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Alted Soils of Arid Territories and their Ecological Evaluation (By the Example of the South Aral Sea Region)

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Abstract: ***The article presents the results of studies of various types of soils in arid territories. It was noted that the widespread increase in saline soils and the consequent reduction of arable land necessitates an environmental assessment of saline soils from the point of view of their ecological status. 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, and requires the development of new approaches to the development of irrigation in the region.***

Keywords: Southern Aral Sea region, ecological assessment, irrigated lands, agrocenoses, ecosystems

1. Introduction

Salinization of the soil is one of the serious signs of land degradation worldwide. According to the International Institute for Environment and Development (International Institute for Environment and Developmennt) and the World Resources Institute, about 10% of the continent's surface is covered with saline soils [3]. The problem of land salinization is present in many countries of the world. The productivity of plants, especially industrial crops, decreases sharply in saline soils, and this requires appropriate reclamation impacts on the soil [5].

Due to the increase in anthropogenic pressures, soil degradation is one of the most urgent and requiring immediate intervention problems of our time. Soil salinization has been identified as one of the most significant types of soil degradation, taking into account the real occurrence and the natural and economic significance of the consequences. Salinization of soils leads to physical land degradation and their further withdrawal from agricultural use [1]. In turn, physical soil degradation serves as a trigger for a large number of natural disasters.

The widespread increase in the area of saline soils and the consequent reduction in arable land necessitates an environmental assessment of saline soils from the point of view of their ecological status [2, 3]. From this point of view, the protection of soil fertility and its increase is one of the main environmental problems. When using soil, some anthropogenic processes affecting it contribute to a decrease in its fertility, and therefore it is necessary to carry out measures aimed at eliminating them.

2. Material and methods

Studies were conducted in the arid zone of the Republic of Karakalpakstan, occupied by irrigated soils. In farms of Chimbay and Kegeyli districts, which are located in the central part of the South Aral region. The climate is sharply continental with dry and hot summers. Soil samples for determining the degree of salinization were selected using the envelope method from each plot from the upper 0-30 cm layer. During the growing season of sorghum, soil samples were taken from the plots of the experiment on the day of sowing and the following phases of crop development: seedlings, tillering, flowering, ripening of grains. The soil samples selected and prepared for chemical analysis determined the content of water-soluble salts. The degree of salinization of soil and groundwater salinity was estimated by the content of water-soluble salts (ions) according to the method of V. Pankov [4].

3. Results and discussion

Due to existing environmental problems, such as water scarcity, salinization of soils, water pollution, poor supply of high-quality drinking water, degradation of pastures and arable lands, and the loss of tugai and saxaul forests, the region is officially recognized as an ecological disaster zone [4, 6] . One of the main environmental problems in the region is the secondary salinization of land, which occurs as a result of increased groundwater salinity.

The process of soil salinization is one of the leading degradation processes on the irrigated lands of the South Aral Sea region. The current state of soils in the Aral Sea region is critical. The humus content over the past 40-50 years has decreased by 30-40%, and about 60% of the sown area contains less than 1% 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. A set 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 that contain soluble salts in quantities toxic to 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 effects of individual ions, as well as an indirect effect through a change in physicochemical, biological, and other properties under their influence [5, 6]. The greatest toxic effect is exerted by soda, then chloride, then sodium and magnesium bicarbonates and then sodium and magnesium sulfates. Gypsum, as well as calcium carbonate (unlike toxic magnesium carbonate), is not toxic, however, its presence in large quantities (gypsum crust) leads to a decrease in soil fertility [2, 3].

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

The analysis of the irrigated lands of the Southern Aral Sea by soil-reclamation areas showed that the main share of soils is gray-brown soils - 55.6%, followed by desert-sand - 15.7%, the smallest share is swamp-meadow, which amounted to only 0 ,10%. (fig. 1).

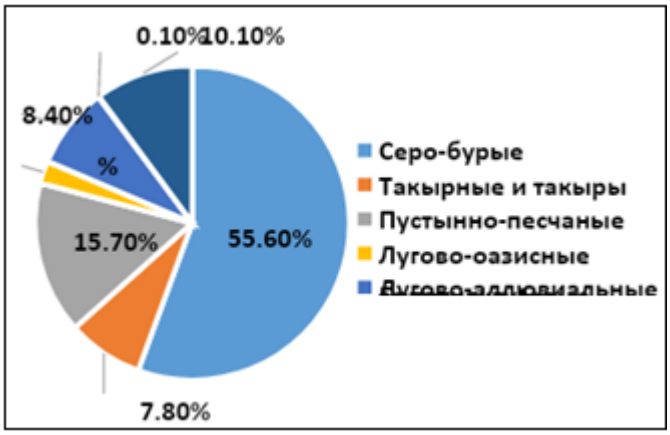

Figure 1: Distribution of irrigated lands of the South Aral Sea region in soil-reclamation areas

The analysis of water extract of soils (in%) showed that the salinity type in the studied territories is mainly chloride-sulfate. Samples were taken at 3 major points in 5 horizons. It was established that at point No. 2 in the horizon of 20-30 cm, the type of salinity changes to sulfate-chloride, and at point No. 3, the transition type of salinity to sulfate-chloride is observed in the horizon of 10-20 cm.

The current methodology for calculating the salt balance of irrigated lands does not take into account the specific features of horizontal drainage, which removes salts not only from soils, but also contributes to the redistribution and removal of deep salt reserves from salt-containing rocks and groundwater.

Thus, on irrigated lands, salts contained in the deep horizons of parent and underlying rocks come into circulation. The volume of salts discharged from deep horizons, depending on hydrogeological conditions, depth and distance between drains, can be from 20 to 60% of the total volume of salts entering the drainage flow.

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, and 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 lands on the basis of modern methods of remote sensing and modeling salinization– desalination processes for individual irrigation massifs in order to establish the direction and intensity of the salt accumulation process. Already on the basis of these data to identify the most promising land for irrigation. It is on these arrays that new, currently widely used in the world irrigation methods should be introduced, in particular, drip irrigation.

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