the soil in layers

Observation pitches	Soil layers, *sm*	Fractions and their amount, %			Specific surface of the soil, F_o, sm^2/q
		sand	dust	silt	
2015 year					
№1	0-10 10-20 20-30 30-40	47,72 56,40 49,88 54,89	40,76 32,80 46,44 44,06	11,52 10,80 3,68 1,05	3399 3098 1699 1056
№2	0-10 10-20 20-30 30-40	40,12 46,80 43,44 47,40	47,08 41,60 53,88 41,08	12,80 11,60 2,68 11,52	3801 3432 1598 3405
№3	0-10 10-20 20-30 30-40	28,16 33,56 48,49 50,89	63,84 55,84 39,20 41,59	8,00 10,60 12,37 7,52	3988 3447 3567 2496
2017 year					
№1	0-10 10-20 20-30 30-40	55,12 47,20 36,18 33,56	39,60 43,96 52,59 55,84	5,28 6,84 11,23 10,60	1949 2380 3536 3447
№2	0-10 10-20 20-30 30-40	46,52 45,72 44,38 33,16	43,87 43,16 40,12 48,84	9,61 11,12 15,50 18,00	3015 2749 4301 5023
№3	0-10 10-20 20-30 30-40	42,68 40,58 47,12 40,89	47,48 48,78 41,88 46,59	9,84 10,66 11,00 12,52	3129 3340 3299 3728

Average specific surfaces of the soil-forming fractions were also determined. The specific surface area of the sand fraction is 59, the dust fraction is 1774, and the silt fraction is 22985 cm^2/g. The specific surface area of silt fractions is 390 times larger than the specific surface area of sandy soils and 13 times larger than the specific surface area of dusty soils. The presence of silt fraction in the soil leads to an increase in its specific surface area. The silt fraction gives special qualities to the soil. The optimal amount of silt fraction leads to an increase in the adsorption and water holding capacity of the soil, improved heat and water permeability, increased water and heat capacity, adhesion and structuring of micro- and macro-aggregates. However, the excessive increase of the silt fraction in the soil damages a number of its quality indicators. For example, such soils evaporate moisture violently, conduct water poorly, increase capillary elevation, which results in re-salinization of soils, which results in large cracks when dried. The problem is that the silt fraction consists of clay and colloidal particles. According to our calculations, the average diameter of colloidal silt is 0.00003 cm, while the value of the specific surface of the soil consisting of colloidal silt is 766 m^2/g or 7.66 million cm^2/g. In this case, the specific surface of colloidal soil is 43,000 times larger than the specific surface of dusty soil, and 130,000 times larger than the specific surface of sandy soil. According to the above, additional and special agro-technical and reclamation measures should be used to improve the quality of lands and increase their productivity.

Results

1. Based on the study and analysis of scientific research conducted in the Absheron Peninsula, it was determined that despite numerous and different studies, changing tendency and reqularities in the hydro-physical properties of the peninsula's soils under the influence of agro-ameliorative measures have not been sufficiently studied. As a result of natural and anthropogenic activity in the peninsula, saline-solonetic, irrigated solonetic, poorly developed, underdeveloped and swampy

gray-brown soil subtypes were formed. Saline-solonetic and solonetic subtypes are distributed in the western of the peninsula, poorly developed and underdeveloped subtypes in the eastern part of the peninsula, and swampy subtypes in the central, eastern and northern parts of the peninsula.

2. Morphological features of soils are studied on the basis of plots of land used under cultivation and placed in crude soil. It was determined that the planted and cultivated lands were cultivated under the influence of agro-ameliorative measures. The thickness of the fertile layer in cultivated soils reached 28 cm. The relatively high moisture in the horizons and the presence of blue spots indicate that irrigation and groundwater play a role in the process of soil formation. The clear and gradual transition of genetic horizons confirms that the soil layers are formed from homogeneous parent rock. Recording of limestone fragments at a depth of 90-120 cm shows that these soils develop on shellfish limestone sediments. The unstructured soils can be explained by the large amount of sand particles in the horizons and the small amount of silt particles. In crude soils, humus is low and the accumulative layer is not clearly distinguished.
3. The amount and reserves of humus in the lands of the Absheron Peninsula vary widely. The amount of humus in the top layer is 0.28-1.60%. The amount of humus in the lower layers decreases sharply and its value reaches 0.03%. These soils are poorly supplied with nutrients. The amount of total nitrogen in the soil layer of 0-25 cm fluctuates between 0.05-0.12%, the amount of total phosphorus fluctuates between 0.10-0.30%, and the amount of potassium fluctuates between 0.50-1.50%. The soil profile is well provided with carbonate. The content of calcium carbonate in the soil layers varies between 4-24%. However, the amount of carbonate in the bottom layer (0-30 cm) is relatively small and is 4-9%. The high carbonate content of these soils is explained by the fact that the soil-forming rocks are composed of calcareous sediments.

The relatively low carbonate content of the topsoil is due to cultivation and irrigation.

4. The soils of the Absheron Peninsula have a high absorption capacity and its value varies from 8 mg-eq to 15-45 mg-eq per 100 g of soil. However, its amount varies for various reasons. Sandy and crude soils have a lower absorption capacity, while clayey and weakly saline soils have a higher absorption capacity. The absorption complex is dominated by calcium cation, and its content in the upper layers varies from 9 mg-eq to 29 mg-eq. The amount of magnesium and sodium cations is close to each other, 2.3-4.4 mg-eq in the upper layers and 1.1-3.3 mg-eq in the lower layers.
5. According to the results of chemical analysis, the amount of harmful salts in the soil layer of 0-90 cm in the Absheron Peninsula varies between 0.066-0.105%. However, in the lower layers of crude soils (90-160 cm) the amount of salts increases and reaches 1.146%. The amount of salt in irrigated soils increases slightly with depth, and its value varies between 0.07-0.50%. Irrigated soils are dominated by hydrocarbonate and calcium ions, which are 5-10 times higher than other ions. The presence of carbon in the salt ions reduces the likelihood of soda formation in the soils of the peninsula. However, in this case, the possibility of sodium bicarbonate salt may occur.
6. Soil-forming rocks are younger and consist of carbonate limestone, clayey clays and alluvial marine sediments. As a result of irrigation, use of mineral, organic and local fertilizers, weak, medium and highly civilized soils have been formed on the peninsula. Technogenic influences also play an important role in the process of soil formation. Soil pollution is caused by industrial and domestic wastes, produced water from oil fields, oil and fuel oil spills and their waste materials. These factors and economic activities also affect the hydro-physical and other properties of soils. These and other factors lead to the gradual degradation of soil cover, the

weakening of the intensity of the process of soil formation and, ultimately, the reduction of soil productivity capacity.

7. Agro-ameliorative measures include more than 18 economic activities. Some of the activities included in these measures directly affect the hydro-physical properties of soils, while others indirectly affect them. The hydro-physical properties and regime of the soil are directly affected by cultivation and irrigation. Both cultivation and irrigation regulate water, temperature, food, salt and air regimes that ensure the life of higher plants, the intensity of physical, chemical and biological processes in the soil, and the process of rock erosion and soil formation.
8. The value of the moisture cofficient in the Absheron Peninsula is less than 0.7. Therefore, the type of water regime in this zone belongs to the types of washable and exudate. The water regime of the soil is formed only due to atmospheric precipitation and is unstable. Therefore, it is impossible to get a sustainable product on the peninsula without irrigation. Lack of moisture during non-irrigated soils during the growing season is persistent and its value varies between 5-8%. However, irrigated lands have a stable water regime throughout the year and the average monthly moisture content fluctuates between 12-15%. However, in the soils of the Absheron Peninsula, the amount of moisture content of the field is very low, and its price per meter of soil varies from 19 to 24%. Therefore, these lands require frequent irrigation.
9. The soils of the Absheron Peninsula have good water permeability. However, as a result of irrigation during the growing season, the water permeability of the soil is temporarily weakened. While the rate of water absorption into the soil before planting is 1.37-1.42 mm / min in the established regime, its value varies between 1.13-1.15 mm / min after harvest (vegetation). The decrease in water permeability of the soil is caused by the hardening and compaction of the plow layer. However, this process is temporary. The following year, as a

result of plowing, harrowing and disking the soil, the water permeability of the soil is restored.

10. It was determined that as a result of implemented agro-ameliorative measures, changes in granulometric (mechanical) composition occur in 0-30 cm and 30-40 cm layers of soil. However, the granulometric composition does not change in layers less than 40 cm. Experiments conducted over three years have shown that changes in the granulometric composition of the soil are due to irrigation and cultivation. As a result of annual plowing, harrowing and disking, the mechanical elements are periodically mixed together and no stable mechanical composition is formed. However, due to irrigation, dust and silt particles in the plowed layer of the soil gradually migrate to the under plow layer, where they form a thin, poorly permeable, compacted layer of dust, clay and colloidal particles. This leads to the deterioration of the hydro-physical properties of the soil and the violation of its water, temperature, food and air regimes. There is a need for additional agro-technical and reclamation measures.
11. Conducted experiments have shown that the specific gravity of the soil (density of the solid phase) does not change under the influence of agro-ameliorative measures. Volumetric weight under the influence of agro-ameliorative measures, the volume weight of the soil in the plowed layer (0-30 cm) increases during the year and is temporary. In the next year, due to the cultivation of the soil, the volume weight in the plow layer is reduced. However, the value of volume weight in the soil layer of 30-40 cm increases by 0.15-0.18 g / cm^3 during the year, and by 0.049 g / cm^3 during the perennial period. The temporary increase in volume weight in the plow layer is due to the formation of subsidence deformation as a result of pressure exerted by irrigation and agricultural machinery on the soil, which leads to compaction of the plow layer. There is a need for additional measures.
12. Agro-ameliorative measures have a direct impact on soil porosity. The value of porosity in the 0-30 cm layer of soil is

periodic and dynamic. Porosity decreases during the year and is restored the following year. However, there is a gradual decrease in porosity in the 30-40 cm layer of soil. The decrease in porosity below the plowing layer is due to the accumulation of dust, clay and colloidal particles in this layer due to irrigation water. The reduction of porosity in the under plow layer has a negative impact on soil water, air, food and temperature regimes. Therefore, there is a need to develop additional measures.

13. Based on the study of the impact of agro-ameliorative measures on the specific soil surface, it was determined that as a result of the implemented agro-technical measures, the specific surface area decreases in the 0-20 cm layer and the specific surface area increases in the 20-40 cm soil layer. This is due to the migration of dust and silt (clay and colloid) particles from the top layer to the lower layers. The reduction of the specific surface in the upper layer leads to the formation of nets, and in the lower layers to the formation of dense and compacted layers, the deterioration of the hydro-physical properties of the soil and, consequently, the decline in soil productivity capacity. It is important that the silt particles in the soil layer be in the optimal norm. It was determined that the average specific surface area of the colloidal particle is 766 m2 / g, which is 43,000 times larger than the average specific surface area of the dust and 130,000 times larger than the average specific surface area of the sand particles.

Suggestions and recommendations for application and use of the results obtained in the dissertation

1. The water holding capacity of the Absheron Peninsula is weak, and the water permeability is high. The results obtained on these indicators can be used to solve practical problems, including the preparation of projects on irrigation techniques and technologies, the establishment of irrigation norms and regimes.
2. Due to global climate change, freshwater resources have been declining in recent years and the demand for water is increasing year by year. Therefore, there is a need to use water needs more efficiently and economically. Experience shows that it is possible to save a lot of irrigation water by highly structuring the arable land of agricultural lands and granulating it. The problem is that the amount of unproductive evaporation in the improved and granulated soils is reduced several times, the water resistant capacity is higher, the density is lower, the porosity is higher and the aeration (aeration) capacity is higher than in the crude and rested soils. In order to structure the soil layer and make it granular, the soil should be plowed, disced and harrowed before planting. At the same time, organic fertilizers, including manure, green manures, poultry farm waste, composters, etc. are added to the soil should be given in optimal doses. Micro- and macro-depressions and hills in the field should be removed by leveling.
3. Implemented agro-ameliorative measures, mainly as a result of intensive irrigation, change the hydro-physical properties of the subsoil (below the plowing layer). For example, as a result of intensive or industrial irrigation, dust, silt, clay and colloidal particles accumulate below the plowing layer, forming a thin, densely packed and poorly permeable layer. With the formation of this layer, soil water, air, food, salt and temperature regimes deteriorate, and as a result, soil productivity capacity decreases.

4. Based on the above, it is proposed to implement the following measures:
   - Deep plantation plowing, disc plowing and quality harrowing every 4-5 years to remove the compacted, hardened, compacted and poorly permeable layer formed under the plow layer;
   - sowing with the help of agricultural tools that vibrate every 4-5 years, taking into account the thickness of the compacted layer in the under plow layer and the hydro-physical properties of the soil (permeability, density, porosity, volume weight, specific gravity, specific surface, etc.) simultaneous softening of subsoil layers;
   - one of the above measures can be implemented, taking into account the production capacity and technical and economic efficiency;
   - application of rotational (rotational) sowing system with the participation of plants whose root system penetrates deeper layers of soil;
   - if possible, abandon primitive, flooding and top-down irrigation methods and use advanced irrigation techniques and technologies developed for each plant species;
5. The use of substances that create a modern biological structure, along with physical and mechanical methods.Experience shows that over a long period of time, the hydro-physical properties of the lands used under cultivation gradually deteriorate and the productivity gradually begins to decline. To prevent this process, the lands are left to rest for a while. Analysis of physical and chemical processes in the soil shows that long-term rest of the soil is not considered economically viable. Based on the changing tendency of the hydro-physical properties of soils, it is proposed to establish a system of land rest as follows.

A five-field forage and vegetable rotation system is used. 1. Alfalfa an annual + grain (barley or wheat); 2. Alfalfa multiplicity; 3. Melons and vegetables; 4. Legumes; 5. Peaceful land. The period of rest of the soil should not exceed 1-2 years.

Appendixes. The results of the experiments conducted in the appendix of the dissertation were involved in mathematical-statistical analysis and their accuracy and reliability were determined.

The deviation of the obtained results from the norm or the allowable limit was checked by two methods - 1) the average value of the differences and 2) the methods of difference of the average values. These methods determined the average mathematical value of the indicators, the dispersion of the differences and the standard deviation, the mean error of the difference, the normalized value of the deviation, the marginal error and the actual deviation. The probability level was taken to be $p = 0.05$. The accuracy and reliability of the experimental results were determined by comparing the marginal error with the actual error, the normalized value of the deviation and the values of the actual deviation. Mathematical-statistical analysis involved the results of soil volume and specific gravity, physical clay, quantity, soil water regime and changes.

It was found that the reliability and accuracy of the changes that occur as a result of the impact of agro-ameliorative measures on the hydro-physical properties of the soil is more than 95%. At the same time, based on mathematical and statistical assessment, it was confirmed that agro-ameliorative measures do not only affect the specific gravity of the soil for a short period of time (this period is equal to 4 years in this case).

Published scientific works on the dissertation:

1. Influence of natural and anthropogenic factors on agrophysical properties of soils in Absheron peninsula // Scientific works of ASU, - Ganja: - 2014, № 3, - p. 50-.51.
2. Monitoring of hydrothermal regime of irrigated gray-brown soils in Absheron peninsula // - Baku: Soil science and agrochemistry, - 2015, -c. 22, № 1-2, - p. 378-383 (co-author Y.C. Hasanov).
3. Some physical and water-physical properties of gray-brown soils of Absheron peninsula // - Baku: Geography: theory, practice and information, - 2015, BSU, - p. 369-372.
4. Some physical and chemical indicators of gray-brown soils of Absheron peninsula // - Baku: Azerbaijan agrarian science, - 2016, № 3, - p. 45-47 (co-author N.Y. Seyidaliyev).
5. Monitoring of hydro-physical properties of irrigated gray-brown soils in Absheron peninsula depending on soil complex // Materials of the 8th scientific-practical conference "International cooperation in the development of agrarian science, food security and environmental protection", - Ganja: 03-04 October 2016, - c. II, - p. 172-175.
6. Agrophysical characteristics of sulfur-brown soils of the Apsheron Peninsula // (International Scientific Conference “World Science”, Vol. I No. 2 (18), February 2017) – Dubai, UAE, Proceedings of the III International Scientific and Practical Conference “The goals of the Word Science 2017”, Janury 31, - 2017, - p. 24-26.
7. Monitoring the impact of agroreclamation measures on the specific surface of irrigated gray-brown soils of the absheron peninsula // (West Siberian Scientific Center, International Cooperation: Experience, Problems and Prospects - September 30, 2020 - Kemerovo - p. 64-67.
8. Influence of agro-reclamation measures on the specific soil surface // Bulletin of science and practice. 2020. V. 6. No. 10. pp. 135-142. https://doi.org/10.33619/2414-2948/59/13.

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