



Measures For The Reclamation Of Saline Lands And Improvement Of Soil Productivity In The Republic Of Karakalpakstan

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ABSTRACT

This article examines measures for the reclamation of saline lands and the improvement of soil productivity in the Republic of Karakalpakstan. The study focuses on the assessment of soil salinity, the causes and extent of soil degradation, and the application of effective reclamation and agrochemical measures to restore soil fertility. Particular attention is given to irrigation and drainage management, leaching of saline soils, improvement of soil structure, and the use of organic and mineral fertilizers. The implementation of scientifically based land reclamation practices can contribute to improving soil quality, increasing agricultural productivity, and ensuring the sustainable use of agricultural land in the region.

Keywords:

Saline soils, soil reclamation, soil fertility, soil productivity, soil salinity, agrochemistry, irrigation, drainage, land reclamation, Karakalpakstan, sustainable agriculture

INTRODUCTION

Soil salinization occurs when soluble salts accumulate in the soil profile at concentrations that adversely affect plant growth, nutrient uptake, and soil biological processes. FAO identifies salinity and sodicity as major forms of salt-affected soil degradation and emphasizes that the appropriate reclamation strategy must be determined according to soil type, topography, groundwater conditions, crop requirements, water quality, irrigation practices, and drainage conditions. Therefore, the reclamation of saline land cannot be based on a single technological measure; it requires an integrated system combining soil monitoring, appropriate irrigation, drainage, leaching, soil management, and agrochemical measures.

The relationship between irrigation, groundwater and soil salinity is particularly

important in the lower Amu Darya region. Historical FAO assessments have identified salinity and waterlogging associated with high groundwater levels as major land-quality problems in Uzbekistan. A FAO assessment published in the context of Uzbekistan's irrigation and drainage development reported that, in 1994, approximately 95 percent of land in the downstream part of the country, particularly Karakalpakstan, was classified as saline, highly saline, or very highly saline according to the assessment methodology used at that time. This historical figure should not be interpreted as a current 2026 estimate; rather, it demonstrates the scale of the salinity problem documented during the period under assessment.

MAIN PART

One of the principal measures for the reclamation of saline soils is salt leaching. The

objective of leaching is to remove soluble salts from the root zone by applying an appropriate quantity of irrigation water and ensuring that the resulting saline drainage water is effectively removed from the soil profile. FAO notes that leaching is effective only when adequate drainage is available to carry dissolved salts away from the reclaimed area. Consequently, leaching without functional drainage may raise the groundwater table and potentially contribute to renewed salinization.

Drainage management is therefore a fundamental component of land reclamation in Karakalpakstan. Depending on local hydrogeological and soil conditions, surface, subsurface, or vertical drainage systems may be used. FAO indicates that the appropriate depth and spacing of drainage infrastructure should be determined according to soil permeability, the presence of impermeable layers, groundwater conditions, and economic considerations. Proper maintenance of collector-drainage networks is equally important because damaged or poorly functioning drainage infrastructure can reduce the effectiveness of irrigation and reclamation measures.

Historical information demonstrates the importance of drainage infrastructure in Uzbekistan. FAO reported that approximately 3.3 million hectares of irrigated land required artificial drainage in the 1990s, while approximately 2.8 million hectares had drainage infrastructure at that time. The same assessment noted that drainage systems included surface, subsurface, and vertical drainage, while the condition and maintenance requirements varied significantly between regions. These figures represent the historical situation described in the source and should not be treated as current statistics for 2026.

Another important measure is improvement of irrigation efficiency. Excessive or poorly controlled irrigation can increase groundwater recharge and accelerate secondary salinization, particularly in areas with inadequate drainage. Efficient irrigation should therefore be based on crop water requirements, soil moisture conditions, climatic factors, and water quality. FAO recommends

considering irrigation management together with drainage and soil conditions rather than treating them as separate agricultural practices.

Land levelling can also contribute to improved reclamation efficiency. Properly levelled fields allow irrigation water to be distributed more uniformly, reducing areas of excessive infiltration and insufficient irrigation. FAO identifies land levelling, including laser land levelling where technically and economically feasible, as one of the physical measures that can improve water distribution and support more effective salinity management.

The agrochemical improvement of saline soils should be based on systematic laboratory analysis. Soil samples should be analyzed for electrical conductivity, pH, soluble salts, exchangeable sodium and other relevant chemical indicators. Such analyses make it possible to determine the degree and type of soil degradation and to develop appropriate reclamation and fertilization measures. FAO's country information for Uzbekistan records a Presidential Resolution dated 18 June 2019 concerning improvement of the system of agrochemical soil analysis and increasing the fertility of cultivated lands.

Improving soil productivity also requires restoration of the soil's physical and biological properties. The application of organic matter, properly balanced mineral fertilizers, crop residues, and appropriate crop-management practices can contribute to improving soil structure and nutrient availability. However, fertilizer application should be based on soil-test results and crop requirements. In saline soils, simply increasing fertilizer application without controlling salinity and water management may not solve the underlying productivity constraints.

Crop selection and agricultural practices adapted to saline conditions are also relevant to the reclamation process. FAO emphasizes that the choice of crops and planting methods should take into account the degree of soil salinity and the local environmental conditions. Raised beds and other planting configurations can help reduce salt accumulation around the seed zone under certain saline conditions.

Research and practical experience in Uzbekistan have also demonstrated the potential of conservation agriculture for improving the management of degraded and salt-affected irrigated soils. FAO documentation reports that no-till and raised-bed planting technologies tested in Karakalpakstan and Tashkent Province were considered technically and economically suitable under local conditions. Such practices can contribute to resource conservation while maintaining or improving crop production under appropriate management conditions.

The issue of saline agriculture remains relevant to Uzbekistan's current environmental policy. In July 2026, an official government publication reported that soil salinization, land degradation, water scarcity and desertification remain significant environmental challenges, with particularly serious implications for Karakalpakstan and other arid regions of Uzbekistan. The same source connected these challenges with the continuing environmental consequences of the Aral Sea crisis.

International cooperation has also focused specifically on saline soil management in Uzbekistan. In May 2023, the FAO Global Soil Partnership held the second meeting of the International Network on Salt-affected Soils (INSAS) in Uzbekistan. Among the presented research topics was the restoration of saline landscapes in Karakalpakstan through mixed agroforestry systems. This demonstrates that restoration of salt-affected land in Karakalpakstan is being considered not only through conventional irrigation and drainage measures but also through ecological and landscape-based approaches.

In March 2024, FAO's WASAG initiative conducted a training workshop in Uzbekistan focusing on soil and water management under saline conditions. The stated objective was to strengthen the capacity of farmers, extension specialists, agricultural practitioners and researchers to address salinity and sodicity and to support the adoption of appropriate soil and water management practices.

Uzbekistan has also adopted a number of national measures related to the reclamation and protection of irrigated lands. According to

the FAO legal and policy database, these include Presidential Decree No. 1958 of 19 April 2013, concerning improvement of the ameliorative condition of irrigated lands and rational use of water resources for 2013–2017; Programme No. PP-3405 of 27 November 2017, concerning irrigation development, improvement of the reclamation condition of irrigated land and rational use of water resources for 2018–2019; and measures adopted in 2019 to improve agrochemical soil analysis and increase soil fertility.

These measures demonstrate that irrigation, drainage, land reclamation, water-resource management and soil fertility are interconnected elements of Uzbekistan's agricultural policy.

CONCLUSION

An additional area requiring attention is the management of collector-drainage water. Research published through the FAO AGRIS system in 2023, based on analysis of Uzbekistan data from 2005–2020, examined the use of collector-drainage water for irrigation and emphasized the importance of maintaining the reclamation condition of irrigated lands and improving soil fertility. The study also reported that inappropriate use of collector-drainage water can contribute to secondary salinization in some areas.

For Karakalpakstan, an effective reclamation strategy should therefore be based on integrated soil and water management. The first stage should involve systematic assessment and mapping of soil salinity, groundwater depth, groundwater mineralization, soil texture, permeability and drainage conditions. The second stage should include rehabilitation and maintenance of collector-drainage infrastructure where necessary. The third stage should involve scientifically controlled leaching based on the measured salinity level and the hydraulic characteristics of the soil. The fourth stage should focus on improving irrigation efficiency, field levelling, appropriate crop selection and soil fertility management. Finally, continuous monitoring should be carried out to determine whether salinity is decreasing and whether soil productivity is improving.

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