SOIL POLLUTION RESULTING FROM RISING GROUNDWATER LEVELS IN SYRDARYA REGION

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Abstract: *This article scientifically examines the processes of soil pollution and degradation occurring in the Syrdarya region as a result of rising groundwater levels. The intensification of secondary salinization in irrigated lands, accumulation of chemical substances, and decline in soil biological activity are analyzed as major environmental challenges. The results of the study indicate that an increase in groundwater levels has a negative impact on soil fertility and disrupts the stability of agroecosystems.*

Keywords: *groundwater, soil degradation, secondary salinization, Syrdarya region, reclamation condition.*

INTRODUCTION

Currently, the rise in groundwater levels has become a serious environmental problem in many irrigated regions of Uzbekistan. In particular, this process in the Syrdarya region leads to soil salinization, chemical contamination, and a decline in agricultural land productivity. Under conditions requiring rational use of land resources and sustainable agricultural development, scientific investigation of this issue is of great importance.

The problem of rising groundwater levels and their impact on soil ecological conditions has been widely discussed in both international and local scientific literature. Numerous studies emphasize that elevated groundwater levels in irrigated areas contribute to secondary salinization, soil degradation, and reduced agricultural productivity [1]. Scientific sources indicate that excessive use of irrigation water and inefficient operation of collector-drainage systems are the main factors contributing to groundwater rise.

This process is particularly significant in Central Asia, where dissolved salts migrate upward through capillary action and accumulate in the topsoil layer [2]. Several studies report that nitrates, pesticide residues, and certain heavy metals transported by groundwater enhance chemical contamination along the soil profile. This negatively affects soil agrochemical properties and limits nutrient uptake by plants [3].

In addition, excessive soil moisture deteriorates physical properties, disrupts aeration, and reduces biological activity. A decline in microbial activity slows humus formation processes and weakens the soil's self-recovery capacity [4]. Research conducted by Uzbek scientists, including studies in the Syrdarya region, confirms that rising groundwater levels adversely affect the reclamation condition of agricultural lands and reduce the efficiency of land use.

The authors highlight the necessity of implementing comprehensive reclamation and agroecological measures to address this issue [5]. Overall, the literature review

demonstrates that groundwater level rise is a significant factor driving soil pollution and degradation, emphasizing the importance of scientifically grounded management strategies.

Research Object and Methods. The object of the study is irrigated agricultural lands of the Syrdarya region. To assess the ecological condition of soils and groundwater, the following scientific methods were applied:

- chemical analysis of soil and groundwater composition;
- assessment of soil salinity levels;
- agroecological evaluation of reclamation conditions;
- comparative analysis of existing scientific literature and statistical data.

Results and Discussion.

Causes of Rising Groundwater Levels. In the Syrdarya region, groundwater rise is primarily associated with irrational irrigation practices. Excessive water application, inefficient collector-drainage networks, and limited natural drainage conditions significantly accelerate this process.

Soil Pollution Processes.

Secondary Salinization. When groundwater levels rise to 1.5-2.0 m, capillary water movement intensifies. As a result, dissolved salts, particularly chloride and sulfate ions, migrate to the soil surface, intensifying salinization processes.

Chemical Contamination. Groundwater serves as a pathway for nitrates, agricultural chemical residues, and certain heavy metals to enter soil layers. This leads to deterioration of soil chemical composition and agrochemical characteristics.

Physical and Biological Degradation. Prolonged excessive soil moisture causes compaction and disrupts soil aeration. Consequently, microbial activity decreases and humus formation processes slow down.

Environmental and Social Consequences. Rising groundwater levels negatively affect both environmental stability and socio-economic development of the region. Excessive soil moisture and salinity worsen plant growth conditions, leading to a significant reduction in crop yields.

This decreases land-use efficiency and accelerates long-term land degradation. Furthermore, the accumulation of salts and chemical substances deteriorates the quality of agricultural products, posing risks to food security. Pollution associated with elevated groundwater levels also increases environmental health risks, as toxic substances may enter the human body through the food chain.

Mitigation Measures.

To reduce and eliminate the adverse effects of rising groundwater levels, an integrated approach is required. Reconstruction and improvement of collector-drainage systems can help stabilize groundwater levels. In addition, scientifically based optimization of irrigation regimes and rational water use are essential to prevent excessive groundwater rise.

Conclusion.

The study results demonstrate that rising groundwater levels in the Syrdarya region intensify secondary salinization, chemical contamination, and biological degradation of soils. Addressing this issue requires a comprehensive approach that integrates reclamation, agroecological, and organizational measures.

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