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CURRENT STATE AND FERTILITY FACTORS OF IRRIGATED MEADOW SOILS

(A CASE STUDY OF BESHARYK DISTRICT, FERGANA REGION)

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Abstract:
This study provides an analysis of the present mechanical and agrochemical properties of irrigated meadow soils in the Besharyk district of the Fergana region. It also discusses the ongoing research work conducted within the country on this subject. Furthermore, it delves into how soil characteristics change when a single type of crop is cultivated over an extended period.

Keywords: Meadow soil, fertility, mechanical composition, humus, mobile phosphorus, mobile potassium, salinity.

Introduction

In the process of developing our country's agricultural sector, extensive scientific research has been conducted to ensure the rational and efficient use of land resources, enhance soil fertility, and implement new technologies in soil management. Significant progress has been achieved in this regard. Additionally, comprehensive measures have been implemented to promote scientifically grounded agricultural practices by introducing resource-efficient technologies for the effective use of irrigated soils. Globally, agricultural research has focused on several priority areas, including further development of agriculture, preservation, restoration, and improvement of soil fertility, efficient utilization of land resources, and optimization of the ecological status of soils. Current studies are particularly concerned with evaluating the water-physical, agrochemical properties, and ameliorative conditions of land. Special attention is being given to developing agrotechnical and agrophysical measures suitable for the soil-climatic conditions to improve, restore, and increase soil fertility, while extensively applying scientific and practical advancements in these areas【1,2,5,10】.

The Fergana Valley spans three countries—Uzbekistan, Kyrgyzstan, and Tajikistan—with a current population exceeding seven million. Cities and large villages in this geographical area are located within agricultural landscapes, where numerous storage facilities and processing plants for agricultural products are situated. The region's agriculture is heavily dependent on the redistribution of water from the mountains to

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the lowlands. The Fergana Valley is associated with the foothill regions, where intensive irrigation began in the 1930s and continues to the present day【4,7,9】.

Under the direct influence of anthropogenic factors, the soils of the Fergana region, which began to develop intensively during the 1930s-1950s, have undergone significant changes. Notable alterations have occurred in their morphology, agrochemical parameters, and salt composition.

Research Methodology:

The research was conducted in the Besharyk district of the Fergana region, focusing on the irrigated meadow soils in the CNBN and Agrotexservice tracts. The studies primarily took place in the laboratory of "Tuproqsifattahlil" DUK, where the soil's humus content, mobile phosphorus and potassium, gypsum content, carbonate content, and overall NPK levels were analyzed.

Analysis and Results

In the Fergana Valley, the primary source of irrigation for agriculture is the Syrdarya River, formed by the confluence of the Karadarya and Naryn rivers, which flow from the Fergana range and the Tien Shan mountains. Water from the Syrdarya is channeled into the North Fergana, Great Namangan, and Akhunbabaev canals, which supply irrigation water to the entire district, including the desert and foothill zones. The streams flowing from the northern mountains primarily derive their water from snowmelt and rainfall. The foothill slopes, formed from alluvial fans of the Quaternary period, serve as the zone where groundwater originates. The central part of the valley and the alluvial plains stretching from east to west (Central Fergana) act as reservoirs for subterranean water flow, marking the final stage of groundwater formation【3,6,8,11】.

The hydrogeological conditions of the district are influenced by several factors, including the depth of groundwater, the geological-morphological structure, climate and surface water regime, the level of development of irrigation networks, and the presence of artificial underground drainage systems. As the distance from the irrigation areas increases, the depth of the groundwater table also increases.

In areas where the groundwater table is shallow and stable, springs emerge, while the remaining water flows underground towards the alluvial plains of the Syrdarya River. In the region of ancient alluvial deposits of the Syrdarya, the groundwater source consists of stratified alluvial formations, where the rise of water levels is influenced by subsurface pressure, seepage from irrigation systems, and infiltration from irrigated fields. The mineralization of these waters typically ranges from 0.8 to 1.3 g/l, although it can reach up to 3 g/l in certain localized areas. Sulfates (SO_4) are predominant among the ions present, with chloride ions being relatively more concentrated in the lower parts of the alluvial fan. The type of salinity is primarily sulfate, with some localized areas exhibiting chloride-sulfate and sulfate-chloride types (see Figure 1).

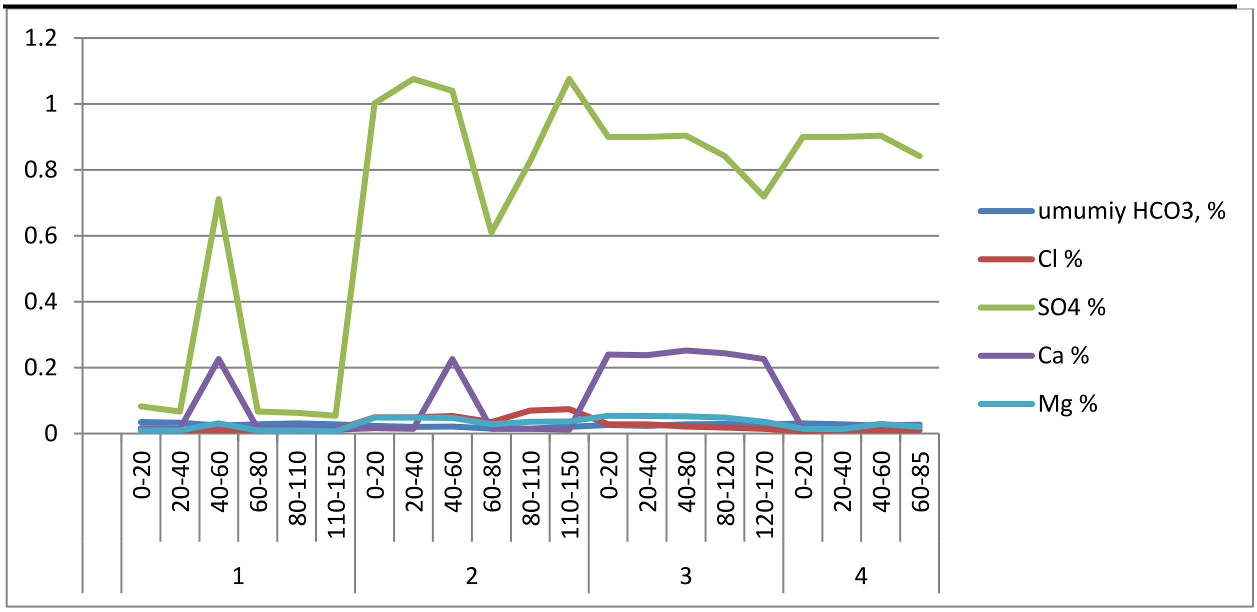

Figure 1. Soil Salinity Classification (Results of Soil Extraction)

All processes occurring in the soil are closely related to its mechanical composition. Determining the mechanical composition of soils is crucial for conducting initial field soil surveys and mapping activities with high quality. This information serves as a scientific foundation for developing necessary agrotechnical and agromeliorative measures, such as identifying soil types, establishing appropriate irrigation or salt leaching rates, organizing and positioning drainage-collector systems, and determining fertilizer application norms.

The mechanical composition of soil significantly influences its physical, physicochemical, agrochemical, and biological activity properties. It also affects the soil's moisture retention capacity and the availability of nutrients absorbed by plants. Research has shown that as the diameter of effective mechanical elements in the soil fractions decreases, there is a corresponding increase in the amount of humus, absorption capacity, moisture retention capacity, and soil swelling.

The findings indicate that the soils in the studied area vary in mechanical composition, ranging from light, medium, and heavy loam to sandy loam in some locations. In Section 1, the soil's mechanical composition along the profile revealed that fine sand (0.1-0.05 mm) constitutes 4.5-28.0%, coarse silt (0.05-0.01 mm) dominates with 15.1-35.0%, while the clay fraction (<0.001 mm) is relatively low, comprising 9.1-15.9%. In Section 2, coarse silt fractions (0.05-0.01 mm) make up 12.1-32.1%, and fine sand fractions (0.1-0.05 mm) dominate with 25.4-54.1%, while the clay fraction (<0.001 mm) is relatively low, ranging from 4.0-18.3%. In Section 3, coarse silt fractions (0.05-0.01 mm) account for 15.1-24.2%, and fine sand fractions (0.1-0.05 mm) dominate with 27.0-34.2%, while the clay fraction (<0.001 mm) remains relatively low, between 7.6-18.3%. In Section 4, coarse silt fractions (0.05-0.01 mm) constitute 17.9-25.5%, and fine sand fractions (0.1-0.05 mm) dominate with 25.4-32.6%, while the clay fraction (<0.001 mm) is relatively low, ranging from 8.7-11.9% (see Table 1)

Table 1 Mechanical Composition and Physical Clay Content of the Soil
(as a percentage)

Kesma	Qatlam, sm	Fraksiyalar, %							Fizik loyqa, %
		>0.25	0.25-0.1	0.1-0.05	0.05-0.01	0.01-0.005	0.005-0.001	<0.001	
1	0-20	2,4	13,4	20,7	21,5	8,0	18,3	15,9	42,1
	20-40	5,3	15,1	16,1	22,3	7,9	17,9	15,5	41,3
	40-60	3,1	11,9	16,7	25,4	9,1	17,9	15,9	42,9
	60-80	32,7	20,7	4,5	15,1	3,2	12,7	11,1	27,0
	80-110	0,2	13,1	27,1	35,0	4,0	11,1	9,5	24,6
	110-150	0,2	13,0	28,0	33,4	5,2	11,1	9,1	25,4
2	0-20	3,3	12,9	14,7	25,4	5,6	19,9	18,3	43,7
	20-40	2,9	11,9	12,1	27,0	7,2	20,7	18,3	46,1
	40-60	1,9	2,9	18,9	35,8	6,4	18,3	15,9	40,5
	60-80	3,3	12,2	32,1	28,6	4,8	10,7	8,3	23,9
	80-110	2,7	7,0	14,0	54,1	12,7	5,6	4,0	22,3
	110-150	2,0	7,8	13,1	54,1	12,7	6,4	4,0	23,1
3	0-20	1,4	7,1	22,4	27,0	8,7	17,5	15,9	42,1
	20-40	1,1	1,6	24,2	29,4	16,7	14,3	12,7	43,7
	40-80	1,0	3,7	15,1	34,2	8,0	20,3	17,9	46,1
	80-120	1,1	2,1	16,6	31,8	9,9	20,3	18,3	48,5
	120-170	10,2	12,6	23,9	27,0	8,7	9,9	7,6	26,2
4	0-20	4,4	19,2	22,4	27,0	2,4	13,5	11,1	27,0
	20-40	4,6	21,3	20,9	25,4	2,4	13,9	11,5	27,8
	40-60	2,6	9,1	25,5	28,6	8,0	14,3	11,9	34,2
	60-85	4,8	18,5	17,9	32,6	7,2	10,3	8,7	26,2

The analysis of soil research data indicates that the irrigated meadow soils in the district exhibit a relatively complex geomorphological-lithological structure. One distinctive characteristic of these soils is the thinness of the humus layer. The upper layers of these soils have undergone varying degrees of leaching due to irrigation and atmospheric precipitation. In some areas, the upper horizons have been eroded, exposing carbonate-rich, low-fertility layers closer to the surface. With a few exceptions, these soils are generally poor in mobile phosphorus and potassium content.

In the plow layer of the region's soils, the humus content varies, showing fluctuations within different sections. In Section 1, the humus content ranges from 1.372% in the upper layer to 0.717% in the lower layer. In Section 2, it fluctuates between 1.182% in the upper layer and 0.844% in the lower layer. In Section 3, the humus content ranges from 1.646% in the upper layer to 0.717% in the lower layer. In Section 4, the humus content varies between 1.350% in the upper layer and 0.781% in the lower layer. As the depth increases, the humus content gradually decreases. This phenomenon is attributed to the increasing salinity of the soils, resulting in a low annual growth rate of organic matter content (see Figure 2).

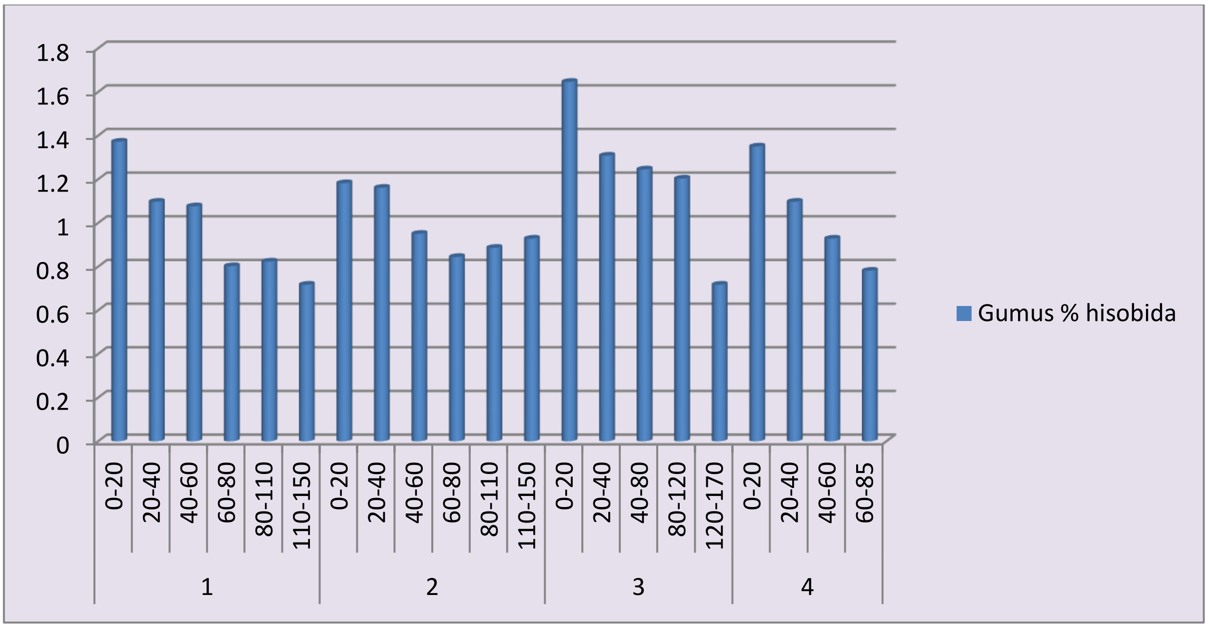

Figure 2. The humus content (%) in the studied soil areas

The content of available phosphorus in the soils of the research area varies widely, ranging from 26.0 to 5.6 mg/kg in the first horizon, 28.0 to 9.6 mg/kg in the second horizon, and 18.0 to 7.2 mg/kg in both the third and fourth horizons. The variability in phosphorus content within soil horizons is associated with the mechanical composition of the soil and its humus content.

In the upper horizons of the soil, the content of available phosphorus is relatively higher, which may be related to biological accumulation. Furthermore, the content of available phosphorus in the arable horizon ranges from 18.0 to 28.0 mg/kg, whereas in the deeper soil layers, it is between 5.6 and 9.6 mg/kg. The variability in phosphorus content across different soil horizons is notably influenced by the humus content and the mechanical composition of the soil. For instance, in soil horizons with a relatively high humus content and heavy mechanical composition, the phosphorus content reaches its maximum value. Conversely, in soil layers with lower humus content, the phosphorus content decreases to its minimum value (see Figure 3).

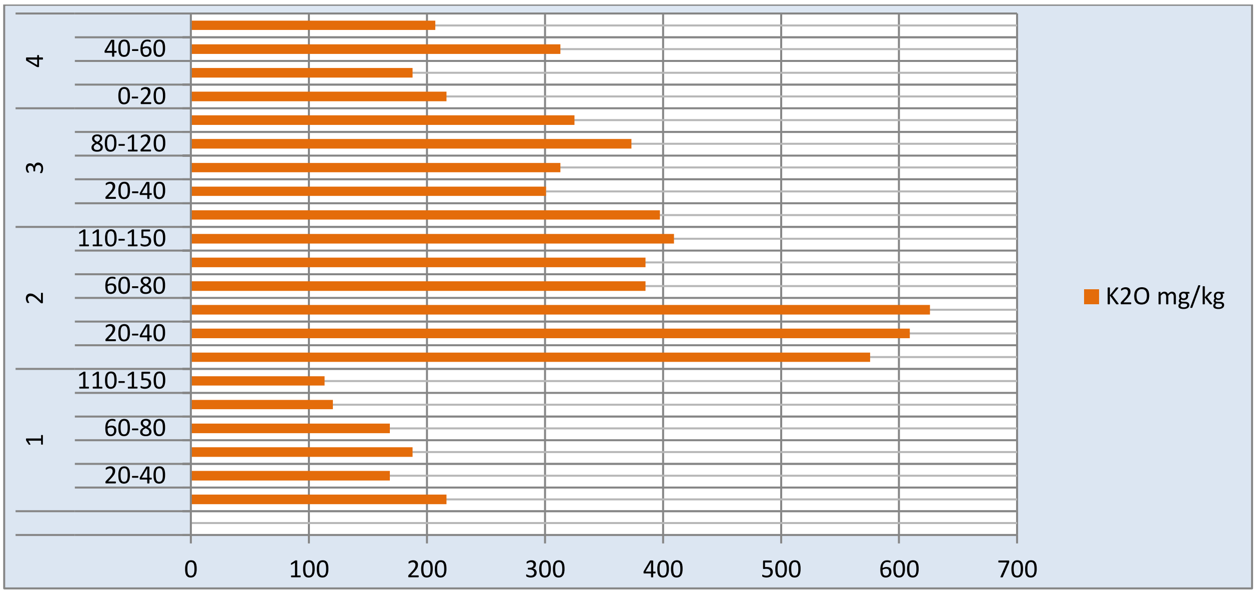

Figure 3. The content of available phosphorus in the soils of the research area (mg/kg)

The content of available potassium in the upper layers of the studied soils ranges from 216.7 to 575.5 mg/kg. A notable correlation was observed between the amounts of nutrient elements, humus content, and the mechanical composition of the soil profile in the research area (see Figure 4).

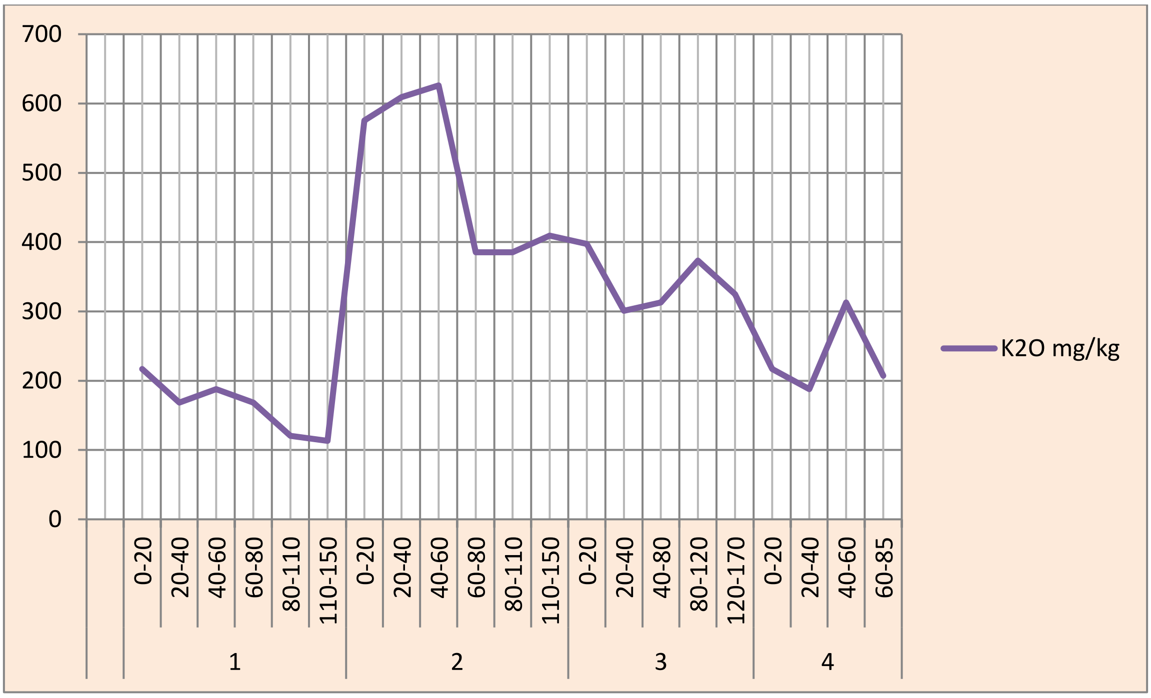

Figure 4. The content of available potassium in the soils of the research area (mg/kg)

In conclusion, the irrigated lands of the Beshariq district exhibit varying degrees of salinization, different mechanical compositions, and types of salinization. To prevent the salinization process, improve soil fertility and productivity, and enhance crop yields, it is essential to implement a comprehensive range of hydrotechnical, agrotechnical, and ameliorative measures.

To prevent the rise of groundwater levels and associated secondary salinization processes, it is crucial to use irrigation water efficiently, technically upgrade and maintain irrigation channels and ditch systems, and accurately schedule irrigation times, frequencies, and norms considering soil-climatic conditions, crop types, growth stages, water demand, groundwater depth, and other factors. Strict adherence to irrigation regimes is of significant importance.

The variability in phosphorus and potassium content is related to changes in humus content.

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