

## Soil-meliorative state of irrigated soils of the intermountain basins of central Asia (On the example of the Fergana region of the Fergana valley)

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### Abstract

The article describes the current state of agricultural lands in the Fergana Valley, located in the eastern part of Uzbekistan, on the basis of data obtained from monitoring and research. In 2019, monitoring studies were conducted in stationary and semi-stationary ecological areas selected from the most widely used soil groups in agriculture in the region. The study found that according to the average quantities of salts in the upper one-meter layer of the soil profile, the highest salt reserves were recorded in irrigated hydromorphic soils of Furkat, Tashlak, Dangara, Altaryk and Yazyavan districts on average from 106 t / ha to 156 t / ha. In the region of ancient alluvial deposits in Central Fergana, due to the rise of groundwater, their mineralization is mainly 1.0-1.5 g / l, in some local areas - 3.0 g/l, in all cases consisting of sulfate and chloride-sulfate salinity types. Salts in the soil profile are dominated by Na<sub>2</sub>SO<sub>4</sub> and MgSO<sub>4</sub> and their quantitatively close CaSO<sub>4</sub> salts, chlorine salts are found to consist mainly of MgCl<sub>2</sub>, rarely NaCl salts.

**Keywords:** monitoring, stationary ecological area, irrigated meadow loam soils, meadow reed-alluvial soils, light gray soils, salinity, groundwater, salt reserves, mineralization level

### Introduction

In 2019, surveys were conducted for the purpose of soil monitoring in the agricultural lands of the Fergana Valley in the Fergana district. In the study, the reclamation conditions of soil groups in the monitoring key areas, its chemical composition, properties and characteristics, isolated from the regions, were studied in detail.

Fergana region is located in the Fergana Valley and is one of the intermountain Valleys of Central Asia. Similar intermountain Valley is found in the Central Asian states of Kazakhstan, Tajikistan, Kyrgyzstan, India and China. In these countries, too, regional soils found in the Fergana Valley are widespread and have been studied by many researchers [1, 2, 3]. The Fergana Valley and its southern part, the northern and northern parts of the Pamirs and Alay mountain ranges, differ from the soils of the intermountain Valleys in Central Asia in terms of the characteristics of irrigated typical and light gray, gray-brown, oozing-meadow and meadow alluvial soils explained by the fact that it is formed in different soil-climatic regions. However, the peculiarity of the study of the Fergana region, the southern part of the Fergana Valley, is the discovery of changes in the properties of soils under the influence of its agricultural culture (plowing, tillage, irrigation, etc.).

### Materials and methods of research

The purpose of the monitoring is to record the current state of irrigated soils of selected base farms in Fergana region, to determine the nature, direction and activity of changes, their impact on soil fertility and crop yields, to prevent negative processes and eliminate their consequences, to improve saline soils, development of proposals and recommendations for the rational and efficient use of irrigated land.

### The Main Findings and Results

Geographical location and study area of the study. Fergana region is bordered by the Republic of Tajikistan in the west, the Kyrgyz Republic in the south and the Namangan and Andijan regions of Uzbekistan in the north-east [4, 5, 6, 7, 8]. Fergana region is one of the most studied regions in terms of soils, hydrogeology and geology. Early research began in the late eighteenth century, and others have conducted research in different areas for specific purposes [9, 10]. All of the above research was conducted in the soil cover of the region in an attempt to radically change the soil improvement and reclamation status and to reveal it. Nevertheless, a number of problems are emerging in irrigated areas from year to year, which are expected to be addressed through research.

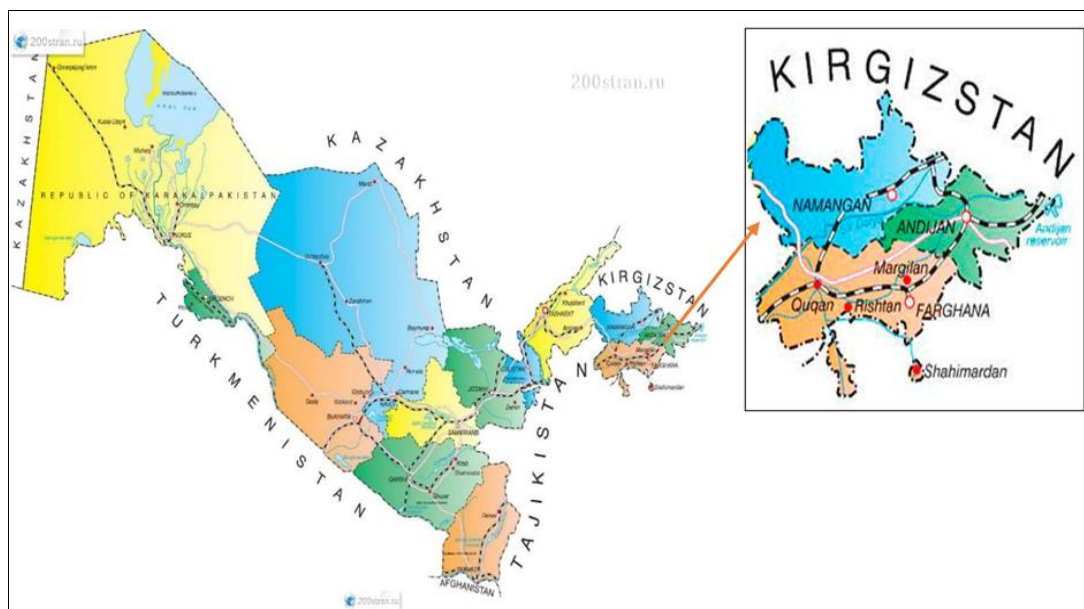
The Fergana Valley joins the Turan Plain through the Khojand Gate. It stretches from northeast to southwest in an "almond-shaped" shape, called mountain range sediment. In the Fergana Valley there are all climatic zones and soils of the republic [11].

The Valley, especially the regional areas, are located in tectonic sediments and formed in the Paleozoic era [12, 13, 14]. In the middle of the Mesozoic era, the Tethys Sea was a bay, and at the end of the Paleogene, as a result of increased tectonic activity, the sea began to recede, and from the Neogene to the alpine folds, the surrounding mountain ranges began to rise and form sediments. In M.N. Gramm's research [15], the Syrdarya River was formed from the melting of glaciers from the Tien Shan and Pamir-Alay mountain ranges, and it crossed the entire Valley and began to flow into the Aral Sea through the Nurata ridge to the north. By the end of the Tertiary, the plain part of the Valley

was so wide that it reached the bottom of the Turkestan and Alay mountain ranges. In later periods, due to the vertical and denudation movements of the earth, the perimeter of the present-day Sokh and Isfayram rivers, that is, the southern sides of the Valley, began to rise. As a result, in the upper reaches of these rivers, deep carved riverbed paths are formed. The plain part of the Valley narrowed, and it retreated to the north, expanding into mountainous areas. As a result, in the lower parts of the Valley there are river deltas and subaerial deltas (subaerial delta), which are inaccessible to water. The territory of the region is divided according to the composition of the deposits during the uprisings in the Quaternary period. According to many researchers, the erosion process is observed in the Quaternary period, in the zonal state, in the types, and in the stratified form according to the conditions, sometimes in the tertiary (Neogene) saline deposits are exposed [18, 19, 20, 21]. Pre-Quaternary deposits are shale, alkaline in the foothills of Turkestan, shale and granite in the Chatkal and Qurama ridges in the Lower Paleozoic, limestone, conglomerate and sandstone in the Middle and Upper Paleozoic in the Turkestan, Alay and Kurama mountain ranges. All of the above deposits were involved in the formation of the regional soils. The fact that the bulk of irrigated land falls on alluvial and proluvial deposits has been proven once again in our studies. However, the soil-forming rocks and deposits are distributed in the region in very different shapes and thicknesses, which indicates that the territory of the region has undergone geological and tectonic processes for many years. The main sources of irrigated agriculture in Fergana region are the waters of the Sokh, Isfayramsay, Shohimardonsay, Isfara, Syrdarya rivers. They were formed from streams flowing from the Alay, Pamir, and Tien Shan mountains. From Syrdarya to Greater Fergana, Greater Andijan, Northern Fergana, Greater Namangan and Y. The canals named after Akhunboboev.

Receive water and provide irrigation water (fresh water) to the whole Valley (region) and the Central Fergana desert zone 23, 2009]. Pre-mountain cone formations, formed from the conical distributions of rivers, are the site of formation of groundwater in Quaternary deposits. The middle part of the Valley and the alluvial plains extending from east to west are the last stage zones of groundwater accumulation and groundwater formation. The area of ancient alluvial deposits in Central Fergana is a part of stratified alluvial rocks, a source of groundwater, which is served by rising groundwater, irrigation wells and infiltration of irrigated areas [17]. The mineralization of the waters is mainly 1.0-1.5 g / l, only in some locally specific areas it reaches 3 g / l. In the composition of ions, sulfates (SO<sub>4</sub>) play a leading role; in the main cases the amount of chlorine ions is relatively higher in the waters of the lower part of the diffusion. The salinity type is sulfate, chloride- sulfate and sulfate -chloride in some isolated areas. Monitoring studies have shown that due to the failure of collector-drainage networks and most of the vertical wells in the desert (Central Fergana) region, the groundwater level is increasing near the surface, which causes a number of problems in irrigated agriculture, resulting in increased hydromorphism, cases of salt accumulation in the soil and secondary salinization have caused complications in the reclamation condition of irrigated lands. Occupying the south-western part of the Fergana Valley, Fergana region has a total land area of 675.9 thousand hectares, of which 65.2% is irrigated land. Automorphic and hydromorphic soils are widespread in the region.

The irrigated lands of the region are mainly desert, foothill and sub-mountainous zones, especially desert zone irrigated soils are composed of sand and sandy loam, pre-irrigated light gray, typical gray, gray-meadow, meadow and meadow-alluvial soils are light and. moderately sandy to sometimes heavy sandy loam soils.



**Fig 1:** Map-scheme of Fergana region (Valley) located on the map of the Republic of Uzbekistan

A.J. Ismanov [17] divided the territory of the Fergana Valley into 15 soil-geographical regions on the basis of soil formation conditions, soil distribution, geomorphology, climatic indicators, landscape and other features. The areas occupied by soil types and groups of these regions, which

are most commonly used in irrigated agriculture, are divided into geomorphological regions and soil zones of the Fergana Valley (Fig. 1).

Eleven base monitoring farms (soils) were selected from the most irrigated and most widely distributed land plots in the

Fergana region, and 2019 field-monitoring surveys were conducted in them.

### Object and methods of research

Monitoring regime surveys were conducted in Rapqon-Telov-Fayzi and Adirabad of Besharik district, which differ from each other in different geomorphological regions, hydrogeological, soil-climatic, irrigation and economic conditions, agricultural culture, land use, soil properties and reclamation status and productivity; Friendship in Furkat district; S. Azizov of Uzbekistan district; Poultry farm in Rishtan district; Mulkobod of Dangara district; Gulistan of Quva district; Z. Ganiev from Yazyovan district; Al-Fargani of Altiriq district; From the massifs of the Valley Red Fortress of Fergana district and H. Marozikov of Toshloq district, "base areas" with a total area of 100 hectares were selected, in each of which soil-level field work on a scale of 1: 10000 was carried out in 2009. In this case, soil properties and reclamation status were noted, and the obtained data were used as a basis for initial comparison with the results of routine monitoring. Also, out of every 100 hectares of observation sites, 3 one-hectare regime observation points were identified, 33 stationary-ecological sites were identified in 11 observation areas. In the one-hectare observation areas allocated in 2019, 1 typical stationary-ecological sites (SEA) with an area of 1 hectare were placed in the previous studies in the monitoring regime monitoring works, the other two consisted of semi-stationary-ecological sites (SSEA), all of which were chemically analyzed soil and groundwater samples were taken for which all the properties, chemical composition and other properties of the soil were studied. The basis of monitoring research is the "Methods of land monitoring in the Republic of Uzbekistan" [24], "Guidelines for soil research and soil mapping for the state land cadaster" [25], as well as geochemical, comparative-geographical, laboratory-analytical analysis methods. Analytical research "Methods for studying the agrophysical, agrochemical and

microbiological properties of soils in cotton fields" of the Uzbek Cotton Research Institute [26], "Guidelines for the use of total humus and mobile humus in the soil as an indicator of its productivity" of the Soil Science and Agrochemical Research Institute [27] and performed at the Institute of Soil Science and Agro-chemistry, based on generally accepted methods.

### Results of research and their discussion

According to the monitoring soil studies, the accumulation of water-soluble salts in irrigated lands of Fergana region and the increase of re-salinization processes were noted [28, 29]. Salinity is the main soil process that determines soil fertility and its ecological status, and in the description of saline soils, little information has been used to assess the direction and level of activity of saline processes on the basis of quantitative indicators. Such data are extremely important for the assessment of the reclamation and ecological condition of irrigated soils, for substantiating their reclamation, for the lands of Central Fergana, where the soil reclamation condition is severe.

As of January 1, 2009, the total area of saline lands in Fergana region was 74.0%.

Of this, irrigated lands accounted for 19.63% of the total irrigated area, moderately saline lands for 30.77%, weakly saline lands for 49.33%, and finally for saline (non-saline) soils for 0.27%.

According to a 2009 monitoring study, the observed areas of ground water averaged 120cm. and 200 cm. oscillations were observed at depths up to (VI-VII key areas). This is 195-200 cm. in the range of hydromorphic (irrigated meadow reed soils) soils where groundwater fluctuates, the dry residue is noted to be around 5,100-15,660% at high levels and moderately and strongly saline-type salinity. Groundwater is observed in moderately and strongly saline soils, in the hydromorphic soils of Central Fergana and the western part of the region (Besharik, Dangara, Yazyovan and Furkat districts) (Table 1).

**Table 1:** Depth, mineralization level and chemical composition of sediment, irrigation and drainage waters, 2009

Key field №	Cut, №	Depth, cm								Salinity	
			Dry residue	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	Type	Degree
Oozing water											
IV-KF	6-10	165	1,900	0,152	0,091	0,995	0,190	0,165	0,062	sulfate	weak
V-KF	91-10	195	5,100	0,091	0,070	2,995	0,530	0,421	0,108	sulfate	medium
VI-KF	76-10	120	3,950	0,067	0,084	2,296	0,630	0,159	0,154	sulfate	medium
VII-KF	31-10	200	15,660	0,329	0,882	7,187	0,480	1,330	1,547	sulfate	strong
VIII-KF	126-10	130	2,690	0,079	0,042	1,452	0,410	0,134	0,034	sulfate	weak
Irrigation water											
IV-KF	1-10 <sup>x)</sup>	-	0,530	0,104	0,028	0,234	0,080	0,024	0,032	sulfate	potable
V-KF	101-10	-	0,800	0,073	0,021	0,415	0,180	0,012	0,010	sulfate	potable
VI-KF	61-10	-	0,470	0,134	0,014	0,218	0,070	0,018	0,049	sulfate	potable
VII-KF	46-10	-	0,670	0,165	0,014	0,296	0,070	0,043	0,051	sulfate	potable
VIII-KF	121-10	-	0,670	0,078	0,021	0,341	0,080	0,037	0,052	sulfate	potable
Drainage waters											
IV-KF	13-10	-	1,790	0,177	0,049	0,935	0,245	0,110	0,057	sulfate	weak
V-KF	96-10	-	4,200	0,110	0,056	2,394	0,460	0,311	0,084	sulfate	medium
VI-KF	86-10	-	1,810	0,098	0,056	0,938	0,250	0,091	0,121	sulfate	weak
VII-KF	31-10	-	1,610	0,116	0,077	0,827	0,250	0,104	0,005	sulfate	weak

Note: <sup>x)</sup> - Irrigation and drainage water are taken from around the indicated cuts

The amount of easily soluble salts in irrigation water was observed on average at 0.470-0.800g / l, saline in the sulfate type is considered fresh water, and the study of its chemical composition revealed a predominance of sulfate ions over

chloride ions. This is due to the fact that the water flowing from the surrounding mountains it contains a large amount of sulfate salts compared to chlorine. This situation was also observed in the groundwater run-off; the sulfate averaged

0.827-2.394 g / l and were weakly and moderately saline in the sulfate type. It should be noted that the average amount of dissolved calcium in groundwater and ditch waters ranged from 0.190 g / l to 0.630 g / l, while the amount of magnesium was relatively high, ranging from 0.091 g / l to 1.330 g / l (Table 1). According to the results of the analysis, the areas with high content of magnesium (Mg) and sulfates (SO<sub>4</sub>) in soil and groundwater are difficult to dissolve in the middle and lower profile of soils "horn" (content: SaSO<sub>3</sub> - 30-60%; MgSO<sub>3</sub> - 12-16%), and "valuable" (composition: gypsum CaSO<sub>4</sub>x<sub>2</sub>H<sub>2</sub>O - 20-90%; CO<sub>2</sub> - 15-40%). From this it can be concluded that the irrigated soils of the Central Fergana Desert and adjacent areas of the region are composed of specific gypsum, nutrient and horny soils, formed under certain geological, geochemical, geomorphological and climatic conditions. That is, according to the laws of sedimentation of salts, in the zone of mineralized waters CaCO<sub>3</sub>, CaSO<sub>4</sub>, NaSO<sub>4</sub>, MgSO<sub>4</sub> salts precipitate and lead to an increase in the amount of active salts in the soil. This complex of elements has been associated with the transport (deposit of water) of various substances from the mountains surrounding the Valley in distant geological periods, as well as the migration and accumulation of these geochemical compounds<sup>13]</sup>. As a result, there are now more than 150,000 hectares of difficult-to-reclaim gypsum, fertile and horned land in the Valley. In 2017, according to the maps of salinization of irrigated lands in the districts of Fergana region<sup>[25]</sup>, the total salinity of the region was 61.2%, of which 26.8% of the total irrigated area (average, strong and very strongly saline soils), was 43.8% of the total saline area. The fact that the volume of saline soils has decreased over the past years can be explained by the length of the year

(Season) in which the research was conducted. The hydrogeological conditions of the studied massifs and the SEA and SSEA placed in them are extremely complex, which is reflected in the relief and geomorphological-lithological structure of the area. The condition of groundwater in the irrigated soils of the selected massifs is expressed in different indicators, the level of which is different depth. It was noted that the level of groundwater in Rapkon-Telov-Fayzi in Besharik district, Z.Ganiev in Yazyovan district, Dustlik in Furkat district, H. Marozikov in Toshloq district and Mulkobod in Dangara district fluctuated in the range of 117-174 cm. According to the chemical analysis, groundwater from these farms was mineralized to varying degrees, ranging from moderately saline to very strongly saline, with total salts ranging from 1,055g / l to 6,515g / l of dry matter. Groundwater in irrigated meadow, oozing-meadow and meadow-alluvial soils of Besharik, Dangara, Yazyovan and Furkat districts formed a group of very strongly saline waters. The amount of easily soluble salts in water is observed at an average of 3,815-6,295g / l, of which chloride ion is 0.133-0.399g / l, sulfates are 2.189-3.472g/l. It should be noted that the amount of calcium dissolved in water is 0.40-0.54g / l, while the amount of magnesium is 0.312-0.894g / l (Table 2).According to salinity chemistry, the studied groundwater consists of sulfate and chloride-sulfate salinity types in all cases, the salts are Na<sub>2</sub>SO<sub>4</sub> and MgSO<sub>4</sub> and their quantitatively close CaSO<sub>4</sub> salts, chlorine salts are mainly MgCl<sub>2</sub>, rarely NaCl salts. The water of the ditches is strong and very strong in terms of salinity, and the level of mineralization is 1,610-6,515 g/l (Z. Ganiev, Mulkabad and Ahmad Al-Farghani arrays).

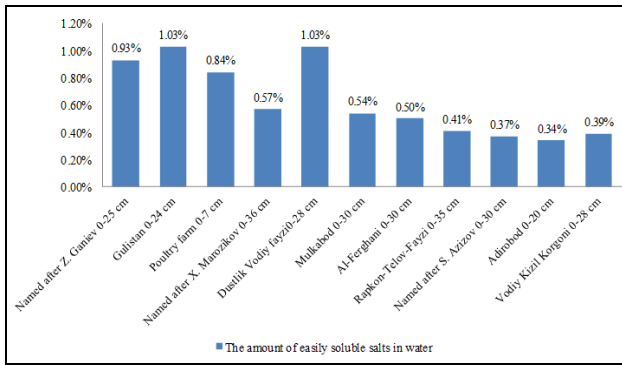
**Table 2:** Depth, mineralization level and chemical composition of sedimentary and ditch waters, 2019

The name of the massifs	SEA, №	Depth, cm	Amount of salts,%							Salinity	
			Dry residue	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	type	degree
Oozing Water											
Rapkon-Telov-Fayzi	SEA-I	164	5,905	0,476	0,609	3,353	0,44	0,87	0,028	Chloride-sulfate	Very strong
Named after Z. Ganiev	SEA -I	117	3,815	0,354	0,133	2,189	0,54	0,312	0,166	sulfate	Very strong
Named after H. Marozikov	SEA-I	143	1,055	0,214	0,063	0,416	0,12	0,066	0,058	sulfate	strong
Friendship	SEA-I	174	6,295	0,897	0,399	3,472	0,40	0,894	0,108	sulfate	Very strong
Mulkobod	SEA-I	153	4,300	0,073	0,035	2,497	0,670	0,183	0,130	sulfate	Very strong
Oozing Water*											
Mulkobod	SEA-I	-	6,515	0,958	0,413	3,571	0,42	0,936	0,085	sulfate	Very strong
Ahmad Al-Farghani	SEA-I	-	1,610	0,116	0,077	0,827	0,250	0,104	0,005	sulfate	strong
Named after Z. Ganiev	SEA-I	-	4,200	0,110	0,056	2,394	0,460	0,311	0,084	sulfate	Very strong

Note: \* - Drainage water is taken from the side of the indicated SEM-I sections

The different salinity of the irrigated soils of the massifs, some of which are almost washed out of salts, is clearly expressed in the specific structure of the soil cover, which forms the soil-lithological profile. According to the analysis of soil monitoring data in 2009, the soils of the studied massifs (SEA -Stationary ecological area and SSEA- Semi-stationary ecological area.) formed groups of unsalted (washed out of salts), weak, moderate, strong and very strong (saline) saline soils, I-KF (key field), Valley red the drive layers of typical gray soils irrigated from the old massif of the fort consist of washed (SEA-I and

SSEA-III; unsalted) and weakly saline (SSEA-II) soils, weak salinities were recorded starting from the subsurface layers of all sections (Fig. 1). The total amount of water-soluble salts in the subsoil (19-46 cm) of the cross-sections of all ecological areas is weakly saline with 0.280-0.330%. The Adirabad and Poultry Farm massifs range from 0.335-0.415% to 0.835-1.100% of the total salinity in the upper strata of the protected brown soils, with weak and moderately saline, weak, moderate, and sometimes very strong downstream from the subsurface strata, salinity formed groups of soils.



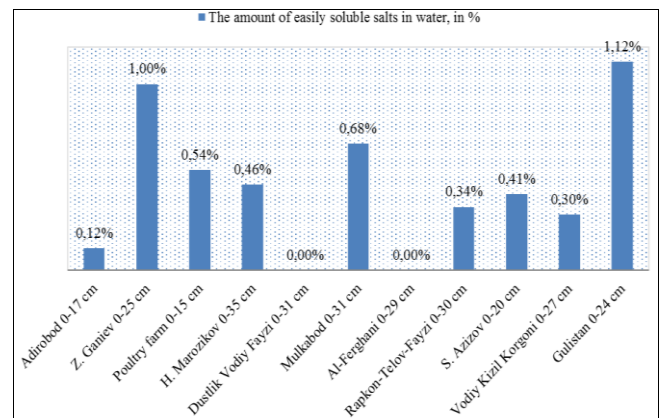
**Fig 2:** 2009y. The amount of water-soluble salts in the soils of stationary ecological sites, in %

The driving layers of the S. Azizov massif, irrigated bald meadow soils and irrigated meadow soils of the Rapqon-Telov-Fayzi massif are weak and moderately saline soils, with a total salinity of 0.340-0.410% to 0.630-1.290% to the soils, the irrigated meadow-gray soils of the Al-Fargani massif are moderately and weakly saline in the sulfate type, in which the dry residue fluctuates around 1,080-1,120%.

Irrigated meadow soils of Mulkabod and H. Marozikov massifs are weak and moderately saline - the total amount of salts in the dry residue ranges from 0.375-0.495% to 0.675-0.760%, saline-type salinity. The irrigated meadow soils of the DustlikVodyFayzi massif consist of less weakly saline soils, the total amount of salts in the arable layer ranges from 0.465% to 1.110%, the salinity of the sulfate type and the irrigated meadow-alluvial soils of the Z. Ganiev massif are weakly saline. Sulfate-type salinity and light gray soils irrigated in the Gulistan massif are moderately and weakly saline - the total amount of salts in the dry residue is 0.365-0.415%, sometimes up to 1.120%, with an average salinity of 0.640-0.995% was found. Quantitative indicators of salts in the soils of the studied massifs increased or decreased depending on the upper or lower layers, rather than the location of the saline layers in the soil profile. It should be noted that the situation is typical for the newly irrigated soils of Gulistan, Dustlik, Mulkabod, Al-Fargani, Rapqon-Telov Fayzi, S. Azizov massifs, their “profile salinity”, and all the layers up to groundwater are almost the same, weak or moderately saline was detected (Fig. 1). In the soil monitoring studies conducted in 2019, the processes of salt accumulation and salinization-salinization in irrigated typical gray, oozing-meadow, bald-meadow,

Meadow-Alluvial and protected brown soils, their formation, general direction and distribution laws lithological-geomorphological depending on the structure, hydrogeological, soil-climatic and irrigation-economic Conditions, it is observed that it occurs at different levels in different massifs.

According to the data analysis, the soils of the studied massifs formed groups of unsalted (washed from salts), weak, moderate, strong and very strong (saline) saline soils. The drive layers of typical gray soils irrigated by the Valley Red Fortress Massif consist of washed (unsalted) and weakly saline soils, with weak salinities recorded from the underlying drive layers of all sections. A characteristic feature of irrigated soils was that all their layers up to groundwater were equally weakly or moderately saline. The reclamation of irrigated lands in the studied massifs, which are intensively used in agriculture, is mainly hydromorphic soils, which are distributed in the Central Fergana desert zone and Kokand group of districts (Furkat, Buvayda, Dangara, Besharik, Uzbekistan districts) (Figure 2).



**Fig 3:** The amount of water-soluble salts in the soils of stationary ecological area, in %, 2019

Taking into account the different salinity of salts in the soil profile, the average quantitative indicators of the degree of salinity for this or that layer of soil were determined. An important and easily comparable indicator of soil salinity for irrigated areas is the average amount of salts for the top 0-1 m layer of soil and the calculated salt reserves on this basis, the amount of easily soluble salts in water for massif (SEA and SSEA) soils ( % ) and reserves ( t / ha ) (Table 3).

**Table 3:** Average amount (%) and reserves (t / ha) of water-soluble salts in the 0-1 meter layer of stationary ecological area soils. 2009-2019

KF №, name of massifs	Years of monitoring research	By SEA (cross-section number)	Dry residue		Chlorine		Sulfate	
			%	т/га	%	т/га	%	т/га
I-KF. Valley red castle massif	2009	106	0,382	53,49	0,017	2,32	0,206	28,77
	2019	I-SEA	0,340	47,60	0,044	6,58	0,676	94,64
II-KF. Adirobod massif	2009	16	0,308	43,16	0,012	1,73	0,172	24,08
	2019	I-SEA	0,331	46,47	0,331	46,42	0,193	27,10
III-KF. Massif named after S. Azizov	2009	46	0,361	50,50	0,015	2,05	0,201	28,17
	2019	I-SEA	0,349	48,86	0,031	4,39	0,176	24,69
IV-KF. Rapqon Telov-Fayzi massif	2009	8	0,298	41,70	0,016	2,26	0,171	23,87
	2019	I-SEA	0,336	47,07	0,013	1,85	0,160	22,4
V-KF. Al-Fergani massif	2009	92	0,840	117,60	0,023	3,15	0,52	72,89
	2019	I-SEA	1,221	170,97	0,008	1,19	0,744	104,23
VI-KF. Mulkabod massif	2009	76	1,026	143,71	0,021	2,95	0,656	91,84
	2019	I-SEA	0,546	76,47	0,013	1,92	0,334	46,76
VII-KF. Dustlik massif	2009	31	0,927	129,72	0,053	7,41	0,573	80,25
	2019	I-SEA	0,37	51,8	0,012	1,78	0,25	30,1

VIII-KF. Massif named after H. Marozikov	2009	121	1,061	148,59	0,020	2,83	0,699	97,79
	2019	I-SEA	0,751	105,17	0,013	1,855	0,446	62,54
IX-KF. Massif of Paultry farm	2009	61	0,708	99,15	0,011	1,53	0,470	65,86
	2019	I-SEA	0,339	47,46	0,010	1,512	0,163	22,82
X-KF. Massif named after Ganiev	2009	66	0,684	95,74	0,014	1,98	0,436	60,97
	2019	I-SEA	1,122	157,15	0,008	1,19	0,712	99,71
XI-KM. Massif of Gulistan	2009	75	0,597	83,58	0,010	1,45	0,375	52,46
	2019	I-SEA	0,593	83,02	0,009	1,34	0,369	51,66

According to the average quantitative indicators of salts in the upper 0-1 m layer of the soil profile studied in the monitoring studies, their salt reserves fluctuate over a large range, from 47.07 to 170.97 t / ha, of which chlorine reserves are 0.010 t / ha and 46.42 t / ha. up to 22.4t / ha of sulfates from 104.23t / ha. High levels of salt reserves were recorded in irrigated meadow-gray soils at 170.97 t / ha, irrigated meadow-alluvial soils at 157.15 t / ha and irrigated meadow-loam soils at 105.17 t / ha (Table 3). In order to monitor the soil and reclamation status of the selected base massifs, accurate data on the reclamation status of stationary ecological sites located in the monitoring areas were obtained on the basis of regular monitoring data. According to him, the soil is irrigated meadow-gray, meadow and meadow-swamp soils formed in Besharik, Altariq, Yazyovan and Tashlak districts, where the ecological and reclamation condition is difficult. It was noted that in their one-meter soil profile, the average salt reserves were 157.1-170.9 t/ha.

### Conclusion

According to the chemical analysis, the obtained groundwater was mineralized to varying degrees, ranging from weakly saline to strongly saline, with total salts ranging from 1.05% to 6.29% of the dry residue. Groundwater in the irrigated meadow soils of the Dustlik massif in Furkat district is a group of highly saline water with a residual content of easily soluble salts of 6.29%, of which chloride ion is 0.399% and sulfate is 3.47%. This situation was observed in the groundwater of Rapqon Telov Fayzi massif of Besharik district, Z. Ganiev massif of Yazyovan district, H. Marozikov massif of Toshloq district and Mulkobod massif of Dangara district.

According to the salinity chemistry, the studied groundwater consists of sulfate salinity types in all cases, the salts are  $\text{Na}_2\text{SO}_4$  and  $\text{MgSO}_4$  and their quantitatively close  $\text{CaSO}_4$  salts, chlorine salts are mainly  $\text{MgCl}_2$ , rarely  $\text{NaCl}$  salts. Irrigation water consists of fresh water (<1 g/l) in terms of salinity, 0.470-0.964 g/l in the studied massifs, and the salinity of drainage water (in terms of dry residue) is 6.29%. Dangara district).

Salt accumulation and salinization in irrigated meadow-gray, meadow and meadow-swamp soils distributed in the selected massifs - salinization processes, their formation, general direction and distribution patterns in the massif, lithological-geomorphological structure of the region, hydrogeological, soil-climatic and irrigation-economic conditions, have been observed to occur to varying degrees in different arrays. According to the general law, the movement of groundwater is directed to the north-west towards the Central Fergana desert zone, and as a result, water-soluble salts accumulate in the desert zone.

In irrigated soils in 2019, the average amount of dry residue in the soils of Gulistan massif was 1.12%, in the soils of Z. Ganiev massif 1.00% and in DustlikVodiyFayzi massif

0.46%, the soil cover of these massifs was moderately and strongly saline was found. According to the average quantitative indicators of salts in the upper 0-1 m layer of the soil profile, the highest salt reserves are in the Al-Fargani massif in Altyaryk district (170.97 t/ha), Z. Ganiev in Yazyovan district (157.15 t/ha) and Tashlak. H. Marozikov (105.17 t/ha) in the irrigated lands of the district. On the basis of the absorption of the soils of the observation areas, the predominance of calcium and low content of sodium was determined by the results of chemical analysis. However, it was noted that the share of sodium absorbed in the irrigated hydromorphic soils of Uzbekistan, Dangara, Furkat districts of the region averaged 5.56-6.80% in the soil, which was involved in the process of weak salinization of these soils.

### Suggestions

The following agro-ameliorative measures should be taken to organize the rational and efficient use of irrigated agricultural lands, to maintain, restore and increase soil fertility and to obtain high yields of agricultural crops:

- Soil leaching is one of the important measures to improve soil reclamation. In this regard, the leaching of soil saline by flooding the checks obtained on plowed and well-leveled areas, before all this work to put into operation all existing collector-drainage networks, taking into account the salinity of the soil, the chemical composition of salts, water permeability properties it is necessary to specify. It is advisable to carry out saline washing in autumn and winter. In soils with a light mechanical content, salts are more easily washed away than in heavy mechanical soils. Therefore, less water is used to desalinate light soils, despite the same amount of salinity. Given these conditions, the optimal values of saline leaching norms are 3-5 thousand  $\text{m}^3$  in weakly saline soils, 5-7 (10) thousand  $\text{m}^3$  in moderately saline soils and 8-10 (12-15) thousand  $\text{m}^3$  in soils with heavy mechanical salinity should be determined<sup>30</sup>.
- Technical failure of existing collector-drainage networks and very low efficiency. The whole set of measures aimed at keeping the groundwater level below the "critical" depth (2.5-3.0 m) should be reflected. The use of a semi-hydromorphic reclamation regime in agricultural production allows irrigated, saline soils to be kept in a favorable reclamation condition.
- Improving the reclamation of gypsum and nutrient soils and increasing their productivity in the region (Baghdad, Rishtan, Uchkuprik, Yazyovan, Tashlak, Kuva, Dangara, Kushtepa districts) requires a special set of measures. In such heavy reclamation soils, deep plowing, application of organic fertilizers, high-quality saline washing give good results. In order to maintain the fertility of such reclaimed soils, it is necessary to establish crop rotation systems, proper use of fertilizers, stratified cultivation and, if necessary, chemical

reclamation measures. Reclamation of soils with horny and nutritious very dense and very low fertility, 40-60% carbonate compounds in the upper layers and 20-30% to 70% gypsum is mainly carried out by deep plowing of the horn and topsoil layers.

- It is necessary to use the system of crop rotation (rice) in the agricultural lands of Yazyovan, Koshtepa, Altariq, Toshloq, Dangara and Furkat districts of Central Fergana region, where the reclamation situation is difficult, the productivity is very low and the planned harvest is limited. In order to ensure the efficient use of the above-mentioned lands, it is planned to plant rice in the first year (mainly at the expense of collector-drainage water), legumes and food crops in the second year, and cotton and grain crops in the third year suitable.
- The implementation of the proposed crop rotation system will lead to the rehabilitation (desalination) of these lands in a short time; will ensure the economic stability of farms operating in these areas in recent years, high yields of cotton, grain and other crops.

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