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SALINE SOILS OF ARID TERRITORIES OF THE SOUTHERN ARAL SEA REGION AND METHODS OF STUDY FOR MONITORING

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ABSTRACT

The article deals with the issues of soil salinization in the arid territories of the Southern Aral Sea region. In irrigated soils, there is a fairly even distribution of nitrates along the soil profile. The development of secondary salinization in the region can be considered as one of the existing problems that arose as a result of the widespread development of irrigation, which determined the transfer of automorphic soils. This issue requires some elaboration of new approaches to the development of irrigation in the region.

KEYWORDS: *Southern Aral Sea Region, Soil Salinization, Monitoring, Soil Physical Condition, Irrigation, Fertility.*

INTRODUCTION

Relevance of the topic

Saline soils are an indispensable component of both natural and anthropogenic landscapes of arid territories. Soil salinity is one of the main genetic indicators of arid soils, as well as a property that limits its fertility. The issues of classification, origin and agro melioration of the soils of arid territories cannot be resolved without painstaking research of saline soils, detailed monitoring of their distribution and forecast development. In connection with the growth of anthropogenic

pressure, soil degradation is one of the most urgent problems of today that call for an immediate intercession. Taking into account the actual occurrence and the natural and economic significance of the consequences, soil salinization is considered as one of the most significant types of soil degradation. One of the main environmental problems of the region is secondary salinization of land, which occurs due to increased salinity of groundwater. The Southern Aral Sea region is officially recognized as an ecological disaster zone due to existing environmental problems, such as water scarcity, soil salinization, water pollution, poor supply of high-quality drinking water to the population, degradation of pastures and arable land, and the death of tugai and saxaul forests [4, 6]. The main criterion for assessing the physical condition of the soil is the correspondence of the complex of soil properties to the nature of the functions performed by the soil in a particular landscape. In this context, the most relevant issues are the quantitative assessment of saline soils. This means that, first of all, it is necessary to establish how, and to what extent, the amount of salts affects the performance of the soil of its ecological functions through changes in physical properties.

Salinization of soils leads to the physical degradation of land and its further loss from agricultural use [1]. In turn, the physical degradation of soils serves as a trigger for a large number of natural destabilized processes. The widespread increase in the area of saline soils and the resulting reduction in arable land makes it necessary to assess the ecological status of saline soils [2, 3]. From this point of view, the protection of soil fertility and its increase is one of the main environmental problems. When using the soil, some anthropogenic processes that affect it contribute to a decrease in its fertility, and therefore it is necessary to carry out measures aimed at eliminating them.

MATERIALS AND METHODS

The research was carried out in the arid zone of the Southern Aral Sea region (Republic of Karakalpakstan), occupied by irrigated soils in shirkat farms of the central zone of the republic (Chimbay, Nukus, Kegeyli, Khodjeyli districts). The climate of the territory is sharply continental with dry and hot summers. Soil samples for determining the degree of salinity were taken by the envelope method from each site from the upper 0-30 cm layer. The content of water-soluble salts was determined in the soil samples selected and prepared for chemical analysis. The degree of soil salinity and the salinity of ground water were estimated by the content of water-soluble salts (ions) according to the method of V. Pankov [4].

DISCUSSION OF THE RESULTS

The process of soil salinization is one of the leading degradation processes in the irrigated lands of the Southern Aral Sea region. The current state of the soils in the Aral Sea region is critical. The humus content has decreased by 30-40% over the past 40-50 years, and about 60% of the cultivated areas contain less than 1% of humus. In this regard, the primary problem of agriculture in the Aral Sea region is the reclamation of saline soils and their return to agricultural circulation. The complex of environmental hazards and problems plays an important role in determining the main strategic directions for ensuring environmental safety, preventing and eliminating environmental threats [5].

Saline soils include soils containing easily soluble salts in toxic amounts for agricultural plants. They have a direct negative effect on plants as a result of an increase in the osmotic pressure of

soil solutions and the toxic effect of individual ions, as well as an indirect effect through changes in physico-chemical, biological and other properties under their influence [5, 6]. Soda, then chloride, then sodium and magnesium bicarbonates, and then sodium and magnesium sulfates show the greatest toxic effect. Gypsum, as well as calcium carbonate (unlike toxic magnesium carbonate), is not toxic, however, its presence in large quantities (gypsum bark) leads to a decrease in soil fertility [2, 3].

In irrigated soils, there is a fairly even distribution of nitrates along the soil profile, the maximum limits of their content in virgin soils are 16.4-75.2 mg/kg in the upper 30-cm layer, and at a depth of 70-100 cm – they vary within 6.3-19.2 mg/kg of soil. In soils with a low content of nitrate nitrogen compounds in virgin conditions, there is a sharp reduction in their concentration in the layer of 50-70 cm. In the low-lying layers of the soil, the reduction is no longer observed. With a high content of nitrates in virgin conditions, there is a consistently high amount of nitrates in the entire meter thickness with an accumulation in the layer of 0-30 cm and with a tendency to accumulate in the layer of 50-70 cm. In irrigated soils, there is a very gradual decrease in the distribution of nitrates along the soil profile; only in old-irrigated soils, there is a slight increase in their content in the layer of 70-100 cm.

According to researchers [9], in virgin automorphic soils, an increased amount of mineral nitrogen is observed only in the upper, 0-50 cm layer, with a sharp decrease in its content down the profile. The presence of high amounts of nitrates in the lower horizons of the soil profile is an anthropogenic factor [9, 10].

According to the depth of the upper boundary of the salt horizon, saline soils are divided into saline – salts in the layer of 0-30 cm, saline – 30-80 cm, deep saline – 80-100 cm and deep saline - deeper than 150 cm. The salt content is expressed in % and in mg-eq per 100 g of soil. In the first approximation, saline soils are considered to contain water-soluble salts of more than 0.25% of the soil weight, and salt marshes-more than 1, 2, 3%, depending on the type of salinity. A more accurate ecological assessment of soil salinity takes into account the nature of salinity (the predominant chemical composition of cations and anions), and an even more detailed assessment takes into account the amount of toxic salts [3, 4].

The analysis of the irrigated lands of the Southern Aral Sea region by soil-reclamation areas showed that the main share of soils is gray-brown soils – 55.6%, followed by desert-sandy soils – 15.7%, the smallest share is swamp-meadow, which amounted to only 0.10%. (figure 1).

The analysis of water extraction of soils (in %) showed that the main type of salinization in the studied areas is chloride-sulfate. Samples were taken at 3 main points in 5 horizons. The analysis showed that at the sampling site №2, the sulfate-chloride type of salinity was recorded in the 20-30 cm horizon, and at the sample site №3, the transition from the salinity type to the sulfate-chloride type was observed in the 10-20 cm horizon.

According to the authors, the irrigated soils of the northern cotton-growing areas in the Southern Aral Sea region were able to yield raw cotton at the level of 13-15 c/ha due to natural fertility. The content of total nitrogen is gradually reduced until 0,042 % loss of total nitrogen in recent years was 31.8% [8] there is also a significant reduction in the amount of phosphorus and potassium, but for typical stabilization of humus content in soils and its deficiency does not exceed 162-199 kg/ha.

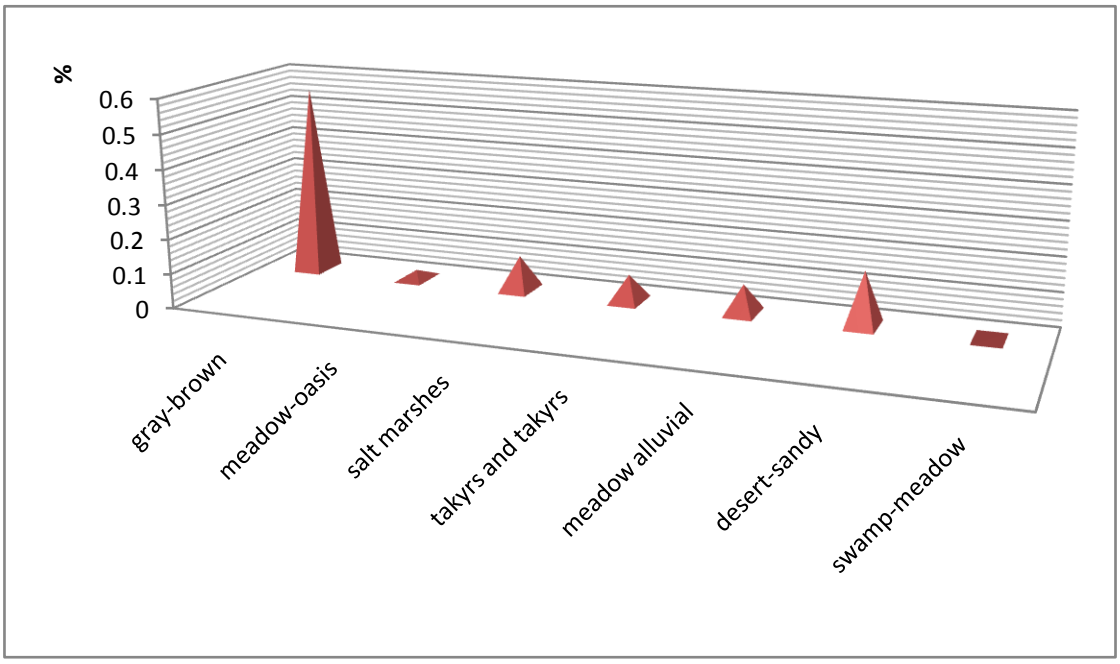

Fig.1. Distribution of irrigated lands in the Southern Aral Sea region by land reclamation areas

It is the stable preservation of the humus content in the soils that shows a stable yield of raw cotton at the level of 13-15 c / ha [8]. The stability of the humus content is also explained by the natural ability of soils to preserve their ecological function, fertility and ensure the yield of cultivated plants, which is achieved due to the activity of soil micro flora, root residues, leaf litter, irrigation water, as well as atmospheric precipitation [7]. With an unfavorable background, the natural processes of transformation, consumption and replenishment of soil reserves with nutrients prevail in the soil [7].

Consequently, on irrigated lands, the salts contained in the deep horizons of the soil-forming and underlying rocks enter into circulation. Depending on the hydrogeological conditions, depth, and distance between drains, the volume of salts discharged from deep horizons can be from 20 to 60% of the total volume of salts entering the drainage runoff. The development of secondary salinization in the region can be attributed to the existing problems that arose as a result of the widespread development of irrigation, which determined the transfer of automorphic soils to this issue requires the development of new approaches to the development of irrigation in the region. First of all, it is necessary to conduct an inventory of irrigated land based on modern methods of remote sensing and modeling of salinization processes for individual irrigation massifs in order to determine the direction and intensity of the salt accumulation process. Already on the basis of these data, the most promising lands for irrigation should be identified and new irrigation methods, in particular, drip irrigation, should be introduced on these massifs.

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