

STUDY OF AGROCHEMICAL PROPERTIES OF IRRIGATED MEADOW-ALLUVIAL SOILS

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Annotation: This article examines the agrochemical properties of irrigated meadow-alluvial soils and their significance for sustainable agricultural production. The study analyzes soil fertility indicators such as humus content, pH levels, nutrient balance (nitrogen, phosphorus, and potassium), and the impact of irrigation regimes on soil structure and productivity. Based on field and laboratory research, the article identifies the main factors influencing the chemical composition and fertility dynamics of meadow-alluvial soils. The findings contribute to the development of optimal soil management strategies aimed at improving crop yields and maintaining ecological balance in irrigated agricultural systems.

Keywords: irrigated soils, meadow-alluvial soils, agrochemical properties, soil fertility, irrigation regime, sustainable agriculture.

INTRODUCTION

Soils play a crucial role in ensuring agricultural productivity and ecological stability. Among them, irrigated meadow-alluvial soils occupy a special place, as they are widely distributed in river valleys and serve as the main resource base for intensive crop cultivation. These soils are characterized by high fertility potential, but their chemical composition and productivity are strongly influenced by irrigation practices, groundwater levels, and climatic factors.

In recent years, increasing anthropogenic pressure and changes in water management systems have caused notable alterations in the agrochemical properties of irrigated meadow-alluvial soils. Excessive irrigation, salinization, and improper fertilization have led to a decline in soil fertility and degradation of its structure. Therefore, studying the agrochemical characteristics of these soils—such as humus content, macronutrient balance, and reaction of the soil solution—is essential for developing measures to improve and maintain soil health.

The present study aims to analyze the agrochemical properties of irrigated meadow-alluvial soils under different irrigation regimes and to identify factors affecting their fertility. The results will serve as a scientific basis for the rational use of soil resources, optimization of fertilization systems, and sustainable development of irrigated agriculture.

Literature Review

The study of irrigated meadow-alluvial soils has been a focus of numerous researchers due to their importance in agricultural productivity and ecological sustainability. According to FAO (2019), maintaining the agrochemical balance of irrigated soils is critical for ensuring long-term soil fertility and preventing degradation processes such as salinization and nutrient depletion.

Khasanov et al. (2018) reported that the fertility of meadow-alluvial soils largely depends on irrigation water quality, groundwater depth, and the intensity of agro-technical measures. Their research highlighted that excessive irrigation without proper drainage can lead to secondary salinization, adversely affecting soil productivity. Similarly, Karimov (2020) emphasized the

role of organic matter and humus in stabilizing soil structure and improving nutrient availability under irrigated conditions.

Several studies, including Rahmonov (2021), have shown that balanced application of mineral and organic fertilizers can significantly enhance the agrochemical characteristics of alluvial soils. Moreover, the use of green manure crops and crop rotation systems has been recommended as an effective strategy for restoring soil fertility.

Research conducted by Iskandarov and Mukhamedova (2022) indicated that the pH level and nutrient dynamics in irrigated meadow-alluvial soils vary with irrigation regimes and seasonal fluctuations. Their findings support the need for region-specific soil management practices that consider both environmental and agronomic factors.

In summary, the reviewed literature demonstrates that maintaining the agrochemical balance of irrigated meadow-alluvial soils requires an integrated approach combining rational irrigation, efficient fertilization, and ecological monitoring. These insights provide the foundation for the current study aimed at evaluating and improving the chemical and biological properties of such soils under modern agricultural conditions.

Methodology

The research was conducted to determine the agrochemical characteristics of irrigated meadow-alluvial soils and to evaluate the influence of irrigation and fertilization on their fertility indicators. The study employed a combination of field experiments, laboratory analyses, and statistical methods to ensure comprehensive and reliable results.

Research Area and Sampling:

The study area was located in a typical irrigated zone characterized by meadow-alluvial soils formed under the influence of periodic flooding and irrigation. Soil samples were collected from different depths (0–30 cm, 30–60 cm, and 60–90 cm) to assess the vertical distribution of nutrients and other properties. Sampling was conducted before irrigation, during the vegetation period, and after harvesting to monitor seasonal changes.

Laboratory Analysis:

Collected samples were analyzed according to standard soil science methods:

Humus content – determined by the Tyurin method.

Soil pH – measured using a pH meter in a 1:2.5 soil–water suspension.

Total nitrogen – determined by the Kjeldahl method.

Available phosphorus (P_2O_5) – determined by the Chirikov method.

Exchangeable potassium (K_2O) – determined by the flame photometric method.

Soil salinity and electrical conductivity (EC) – measured to evaluate the effects of irrigation water quality.

Irrigation and Fertilization Regimes:

Experimental plots were established to compare different irrigation frequencies and fertilizer combinations (mineral, organic, and mixed). Irrigation scheduling was based on soil moisture monitoring using tensiometers and field capacity data.

Data Analysis:

All results were statistically processed using Microsoft Excel and SPSS software. The data were subjected to correlation and regression analyses to determine relationships between irrigation regime, nutrient content, and crop yield indicators.

Research Objectives:

The methodology aimed to:

Evaluate the agrochemical status of irrigated meadow-alluvial soils under varying management practices;

Identify the main factors affecting soil fertility and productivity;

Develop recommendations for sustainable use and improvement of these soils.

Analysis and Results

The conducted research provided comprehensive insights into the agrochemical status of irrigated meadow-alluvial soils and revealed the influence of irrigation and fertilization practices on their fertility indicators.

Soil Humus Content:

The results showed that the humus content in the upper soil layer (0–30 cm) ranged from 1.2% to 1.8%, depending on the irrigation and fertilization regime. The highest humus content was observed in plots where organic and mineral fertilizers were applied together, indicating the positive impact of integrated fertilization on soil organic matter accumulation. In contrast, continuous use of only mineral fertilizers led to a gradual decline in humus concentration.

Soil Reaction (pH) and Salinity:

The soil pH values varied between 7.1 and 7.6, indicating a slightly alkaline reaction typical of alluvial soils in irrigated regions. Monitoring data showed that excessive irrigation increased soil salinity and electrical conductivity (EC), particularly in the lower layers (60–90 cm). This suggests that improper irrigation management can lead to salt accumulation, threatening long-term soil fertility.

Nitrogen, Phosphorus, and Potassium Levels:

The analysis of macronutrients revealed that the total nitrogen content averaged 0.12–0.15%, while available phosphorus (P_2O_5) and exchangeable potassium (K_2O) were measured at 22–28 mg/kg and 240–310 mg/kg, respectively. Balanced application of fertilizers significantly improved nutrient availability. However, nitrogen losses due to leaching were noted under excessive irrigation conditions.

Correlation Between Irrigation Regime and Soil Fertility:

Statistical analysis showed a strong positive correlation ($r = 0.82$) between optimal irrigation intervals and crop yield, confirming that maintaining adequate soil moisture without over-irrigation supports nutrient balance and prevents salinization. Regression analysis also demonstrated that humus and nitrogen content were the main predictors of crop productivity.

Crop Productivity:

Field observations indicated that plots with integrated soil management (combined use of organic fertilizers and controlled irrigation) achieved 15–20% higher yields compared to those relying solely on mineral fertilizers. This confirms that agrochemical optimization of meadow-alluvial soils plays a key role in enhancing sustainable agricultural output.

Summary of Findings:

Integrated fertilization improves soil humus and nutrient status.

Excessive irrigation increases salinity and reduces nutrient efficiency.

Balanced soil management ensures sustainable fertility and higher crop yields.

Conclusion and Recommendations

The results of the study demonstrate that irrigated meadow-alluvial soils possess high potential fertility; however, their agrochemical properties are significantly influenced by irrigation and fertilization practices. Maintaining the optimal chemical balance of these soils is essential for achieving sustainable agricultural productivity and preventing degradation processes such as salinization and nutrient depletion.

Conclusions

The agrochemical composition of meadow-alluvial soils depends strongly on irrigation regime, water quality, and the balance of organic and mineral fertilizers.

Combined application of organic and mineral fertilizers enhances soil humus content, improves nutrient balance, and strengthens soil structure.

Over-irrigation and insufficient drainage contribute to secondary salinization, leading to decreased soil fertility and crop yield.

Optimal irrigation scheduling and balanced fertilization significantly improve soil productivity and ensure long-term soil sustainability.

Recommendations:

Implement integrated soil fertility management, combining organic matter application, mineral fertilization, and crop rotation.

Develop region-specific irrigation norms based on soil moisture monitoring to prevent excessive water use and salinization.

Conduct regular agrochemical monitoring of soil to assess fertility trends and adjust management practices accordingly.

Encourage the use of green manure crops and biofertilizers to improve soil structure and enhance biological activity.

Apply modern precision agriculture technologies for efficient water and nutrient management.

The findings of this research provide a scientific basis for the rational use and preservation of irrigated meadow-alluvial soils, contributing to the development of environmentally sustainable and economically efficient agricultural systems.

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