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Soil as an Indicator of Natural Processes in the South Aral Sea Region

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Abstract: ***The article deals with the current state of soils in the southern Aral sea region. It is shown that the soils of the Republic of Karakalpakstan due to the extreme climate and hydrogeological conditions are characterized by a low humus content and a high tendency to salinity.***

Keywords: southern Aral sea, soils, salinization, indication, formation, aridity

1. Introduction

The Aral ecological catastrophe, which occurred in a relatively short period of time and expressed in salinization of soils, degradation of vegetation cover, progression of various diseases among the population and other negative processes, requires the accumulation of fresh information on the state of individual components of the natural environment.

As you know, soil is an indicator of natural processes, and its condition is the result of prolonged exposure to various sources of pollution. Air emissions from industrial enterprises, heat power engineering and transport facilities lead to soil pollution, deterioration of their physical and chemical state and, as a result, to a decrease in fertility. Due to the extreme climate and hydrogeological conditions, the soils of the South Aral Sea region are characterized by a low humus content and a high tendency to salinization [1]. In recent years, widespread land development has led to their degradation, increased salinity, decreased soil fertility, increased deflation and erosion processes [3]. Due to the use of increased amounts of various mineral fertilizers and pesticides, most of the irrigated soils are contaminated with various ingredients.

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On the post-arid land of the Aral Sea, salt marshes are formed by intensive evaporation of sufficiently moist soil in areas exposed to the sun, i.e. positive landforms. In this case, the accumulation of salts in the upper horizons of the soil occurs as a result of the capillary rise of salts to the surface.

Automorphic salt marshes are developed both in Adzhibay Bay and on most of the dried bottom, and can be divided into cortical, cortical-puffy and puffy varieties. Basically, these salt marshes are composed of a highly saline clay substrate with a predominance of sediments of heavy mechanical composition and, less commonly, loams. As was shown in [5], in the initial stage of exposure of the seabed, hydromorphic and semihydromorphic salt marshes usually develop. The leading factor in this process is the proximity of highly mineralized groundwater. The coastal strip is characterized by groundwater depths of up to 0.5 meters. When this level decreases, caused by the departure of the coastline, the soil dries up with the formation of a cracked surface layer. These areas of post-aquarium land become a source of salt-dust mixture [4].

2. Result and Discussion

As is known, the maximum salt content (up to 27%) falls on the cortical and subcortical horizons. In general, the periphery of the Aral Sea is characterized by sodium sulfate – chloride, calcium, and magnesium – sodium salinization types [3, 4]. Cortical and cortical-puffy salt marshes, whose tenardite fluff is one of the main sources of salt storms in the Aral Sea region, are characteristic of semi-automorphic salt marshes. This type of post-arid land is usually characteristic of zones framing the formed automorphic salt marshes, or stretches in a narrow strip along the swapped sand spits. [fifteen].

Widespread crusty-chubby salt marshes during the early drying period are developed as separate fragments on the sands of the Sorgul lagoon, near the former Muynak seaside and along the east coast. The maximum amount of salts (up to 15%) in such solonchak massifs is confined to the salt crust. Due to the sulfate-chloride-sodium type of salinization, heating of the soil in the spring-summer season causes the formation of 1-2 cm layer of tenardite-clay clay powder. By the period of autumn precipitation, the puffer formed during the summer period is almost completely carried away from the surface, but subsequently self-restores [4]. Such a regime of saline salt marshes makes them the most powerful source of salt-dust flow.

Hydromorphic soils of post-aqua land are a transitional stage to the automorphic development of the soil layer or are found only in areas of constant moisture. The source of subsurface water is inflow from the side of coastal water bodies. Unlike automorphic salt marshes, they are not armored with a purely salt crust, but with a complex mixture of gypsum, clay minerals and water-soluble salts.

Such a composition is extremely unstable to water erosion, and precipitation, even minor ones, leads to its destruction;

then the gypsum crust can recover, followed by cracking in the summer months. On the whole, this type of salt marshes is relatively inactive as a source of salt and dust removal, and their exposure after the aeolian movement of the cover layers of sand and silt is stabilized. They are characterized by a takyr-like surface. [4, 5].

Closer to the coastline, coastal excess hydromorphic cortical and estuarine brine solonchaks develop. The strip of their development depends on the slope of the seabed and reaches a width of 15 kilometers. Water-soluble salts carried out by capillary current form a wet crust on the surface with a salt content of up to 15%. In the immediate vicinity of the coastline, the groundwater level merges with the day surface. This leads to the fact that the negative forms of the meso- and microrelief are filled with a supersaturated salt solution (brine). In these natural polders, salt capping occurs. NaSO4 crystallizes in the form of large oblong friends of mirabilite, and NaCl precipitates in the form of large square halite crystals. After drying of these centers of salt accumulation, crystalline halite remains quite stable, covering the surface with an even layer. Mirabilite, being subject to weathering, when dehydrated under the influence of high daytime temperatures, turns into a fluff of tenardite, easily tolerated even by a weak wind.

The formation of coarse-grained salt began in the mid-90s and was previously noted only in the Aktumsyk straits separated from the sea.

On shallow-sloping flattened sections of the sea coast, surge waves form marching salt marshes. Earlier, as a result of the flushing regime, the formation of salt cows was not observed here, but in recent years there is evidence of their appearance.

Salt aerosol from the post-arid land of the Aral Sea makes a significant contribution to soil salinization and thereby to the processes of intensive degradation of the soil-natural complex of the southern Aral Sea region. The formation of saline soils is associated with the accumulation of salts in groundwater and rocks and the conditions conducive to their accumulation in soils. One of the sources of salts in soils is mineralized groundwater with a shallow occurrence of them [1, 3].

The accumulation of salts in groundwater, rocks and soils is associated not only with the processes of their formation, but also with their redistribution on the earth's surface. Currently, as a result of the drying up of the Aral Sea, the equilibrium of the Southern Aral Sea ecosystem is disturbed, pressure on natural complexes reaches extreme strength, and anthropogenic desertification and aridization are occurring everywhere [1, 2]. In areas with an arid climate, and especially in the semi-desert and desert, where evaporation is much higher than precipitation, conditions are created for the accumulation of salts in groundwater and parent rocks. In these areas, mainly saline soils are located.

Solonchaks include soils containing a large amount of water-soluble salts at the surface. Depending on the salinity chemistry, the salt content in the upper horizon of salt marshes ranges from 0.6-0.7 to 2-3% or more. A sharp drop in the level of the Aral Sea and a decrease in the flow of water into the channels of the Amu Darya and Syr Darya led to the formation of an arid strip along the coastline with a width of 100 km or more [2]. Soils in the coastal zone have become vulnerable to wind. Numerous sand mounds appeared, towering 1-3 m above the salt plain. When the sea level dropped by 14 m (1990), wetlands and tree-shrubbery changed to arid.

A clumpy desert plain was formed, sometimes with thickets of hodgepodge. The main factor determining aridity is the constantly observed imbalance between the amount of precipitation and evaporation at high temperature and winds [1, 2].

Currently, the removal of nutrients from irrigated lands significantly exceeds the returned amount and, accordingly, the "law of return" is violated. Therefore, we consider it necessary:

1) Strengthen organizational measures to implement the "Law on Soil Fertility";
2) prosecute land users and farmers, reducing soil fertility through various types of pollution;
3) to increase the planned manure turnover in the irrigated lands of the republic;
4) to intensify the landscaping of various industrial enterprises and settlements, as World practice has proved the irreplaceable role of green spaces as the main component of the biosphere in the formation of favorable conditions for the existence of life.

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