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SOIL MAPPING AND FERTILITY ASSESSMENT OF IRRIGATED SANDY DESERT SOILS IN BUKHARA REGION

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Abstract

This article presents the results of soil mapping and fertility assessment of irrigated sandy desert soils in the Bukhara region, using Jondor district as a case study. The research focused on the morphological, granulometric, agrochemical and reclamation characteristics of irrigated soils. Particular attention was paid to soil texture, humus content, available phosphorus, exchangeable potassium, salinity level and soil quality rating.

The findings indicate that a considerable part of the irrigated soils of Jondor district is characterized by low humus content, insufficient nutrient supply, light mechanical composition and weak to moderate salinity. The main part of the studied lands belongs to soils with a bonitet score of 21–40 points, which corresponds to below-average quality lands. Based on the obtained results, scientifically grounded recommendations are proposed to improve soil fertility, reduce salinity and ensure the rational use of irrigated agricultural lands.

Keywords: Irrigated soils, sandy desert soils, soil map, soil fertility, bonitet score, humus, granulometric composition, salinity, reclamation, Jondor district.

Introduction

The rational use of land resources and the preservation of soil fertility are among the most important issues in modern agriculture. In arid regions such as Bukhara, the productivity of irrigated lands largely depends on the agrochemical, reclamation and ecological condition of soils [1, 2].

Soil is the main natural resource of agricultural production. Its productive capacity is determined by a combination of factors, including soil genesis, granulometric composition, humus content, nutrient availability, salinity level, groundwater depth and the effectiveness of reclamation measures [4].

The study of irrigated sandy desert soils is of particular scientific and practical importance. These soils are usually characterized by low organic matter content, weak structure, high water permeability, susceptibility to wind erosion and risk of secondary salinization. Therefore, soil mapping and soil quality assessment provide a scientific basis for the rational placement of crops, planning of reclamation activities and improvement of land-use efficiency [3, 5].

The purpose of this study was to investigate the properties of irrigated sandy desert soils in Jondor district of Bukhara region, to assess their fertility and to determine their soil quality rating for scientifically based agricultural use [1, 2].

Materials and Methods

The object of the study was irrigated sandy desert, meadow-alluvial and meadow-marsh soils formed under different soil-climatic conditions of Jondor district, Bukhara region.

The research was carried out through preparatory, field, laboratory and analytical stages. During the field stage, soil profiles were described, morphological features were recorded and soil samples were collected from genetic horizons. In laboratory conditions, mechanical composition, humus content, available phosphorus, exchangeable potassium, water-soluble salts and other fertility indicators were determined.

The study used generally accepted methods of soil science, including geographical, genetic, comparative-geographical, lithological-geomorphological, chemical-analytical and profile methods. The obtained data were processed using mathematical and statistical methods.

Jondor district is located in the subtropical desert zone of Central Asia. The climate is sharply continental, with hot and dry summers, low precipitation and high evaporation. Under these conditions, soil formation is influenced by irrigation, parent material, groundwater level, salinity processes and anthropogenic pressure. [3, 5]

Results and Discussion

Granulometric Composition of Irrigated Soils. The results showed that newly irrigated meadow soils with different mechanical compositions are widespread in Jondor district. According to granulometric composition, the studied soils include clayey, heavy loamy, medium loamy, light loamy, sandy loamy and sandy soils.

Table 1. Distribution of irrigated soils of Jondor district by mechanical composition

Mechanical composition of soils	Area, ha
Clayey soils	347.3
Heavy loamy soils	2,953.4
Medium loamy soils	13,304.7
Light loamy soils	8,128.5
Sandy loamy soils	2,830.3
Sandy soils	626.9

As shown in Table 1, medium loamy soils occupy the largest area — 13,304.7 ha. Light loamy soils also cover a significant area — 8,128.5 ha. The presence of sandy loamy and sandy soils

indicates the need for special agrotechnical and reclamation measures aimed at improving soil structure, increasing water-holding capacity and accumulating organic matter.

Agrochemical Properties and Soil Quality Assessment

Agrochemical indicators are among the main criteria for assessing soil fertility. The analysis showed that the studied soils are generally poor in humus and available phosphorus. Humus content varies from 0.303% to 1.054%, which indicates a low level of organic matter accumulation. Available phosphorus ranges from 4.1 to 19.8 mg/kg, while exchangeable potassium ranges from 103 to 209 mg/kg.

The cadastral assessment showed that the studied lands belong mainly to the first cadastral group, III–IV land classes. Their bonitet score is 21–40 points, which corresponds to below-average quality lands.

Table 2. Agrochemical and cadastral characteristics of irrigated soils of Jondor district

Indicator	Characteristics / Value
Main studied soil types	Irrigated meadow-desert and meadow-takyr soils
Studied soil depth	0–125 cm and 0–157 cm
Humus content, %	0.303–1.054
Available phosphorus, P_2O_5, mg/kg	4.1–19.8
Exchangeable potassium, K_2O, mg/kg	103–209
Humus supply level	Very low and low
Dominant salinity degree	Weak, locally moderate
Main salinity type	Chloride-sulfate
Cadastral group	First group
Land class	III–IV class
Bonitet score	21–40 points
Land quality	Below average
Main limiting factors	Salinity, low humus content, poor nutrient supply, risk of wind erosion
Recommended measures	Salt leaching, organic fertilizers, crop rotation, drainage improvement, soil monitoring

The results confirm that low humus content is one of the major limiting factors of soil fertility in the irrigated lands of Jondor district. A significant part of the studied soils contains less than 1% humus, which negatively affects soil structure, biological activity, water retention and nutrient availability.

The weak supply of available phosphorus also limits crop productivity. Although exchangeable potassium is present in moderate amounts in some soil layers, its distribution is uneven. Therefore, balanced fertilization based on soil analysis is essential for increasing agricultural productivity.

Salinity is another important factor restricting crop yield. The studied soils are mainly weakly saline, while some areas are moderately saline. The chloride-sulfate type of salinity requires differentiated reclamation measures, taking into account soil texture, salt composition, groundwater depth and the technical condition of the collector-drainage network.

Scientific and Practical Recommendations

To improve the fertility and reclamation condition of irrigated sandy desert soils in Jondor district, the following measures are recommended:

1. Regular monitoring of soil humus, available phosphorus, exchangeable potassium and salt content should be carried out.
2. Organic fertilizers, composts, manure and plant residues should be widely applied to increase soil organic matter.
3. Green manure crops should be introduced into crop rotation to improve soil structure and biological activity.
4. Saline soils should be leached according to the degree of salinity and mechanical composition.
5. The collector-drainage network should be kept in good technical condition to prevent secondary salinization.
6. Crop rotation systems should be scientifically organized, especially with the inclusion of legumes and soil-improving crops.
7. Deep tillage should be applied on compacted and heavy-textured soils where necessary.
8. Modern GIS-based soil mapping methods should be introduced for accurate land evaluation and management.

Conclusion

The conducted research showed that the irrigated sandy desert soils of Jondor district in Bukhara region are characterized by low humus content, weak nutrient supply, light mechanical composition and varying degrees of salinity. Medium loamy and light loamy soils occupy the largest areas, while sandy loamy and sandy soils require special measures to improve their water-holding capacity and fertility.

The agrochemical analysis revealed that the humus content of the studied soils is very low or low, and the supply of available phosphorus is insufficient. The cadastral assessment showed that most of the studied lands have a bonitet score of 21–40 points and belong to below-average quality lands.

Soil mapping and bonitet assessment have significant scientific and practical importance. They make it possible to determine the current condition of the soil cover, identify limiting fertility factors, rationally allocate agricultural crops and develop effective measures for improving soil productivity.

To ensure sustainable use of irrigated lands in Jondor district, it is necessary to improve the humus status of soils, reduce salinity, apply organic fertilizers, introduce crop rotation systems, maintain drainage networks and use modern soil mapping technologies.

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