MECHANICAL COMPOSITION OF IRRIGATED SOILS OF THE LOWER AMUDARYA BASIN AND CHANGES UNDER IRRIGATION

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https://doi.org/10.5281/zenodo.12107709

Abstract. *The article presents information on the amount of physical clay and physical sand particles that make up the elements of the mechanical composition of irrigated meadow-alluvial and takyr-like meadow soils of Chimboy and Shumanay districts. The following results were obtained as a result of the study of the mechanical composition of meadow-alluvial and takyr-like meadow soils distributed on the right and left banks of the Lower Amudarya. These soils are rich in large dust fractions, and small amounts of large sand and medium sand fractions were recorded. According to the mechanical composition, it was observed that light sandy and heavy sandy soils predominate, and sand, medium sandy and light clay areas were also noted. Among the studied soils, we can say that Ch-B, sample 4, which has been irrigated for a long time, has medium loamy upper layers, and light sandy loamy lower layers, is the best in terms of fertility and chemical properties. In general, it is characterized by the characteristic features and their complexity, as well as dramatic changes in the mechanical composition of the soil profile. In some cases, it is noted that sandy layers alternate with sandy layers, and sometimes sandy layers alternate with silty layers. The sharp fluctuations of the mechanical fractions in this form are explained in connection with the sharp and contradictory changes in the lithology of the alluvial deposits. The mechanical composition of the soil is considered its important property, and according to it, soils are divided into different categories. Determining the mechanical composition of soil layers and studying its genesis (origin) is of great importance, since its mechanical composition depends not only on the composition of the parent rock, but also on the soil formation processes occurring in the soil.*

Keywords: *meadow-alluvial and takyr-like meadow soils, mechanical structure, mechanical elements, light, medium and heavy loams, physical clay and silt particles.*

Introduction: Today, one third of the world's soils are degraded by erosion, leaching of organic matter, alkalinization, pollution and other negative processes. A number of decisions have been developed to prevent such processes, maintain and increase soil fertility.

In the decision of the President of the Republic of Uzbekistan dated June 10, 2022 "On measures to create an effective system of combating land degradation" No. PD-277 on preventing land degradation in Uzbekistan and eliminating its consequences important tasks are defined. In this regard, it is important to deeply study the characteristics of irrigated lands in different soil and climate conditions of our republic, to determine the evolutionary changes occurring in the soil, to

restore and increase soil fertility, and to carry out fundamental and innovative research [1]. This decision includes forecast indicators aimed at reducing and preventing land degradation processes in 2022-2025, reducing the area of existing saline soils from 1902.3 thousand hectares to 1809.0 thousand hectares in 2022 planned. The area of land with less than 1% humus reserve is planned to decrease from 2413.7 thousand hectares to 1524.3 thousand hectares [2].

Land degradation poses a serious problem for the economic development of all Central Asian countries, including our Republic, and causes great damage to agriculture. More than 700,000 hectares of dry land in Surkhandarya, Jizzakh, Samarkand, Tashkent and Kashkadarya regions are affected by water and irrigation erosion, and more than 15% of irrigated land suffers from wind erosion. According to the information provided by the international organization FAO, about 60% of the world's land area has been degraded [6-9pp, 3].

Combating land degradation in our republic and mitigating its negative consequences, preventing desertification and drying, salinization and erosion processes in the regions, preserving biodiversity, maintaining and increasing soil fertility, restoring degraded and deflated lands, advanced scientific developments in this direction and One of the urgent problems of today is the more effective use of soils in irrigated farming zones and regions for agricultural purposes and soil conservation based on the wide use of innovations. Currently, in the conditions of Karakalpakstan, we can find a lot of land that has been deflated.

In comparison with the irrigated soils of the middle and southern parts of the Republic of Uzbekistan, the soil cover of the Aral Sea region is the progress of desertification and our research is aimed at studying the state of the soils in this region, changing such negative phenomena as degradation, dehumification, decrease in nutrient content, reduction of secondary salinization processes, etc. .d., that there is a need for their careful study.

Research conducted in recent years has shown that soil salinization and alkalinization have increased and the content of humus and nutrients has decreased significantly.

Research object and methods: Old and newly irrigated meadow-alluvial and takyr-like meadow soils, widespread in Chimboy and Shumanay districts on the right and left banks of the Lower Amudarya, are the object of research. Generally accepted genetic-geographical, profile-geochemical methods were used in the research [19-26pp, 4]. The mechanical composition of the soil was carried out according to N.A. Kachinsky's modified hydrometer and pipette methods [196-198pp, 5].

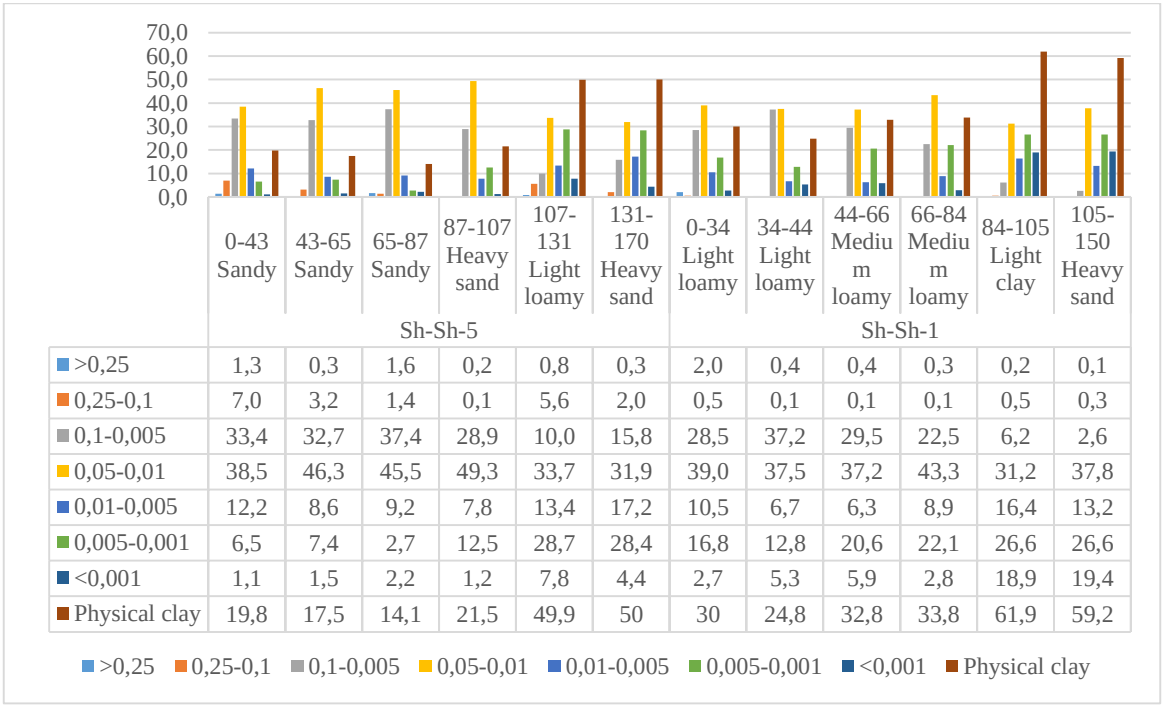
The obtained results and their analysis:

Irrigated takyr-like meadow soils. which underwent the process of desertification in ancient times, are scattered in small areas on the ancient surface of the Amudarya delta in the remote parts of the oases of Kungirot, Chimboy, Takhtakopir and Qonlikol districts. Groundwater 2-3 m. oscillating between Barren soils have previously passed the hydromorphic stage during evolutionary development, and they still have residual signs of hydromorphism, and now this process is developing rapidly. Oxidation-reduction processes are activated in the lower part of the section. According to the mesanic composition, the soil section is sharply layered and uneven: from heavy loam and clay to sandy loam, the arable layer of 27-30 cm is mainly heavy and medium loam, rarely light loam and loam. In soils with a mechanical composition of heavy sand, an 8-10 cm thick compacted subsoil layer was formed. In the lower part of the section, there are signs of old and increasing hydromorphism in the form of rust-brown spots. The soils are weak and moderately saline

If we compare the soil morphology with the previous years, we have observed that seepage waters fall to the lower layer, where the level of seepage waters was 1.5-2 m in previous years, but by today it has decreased to 2.5-3 m [42-46 pp.6]

Depending on the age of irrigation and geomorphological regions, in old irrigated takyr-meadow soils the volumetric mass was 1.45–1.55 g/cm3, in meadow-takyr soils - 1.44–1.71 g/cm3, in newly developed desert- sandy soils - 1.44–1.48 g/cm3. These soils are highly compacted, sometimes very compacted. Also, in old-irrigated meadow soils, the volumetric mass from the upper horizons down the soil profile is, respectively, 1.37–1.50 and 1.49–1.47 g/cm3, in newly irrigated takyr (takyr-like) soils -1.33– 1.56 g/cm3 and soils are considered to be medium to highly compacted. Newly irrigated takyr-meadow soils are the least compacted by volumetric mass throughout the entire territory, where the volumetric mass is 0.97 - 1.31 g/cm3. The specific gravity of the soils of the territory under consideration according to their soil profile ranges from 2.57-2.73 g/cm3, corresponding to low and medium degrees, porosity indicators range from 45–64 % [30p, 6].

The mechanical composition of soils depends on a number of indicators, such as the topography of the place, its mineralogical composition, parent rock, and the level of turbidity of irrigation water used in irrigated agriculture. Mechanical composition is important in knowing the chemical, physical, physico-chemical and other properties of soils, determining their productivity. The solid part of the soil consists of mechanical particles of various sizes. They are rocks, fragments of minerals, as well as various mineral, organic and organo-mineral compounds formed in the process of soil formation. The solid part of the soil consists of mechanical particles of various sizes. They are rocks, fragments of minerals, as well as various mineral, organic and organo-mineral compounds formed in the process of soil formation. Fractions of mechanical particles in the soil have different properties, therefore, the mechanical composition of the soil largely describes its most important properties, i.e., porosity, water-physical properties, thermal properties, soil structure, chemical composition, absorption capacity, biological activity and productivity. [66-77pp, 7].

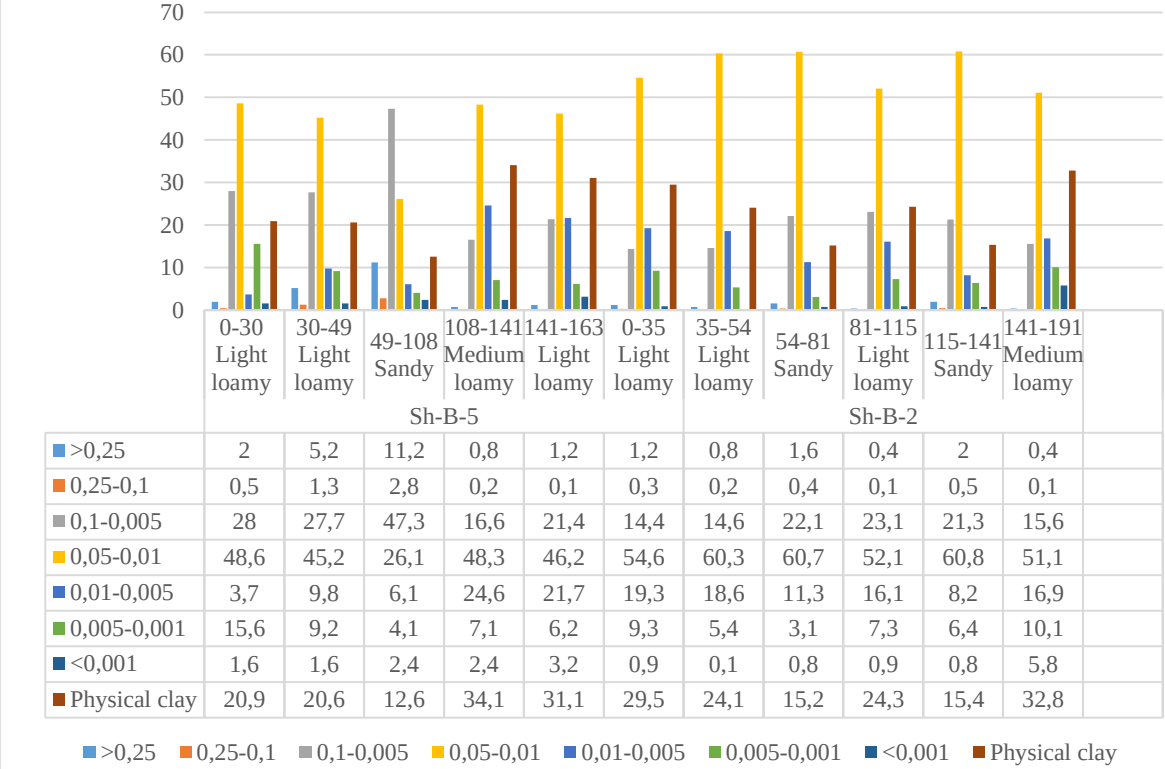


	0-43 Sandy	43-65 Sandy	65-87 Sandy	87-107 Heavy sand	107-131 Light loamy	131-170 Heavy sand	0-34 Light loamy	34-44 Light loamy	44-66 Medium loamy	66-84 Medium loamy	84-105 Light clay	105-150 Heavy sand
	Sh-Sh-5						Sh-Sh-1					
>0,25	1,3	0,3	1,6	0,2	0,8	0,3	2,0	0,4	0,4	0,3	0,2	0,1
0,25-0,1	7,0	3,2	1,4	0,1	5,6	2,0	0,5	0,1	0,1	0,1	0,5	0,3
0,1-0,005	33,4	32,7	37,4	28,9	10,0	15,8	28,5	37,2	29,5	22,5	6,2	2,6
0,05-0,01	38,5	46,3	45,5	49,3	33,7	31,9	39,0	37,5	37,2	43,3	31,2	37,8
0,01-0,005	12,2	8,6	9,2	7,8	13,4	17,2	10,5	6,7	6,3	8,9	16,4	13,2
0,005-0,001	6,5	7,4	2,7	12,5	28,7	28,4	16,8	12,8	20,6	22,1	26,6	26,6
<0,001	1,1	1,5	2,2	1,2	7,8	4,4	2,7	5,3	5,9	2,8	18,9	19,4
Physical clay	19,8	17,5	14,1	21,5	49,9	50	30	24,8	32,8	33,8	61,9	59,2

Fig. 1. Mechanical composition of newly irrigated meadow-alluvial soils, %

According to the results of the analysis of the mechanical composition of the old and newly irrigated meadow-alluvial and takyr-like meadow soils presented in Picture-1, it was noted that the amount of particles of newly irrigated meadow-alluvial soils distributed in the Shumanay massif of Shumanay district in the 5th and 1st samples is unevenly distributed along the cross-section profile. Large sand particles (>0.25) ranged from 0.1% to 2.0%, medium sand particles (0.25-0.1) ranged from 0.1% to 7.0%, while fine sand it was noted that the particles were predominant (0.1 - 0.05) from 2.6% to 37.4%, the amount of physical clay particles (<0.01) in the soils of the studied area was from 14.1% to 61.9% accordingly, it was noted in our research that the mechanical composition of soils varies along the cross-section profile (Fig. 1).

The mechanical composition of 5- and 2- sample of newly irrigated meadow alluvial soils distributed in the Begjap massif of Shumanay district is different. In the upper arable and sub-arable layers of the section profile, they are mainly composed of light loams and sandy. In the lower layers of the section profile, the amount of physical clay is 12.6 % to 34.1% was noted in our research (Fig. 2).



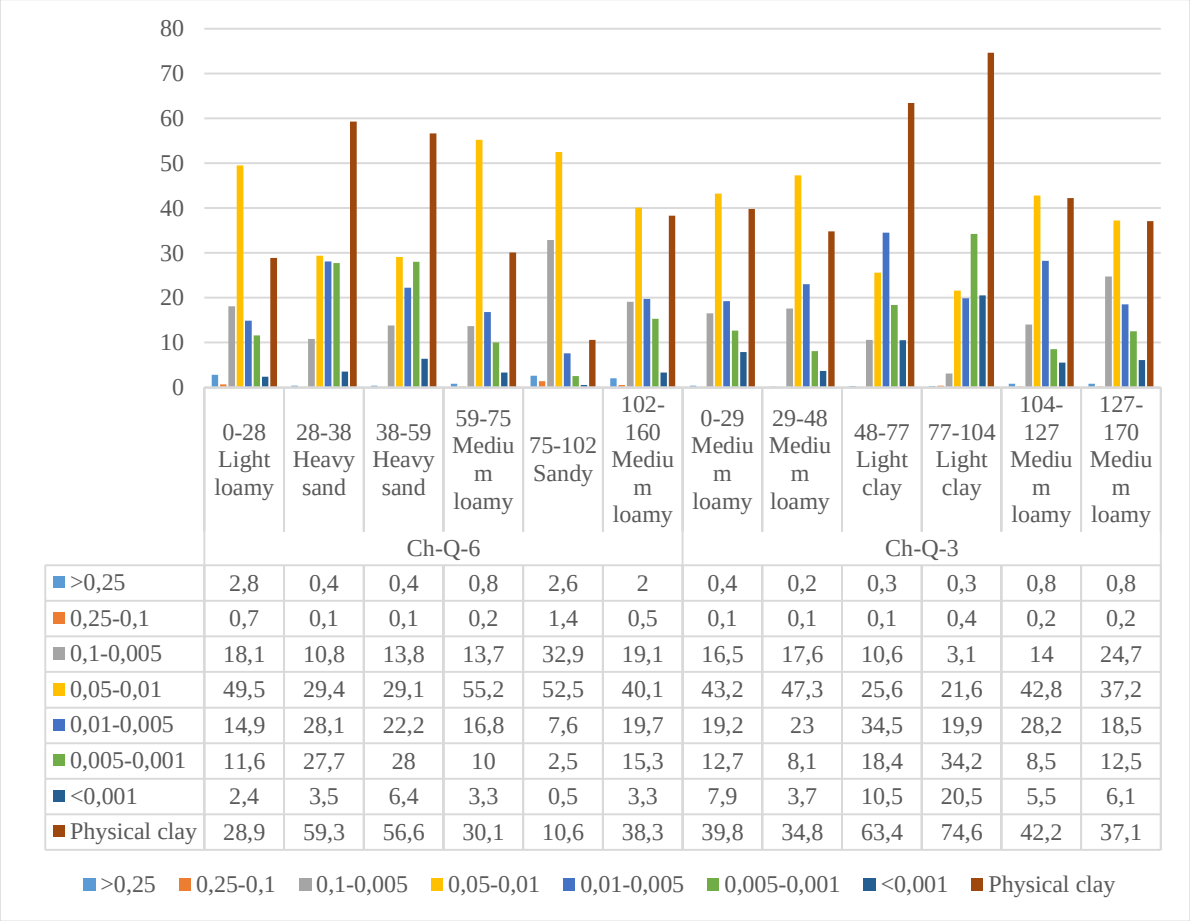
	0-30 Light loamy	30-49 Light loamy	49-108 Sandy	108-141 Medium loamy	141-163 Light loamy	0-35 Light loamy	35-54 Light loamy	54-81 Sandy	81-115 Light loamy	115-141 Sandy	141-191 Medium loamy
	Sh-B-5						Sh-B-2				
>0,25	2	5,2	11,2	0,8	1,2	1,2	0,8	1,6	0,4	2	0,4
0,25-0,1	0,5	1,3	2,8	0,2	0,1	0,3	0,2	0,4	0,1	0,5	0,1
0,1-0,005	28	27,7	47,3	16,6	21,4	14,4	14,6	22,1	23,1	21,3	15,6
0,05-0,01	48,6	45,2	26,1	48,3	46,2	54,6	60,3	60,7	52,1	60,8	51,1
0,01-0,005	3,7	9,8	6,1	24,6	21,7	19,3	18,6	11,3	16,1	8,2	16,9
0,005-0,001	15,6	9,2	4,1	7,1	6,2	9,3	5,4	3,1	7,3	6,4	10,1
<0,001	1,6	1,6	2,4	2,4	3,2	0,9	0,1	0,8	0,9	0,8	5,8
Physical clay	20,9	20,6	12,6	34,1	31,1	29,5	24,1	15,2	24,3	15,4	32,8

Fig. 2. Mechanical composition of newly irrigated meadow-alluvial soils, %

Therefore, the mechanical composition of the soils of the studied area plays an important role in the process of soil formation and the use of land in agriculture. The mechanical composition of the soil is determined by the ratio of physical clay and physical sand, with the help of which it is possible to significantly determine the level of soil moisture and nutrient uptake by plants.

In the massifs, old and newly irrigated meadow-alluvial and takyr-like meadow soils with different mechanical composition are scattered. According to geomorphology, these soils are composed of alluvial deposits and layered alluvial deposits of Amudarya. It belongs to the region of the modern delta of Amudarya. In the course of research, it became known that the mechanical composition of meadow-alluvial and takyr-like meadow soils distributed in Chimboy and Shumanay districts is extremely diverse and varies sharply along the profile. The results of the

mechanical analysis of the 6th and 3rd samples in the Qamishariq massif of Chimboy district are as follows: the amount of large sand (>0.25) particles along the soil profile is 0.2-2.8%, medium sand (0.25-0.1) is 0.1 - 1.4%, fine sand particles (0.1 - 0.05) 3.1-32.9%, large dust (0.05-0.01) particles 21.6-55.2%, medium dust (0.01-0.005) particles 7.6-34.5%, fine dust (0.005-0.001) 2.5-28.0%, clay (<0.001) particles 0.5-20.5% and physical clay particles (<0.01) fluctuated between 10.6-74.6% (Fig. 3).

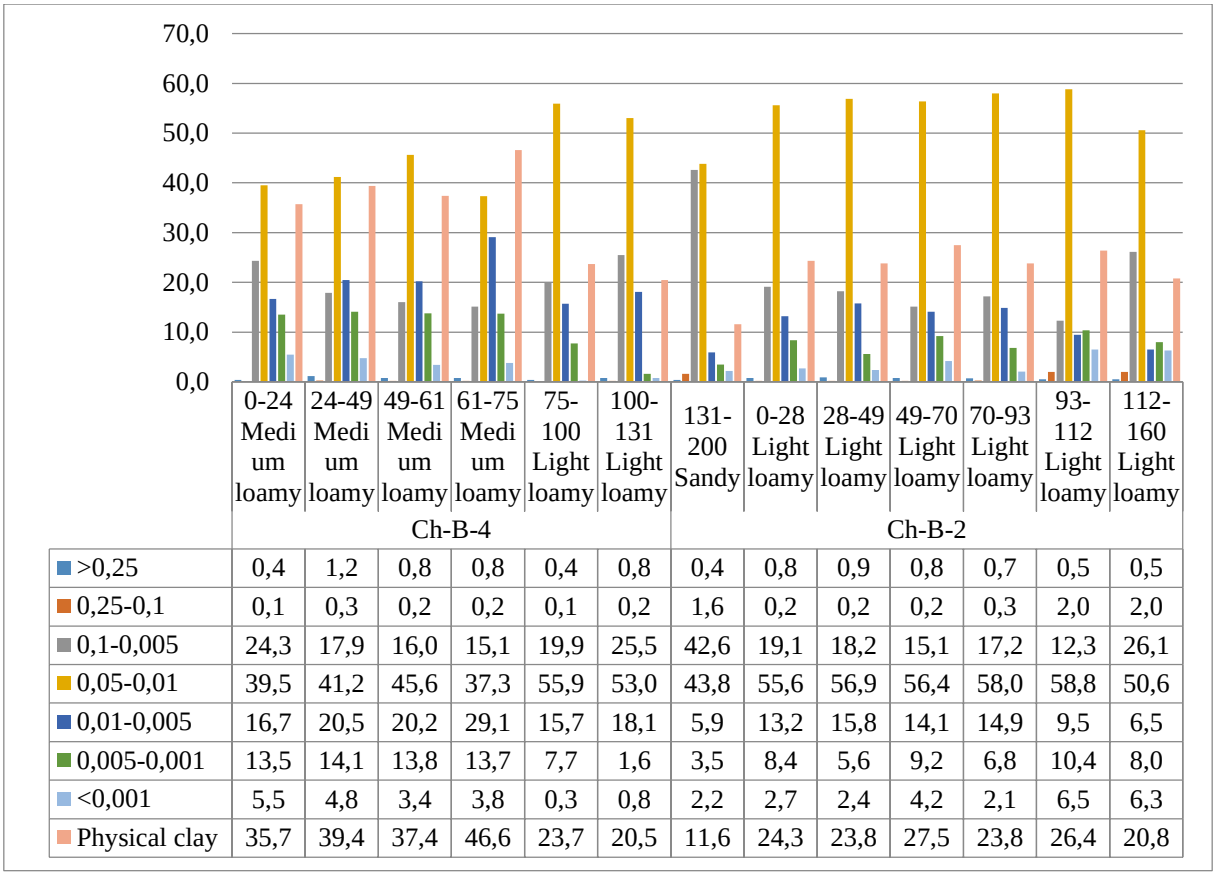


	0-28 Light loamy	28-38 Heavy sand	38-59 Heavy sand	59-75 Medium loamy	75-102 Sandy	102-160 Medium loamy	0-29 Medium loamy	29-48 Medium loamy	48-77 Light clay	77-104 Light clay	104-127 Medium loamy	127-170 Medium loamy
	Ch-Q-6						Ch-Q-3					
>0,25	2,8	0,4	0,4	0,8	2,6	2	0,4	0,2	0,3	0,3	0,8	0,8
0,25-0,1	0,7	0,1	0,1	0,2	1,4	0,5	0,1	0,1	0,1	0,4	0,2	0,2
0,1-0,005	18,1	10,8	13,8	13,7	32,9	19,1	16,5	17,6	10,6	3,1	14	24,7
0,05-0,01	49,5	29,4	29,1	55,2	52,5	40,1	43,2	47,3	25,6	21,6	42,8	37,2
0,01-0,005	14,9	28,1	22,2	16,8	7,6	19,7	19,2	23	34,5	19,9	28,2	18,5
0,005-0,001	11,6	27,7	28	10	2,5	15,3	12,7	8,1	18,4	34,2	8,5	12,5
<0,001	2,4	3,5	6,4	3,3	0,5	3,3	7,9	3,7	10,5	20,5	5,5	6,1
Physical clay	28,9	59,3	56,6	30,1	10,6	38,3	39,8	34,8	63,4	74,6	42,2	37,1

Fig. 3. Mechanical composition of old irrigated takyr-like meadow soils, %

The results of the analysis in samples 4 and 2 of the Bozatau massif of Chimboy district show that the amount of large sand particles (>0.25) along the soil profile is 0.4-1.2%, medium sand (0.25-0.1) is 0.1 - 2.0%, fine sand particles (0.1 - 0.05) 12.3-42.6%, large dust (0.05-0.01) particles 37.3-58.8%, medium dust (0.01-0.005) particles 5.9-21.1%, fine dust (0.005-0.001) 1.6-14.1%, clay (<0.001) particles 0.3-6.5% and physical clay particles (<0.01) ranged from 11.6 to 46.6% (Fig. 4).

On the territory of the Khojeyli region, there are mainly old irrigated, partially newly irrigated meadow alluvial and newly developed meadow soils, differing in mechanical composition. The upper horizon of the studied soils (0-20-30 cm) is mainly medium and heavy loam, sometimes light loams are found. The lower soil horizons vary from light loamy to sandy loam and sand. Judging by the mechanical composition of genetic soil horizons, it can be noted that the studied soils have good water-physical properties and water permeability[307-309pp, 8].



	0-24 Medium loamy	24-49 Medium loamy	49-61 Medium loamy	61-75 Medium loamy	75-100 Light loamy	100-131 Light loamy	131-200 Sandy	0-28 Light loamy	28-49 Light loamy	49-70 Light loamy	70-93 Light loamy	93-112 Light loamy	112-160 Light loamy
	Ch-B-4						Ch-B-2						
>0,25	0,4	1,2	0,8	0,8	0,4	0,8	0,4	0,8	0,9	0,8	0,7	0,5	0,5
0,25-0,1	0,1	0,3	0,2	0,2	0,1	0,2	1,6	0,2	0,2	0,2	0,3	2,0	2,0
0,1-0,005	24,3	17,9	16,0	15,1	19,9	25,5	42,6	19,1	18,2	15,1	17,2	12,3	26,1
0,05-0,01	39,5	41,2	45,6	37,3	55,9	53,0	43,8	55,6	56,9	56,4	58,0	58,8	50,6
0,01-0,005	16,7	20,5	20,2	29,1	15,7	18,1	5,9	13,2	15,8	14,1	14,9	9,5	6,5
0,005-0,001	13,5	14,1	13,8	13,7	7,7	1,6	3,5	8,4	5,6	9,2	6,8	10,4	8,0
<0,001	5,5	4,8	3,4	3,8	0,3	0,8	2,2	2,7	2,4	4,2	2,1	6,5	6,3
Physical clay	35,7	39,4	37,4	46,6	23,7	20,5	11,6	24,3	23,8	27,5	23,8	26,4	20,8

Fig. 4. Mechanical composition of old irrigated takyr-like meadow soils, %

The obtained data show that the amount of physical clay in the second layer of the soil profile (Sh-Sh, cross-section 1) was 24.8%, and we can see that the amount of physical clay increases to 61.9% as it deepens. In another soil sample (Ch-Q, sample 4), we can see a reduction in physical clay content from 46.6% to 11.6% in the deep part of the profile. Such a sharp fluctuation in the amount of mechanical fractions is related to the sharply changing lithology of alluvial deposits.

The mechanical composition of the soil is considered its important property, and according to it, soils are divided into different categories. Determining the mechanical composition of soil layers and studying its genesis (origin) is of great importance, since its mechanical composition depends not only on the composition of the parent rock, but also on the soil formation processes occurring in the soil. The distribution of clay particles across the soil cross-section is considered a good indicator indicating the presence of secondary clay mineral formation (soil turbidity) in the soil. The number of silt particles in silt layers increases compared to the soil-forming rock, and this becomes the basis for the identification of metamorphic layers in the soil section. The nature of the distribution of soil particles in the soil also indicates the speed and qualitative direction of the soil formation process[59-60p, 9].

Conclusion. The following results were obtained as a result of the study of the mechanical composition of meadow-alluvial and takyr-like meadow soils distributed on the right and left banks of the Lower Amudarya. These soils are rich in large dust fractions, and small amounts of large sand and medium sand fractions were recorded. According to the mechanical composition, it was observed that light sandy and heavy sandy soils predominate, and sand, medium sandy and light clay areas were also noted. The structure of the lithological profile is characterized by sharp layering and different mechanical composition. Among the studied soils, we can say that Ch-B,

sample 4, which has been irrigated for a long time, has medium loamy upper layers, and light sandy loamy lower layers, is the best in terms of fertility and chemical properties.

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