Current ecological state of soils in the Caspian lowland of Azerbaijan and conditions of their formation

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Abstract. The article presents an analysis of the current ecological state of the lands of the Caspian coastal territories within the borders of the Republic of Azerbaijan and outlines the influence of various factors on the ecological state of these soils. In the course of scientific research carried out according to numerous criteria, an assessment was made of the current reclamation situation in the coastal areas of the Caspian Sea. It has been established that the ecological situation of the region is very tense and the process of desertification occurs due to a lack of water in the region, located in an arid zone. To improve the reclamation state of the territory, it is recommended to use additional water sources and non-traditional irrigation - Caspian sea water with a mineralization index of 12-14 g/l as irrigation water. The occurrence of groundwater in this region at a depth of 5-10 m from the surface of the earth and its low degree of mineralization allows the use of sea water to irrigate the soils of these areas during the growing season, which creates conditions for the transport of salts accumulated in the upper layer of soil to the lower layers. As a result of a complete study and analysis of the physical, mechanical, chemical and water-physical properties of the soil, it was finally concluded that when cultivating Caspian lands for agricultural crops, non-traditional irrigation waters, especially water from the Caspian Sea, can be used for irrigation. This is possible due to the soil characteristics of the region. The use of sea water for irrigation purposes will have a positive impact on the revitalization of coastal lands that have not been cultivated for years due to lack of water, and will contribute to the abundance of harvests in the republic.

1 Introduction

Drought, which may result from global climate change, is the most dangerous natural phenomenon and should be considered a very complex emergency. Its consequences can last for a very long time. The threat of water shortage should be assessed as an unpreventable type of emergency, and rescue measures related to water supply should be developed now.

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In some regions of our country, located in the arid zone, there is still a shortage of fresh water.

An analysis of literature data shows that there is currently a water shortage on Earth, including a very serious shortage of irrigation water. If in the past the issue of protecting water resources and receiving dividends from them was discussed at the local level, then in the present and in the future this problem is and will be manifested at the national, regional and even global level. Being a necessity of today, the issue of using salt water, including sea and ocean water, is one of the most pressing problems of our time.

The socio-economic and environmental benefits of irrigating coastal areas with seawater are even greater. The coastal zones of the Caspian Sea measure ten thousand hectares. Improvement of the coastal areas of the Caspian Sea can successfully prevent such negative situations.

Purpose of the study. The main goal of the ongoing scientific research is the environmental assessment of the territories located along the Caspian coast of the Absheron Peninsula, and the development of ecological and reclamation principles for the use of sea water for watering plants in conditions of water deficiency.

To achieve the goal set during the study, the following issues were studied: environmental assessment of the Caspian lands, analysis of international experience in irrigation with water from the Caspian Sea, determination of the basic chemical composition of the water of the Caspian Sea, for irrigation purposes, a qualitative assessment of the water of the Caspian Sea, for irrigation purposes, determination of the parameters of sea water in laboratory conditions, etc.

The object of study is the sandy lands of the Caspian coast within the borders of the republic.

2 Materials and methods

Suitability of sea water for irrigation, irrigation of plants with sea water, washing of saline soils. Evaluation of the results of experiments, the study of processes occurring in the soil and other issues have been implemented in institutes of foreign countries, and have also received widespread implementation and recognition when conducting reclamation research in our republic and applied using existing modern methods.

Practical significance of the study. It has found application during years of water shortage when using sea water as an additional source of water for irrigation, when using sea water to lay the clay layer through vegetation in coastal empty sandy zones, when carrying out regulatory and protective measures during irrigation with sea water against salinization, etc. .

3 Results and Discussion

The coastal regions of the Caspian coast include the Samur-Devachin lowland, the Sumgait-Siyazan zone, the Absheron Peninsula, as well as the coastal parts of the Gobustan, Salyan and Neftchala regions located on the South-Eastern Shirvan Plain, the coastal plain parts of the Masalli, Lankaran and Astara regions of the Lankaran region. Tectonic movements and Caspian transgressions of the fourth period played a big role in the formation of the relief. Sediments of the fourth period cover thick Paleogene, Neogene and Mesozoic rocks and consist of marine and continental sedimentary rocks [1]. In many places on the Caspian coast, low sand dunes, composed of aeolian deposits, consist of ridges and dune-like forms, moving in the direction of the prevailing winds in the form of

elongated hills. The sands are inactive and their thickness does not exceed 3-8 meters [2]. Mud volcano deposits are also widespread on the plain.

The role of the Caspian Sea in the formation of the climatic elements of these areas is significant. The average long-term air temperature on the coast of the Caspian Sea ranges from 12.0-14.0ºC, in some areas the air temperature in the summer months reaches 40 ºC. The average annual temperature of the warm months reaches 24.0-25.0 ºC [3]. The annual amount of evaporation and precipitation varies, respectively, between 1085-1180 mm, 230-300 mm in the Samur-Devachin zone; in the Siyazan-Sumgait zone - 1000-1100 mm, 110-226 mm; on the Absheron Peninsula and in Gobustan - 910-1260 mm, 221-320 mm; in southeastern Shirvan - 940-965 mm, 286-295 mm; in the Lankaran zone - 700-900 mm, from 600 mm to 1000 mm.

It should be noted that precipitation falls mainly in the autumn-winter months, and evaporation, according to the laws of nature, is usually greater in the warm months. The ratio of evaporation to precipitation in the Samur-Devachin zone is 0.42, in the Apsheron zone - 0.20, in the Mugano-Salyan zone - 0.31 and in the Lenkoran zone - 1.56. This situation necessitates the cultivation of agricultural crops in most of the territory along the Caspian coast with the help of artificial irrigation; under such conditions, the process of accumulation of salts in the soil also accelerates.

Research shows that marine terraces in the coastal zone are lithologically composed mainly of sand, clay, limestone, etc. In the described areas, the depth of groundwater varies within different limits, while the groundwater level gradually decreases with distance from the sea.

In the territories of South-Eastern Shirvan adjacent to the sea, the depth of groundwater ranges from 0.5 m to 3.0 m, and the degree of mineralization is 16.3-23.2 g/l and higher. In the coastal areas of the Lenkoran zone, the depth of groundwater is 0.5-3.0 m or more, the degree of mineralization is 1.0-3.0 g/l or more. The chemical composition of groundwater is sulfate-chlorine and hydrocarbonate [4]. The vegetation of the Caspian coast is distinguished by its diversity: it varies both by zone from the plains of the foothills towards the Caspian direction, and by meteorological conditions along the study area from Yalama to Astara. If up to the Yalama-Devachi region forests, shrubs and meadow plants predominate, then in the Sumgait, Absheron, Gobustan and Salyan-Neftchala regions ephemeral, semi-desert plant species are common.

According to the hydrographic network, the object of study is not the same [5]. In the Samur-Devachi section, the rivers Gudialchay, Karachay, Valvalachay, Gilgilchay are flooded all year round and flow into the sea. The Atachay River flowing through the Sumgait-Siyazan section is full of water all year round and flows into the sea,

The soils of the Caspian coastal plain of the Samur-Devachi area in the direction from the sea to the mountains change both in type and in physicochemical properties. Sands and sandy soils are spread along the sea coast in the form of a narrow strip. In the northeastern part, meadow-forest lands have formed in the massif along the sea coast. In the direction from northwest to southeast, a strip of meadow and meadow-gray soils stretches along the coastal strip; these soils are salty and saline.

In the described region, light brown, meadow-brown, gray-brown, meadow-gray-brown, meadow-swamp and saline soils are common [6]. Soils are subject to varying degrees of salinity. The type of salinity is sulfate and chloride-sulfate. The soils of the Samur-Devachi zone were formed mainly on clay and loamy deposits. In a layer of 0-200 cm, the density of the solid phase of the soil ranges from 2.60-2.70 g/(cm^3), and the volumetric mass* (* - the concept of volumetric weight means the density of a dry soil sample) - ranging from 1 .35 to 1.55 g/(cm^3) [7]. In the upper two-meter layer, soil porosity ranges from 40.5-50.5%, natural moisture on forb-meadow soils is 13.60-21.30%, on meadow-bog and saline soils - 21.60-25.00 %, minimum water content - 20.30-23.10%.

The degree of soil salinization varies. The amount of absorbed bases in these soils ranges from 25.4-29.9 mg/eq [7]. It should be noted that the amount of magnesium cation absorbed by soils is significant and in the absorbed complex amounts to up to 40%. The unsatisfactory water-physical properties of the described soils are mainly due to their heavy mechanical composition, medium and high salinity. The soils of this area vary dramatically due to the differentiation of genetic layers. The most distinctive features are the presence of an upper thin lumpy layer with a relatively small amount of humus, a middle layer with a columnar-prismatic structure and a clearly defined saline gypsum layer.

According to the mechanical composition of the soil in the area allocated for the experiment in the village of Shurabad, located in the Sumgait-Siyazan massif, it is heavy clay, the amount of physical clay over the entire area in the soil layer 0-100 cm is 80.0-93.0%, the number of clay particles is 40-60 %, sometimes 95%. The values of soil density (2.70-2.83 g/(cm^3), volumetric weight (1.50-1.68 g/(cm^3) and total porosity (40.0-44.0 %) in the 0-200 cm soil layer are justified by the high density of clay particles. Soil moisture is 16.0-22.0%, and the minimum moisture saturation is in the range of 24.0-27.0%.

On the peninsula, gray-brown soils are more common than brown soils. They have less power and fewer nutrients than brown ones; the amount of humus reaches 1.25%.

The mechanical composition of gray-brown soils is very diverse and varies from sandy loam and light loamy to heavy loamy; the water-physical properties of these soils are also varied. According to the classification of R.Kh. Mamedov soils are sandy in mechanical composition (number of particles <0.01 mm - 5.5-19.2%), volumetric weight of impermeable soil 1.33-1.64 g/(cm^3), density of individual phases (specific gravity) is 2.70 g/(cm^3). Soil porosity is 40-50%, the least wet is in the upper layers - 7.0-9.0%, in deep layers - within 16.8-24.0%. The soils have a high water absorption capacity (43.8-50.4 cm/h).

Irrigation erosion is also widespread on irrigated lands. As a result of intensive grazing of livestock on winter pastures, pasture erosion has become widespread in the zone, affecting the productivity of pastures and significantly worsening the quality of the crop. Saline and partially saline soils are common over large areas [8]. The degree of salinity in the 0-1 m layer of soil is 0.32-3.0%, the amount of sodium absorbed from the total amount is 5.5-8.3%.

We studied the water-physical properties of soils in the Neftchala region, located in the described zone, at 8 experimental points under field and laboratory conditions. Soil volumetric mass 1.72-1.55 g/(cm^3), specific gravity 2.64-2.70 g/(cm^3), porosity 48-57%, water absorption 7.92-96.0 cm /h. Coastal podzolic soils of the Lenkoran zone are distributed in the Astara, Lenkoran and Masalli regions [9]. These lands occupy 72.8 thousand hectares (12.0%) of the total amount of flat lands. The degree of salinity in a 0.1 m soil layer is 0.1-2.4%, and the amount of absorbed sodium is 1.5-3.3% of the total amount.

In the region, saline areas amount to 16.4 thousand hectares. Of these, 4.8 thousand hectares (35.9%) are slightly saline, 3.4 thousand hectares (10.3%) are moderately saline and 1.3 thousand hectares (3.9%) are highly saline areas [10]. Up to 56.0% of the entire land fund of the region (343 thousand hectares) is subject to varying degrees of erosion [11]. The water-physical properties of the coastal lands of the Lenkoran Lowland were studied in detail by Kh.M. Guseinov, M.M. Abdinov, F.A. Ilyasov, N.B. Karimov and other scientists [12].

According to studies, the soils in the coastal parts of the Lenkoran Lowland are medium and heavy clayey in their mechanical composition, and sometimes loamy in the lower layers. The volumetric weight of soils is 0.90-1.28 g/(cm^3), according to the classification of R.Kh. Mamedov they can be classified as impermeable, density 2.0-2.80 g/(cm^3),

porosity 50-55%, total water capacity 28.5-54.0%. The water absorption capacity of the soil was 16.2-45.3 cm/hour, which indicates the high water absorption capacity of the soil.

4 Conclusion

Natural factors of the described territories (the Caspian Sea, the Greater and Lesser Caucasus mountains and factors formed as a result of anthropogenic impacts) caused the formation of both the ecological and reclamation state of the soils and, finally, contributed to the development of various ecosystems in this zone. Despite the absence of a sharp gradation in the ecological and reclamation state of the Lankaran, Guba-Khachmaz soils, the lands of the Neftchala, Absheron-Gobustan, Sumgait-Siyazan zones of the Caspian coast are subject to intense degradation, here the process of desertification becomes an inevitable factor. The main condition for improving the soil on the arid shores of the Caspian Sea and restoring the biosphere here is the search for new sources of water and their use for irrigating plants in dry lands.

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