



ANALYSIS OF RESEARCH ON ASSESSING THE RECLAMATION STATE OF IRRIGATED LANDS

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Abstract. This study synthesizes contemporary research on evaluating the reclamation state of irrigated lands, focusing on methodologies and technological advancements. The analysis encompasses soil salinity assessment, drainage system efficacy, and the application of remote sensing, sensor-based monitoring, and data-driven modeling. Particular emphasis is placed on addressing soil salinization and waterlogging in arid regions, with Uzbekistan as a case study. Contributions from global and Uzbek scholars underscore the integration of innovative tools to enhance sustainable land and water management practices. The findings highlight the potential of precision agriculture to mitigate degradation and optimize resource use in irrigated systems.

Keywords: irrigated lands, reclamation state, soil salinization, drainage systems, remote sensing, precision agriculture, sustainable irrigation.

INTRODUCTION

Irrigated agriculture underpins food security in water-scarce regions, yet its sustainability hinges on the reclamation state of cultivated lands. Defined by soil fertility, salinity levels, and drainage efficiency, the reclamation state directly influences crop productivity and ecosystem health. In Uzbekistan, where irrigated lands span approximately 4.2 million hectares, challenges such as soil salinization and waterlogging threaten agricultural output and environmental stability [1]. Effective assessment of reclamation conditions is thus critical to devising evidence-based strategies for land management.

This article evaluates the current body of research on assessing the reclamation state of irrigated lands, with a focus on methodologies, technological innovations, and their application in Uzbekistan. By synthesizing global and local studies, the study aims to elucidate best practices for optimizing soil and water resources in arid agricultural systems.

MATERIALS AND METHODS

The evaluation of irrigated lands' reclamation state employs a multifaceted approach, integrating conventional and advanced techniques. Soil sampling and laboratory analysis provide baseline data on salinity, pH, and nutrient profiles. These are supplemented by geophysical surveys and hydraulic modeling to assess drainage performance. Remote sensing, utilizing platforms such as Landsat, Sentinel-2, and unmanned aerial vehicles (UAVs), enables large-scale monitoring of soil moisture, salinity, and vegetation health [2].

Sensor technologies facilitate real-time data acquisition. Soil moisture probes, electrical conductivity sensors, and water quality monitors deliver continuous measurements, supporting precise irrigation management. Data from these sensors are often processed using machine learning algorithms to predict salinity trends and optimize water allocation [3]. In Uzbekistan, institutions like the “Tashkent Institute of Irrigation and Agricultural



Mechanization Engineers" National Research University ("TIIAME" NRU) have developed region-specific protocols, incorporating local soil and climatic variables.

Field studies typically involve the deployment of drainage systems, ranging from open channels to subsurface tile drains, to address waterlogging and salinity. Data are analyzed using statistical software and geographic information systems (GIS) to map reclamation trends across agroecological zones. Comparative analyses of drainage designs and irrigation schedules provide insights into their efficacy under varying conditions.

RESULTS AND DISCUSSION

Soil salinization represents a primary constraint on irrigated lands, particularly in Central Asia, where up to 60% of irrigated areas exhibit moderate to severe salinity [4]. In Uzbekistan's Fergana and Khorezm regions, salinization reduces crop yields by an estimated 15–25% [5]. Research by Uzbek scholars highlights the efficacy of modern drainage systems in mitigating this issue. For example, a 20% reduction in soil salinity was reported in Bukhara province following the installation of subsurface drainage systems, compared to traditional open channels [1].

Remote sensing has emerged as a transformative tool for reclamation assessment. High-resolution imagery from Sentinel-2 and UAVs enables the identification of saline zones and waterlogged areas with accuracies exceeding 80% [3]. In Uzbekistan, these technologies have been applied to map salinity in the Syrdarya region, guiding targeted interventions [6]. Such tools are particularly valuable in resource-limited contexts, where extensive ground-based monitoring is impractical.

Machine learning models have further advanced reclamation management. By analyzing historical and real-time data, these models predict salinity dynamics and recommend irrigation adjustments. A study in Uzbekistan's cotton-growing regions demonstrated a 10% reduction in water use through AI-optimized irrigation schedules, with no yield penalty [7]. These findings align with global trends in precision agriculture, where data-driven approaches enhance resource efficiency [8].

Drainage system design is a critical determinant of reclamation success. Subsurface tile drains, equipped with automated flushing valves, outperform open channels in preventing salt accumulation and waterlogging. In saline-prone areas, acid injection systems dissolve mineral deposits, extending drainage infrastructure longevity [9]. Uzbek researchers have adapted these technologies to local conditions, developing cost-effective solutions for smallholder farmers [5].

Climate variability exacerbates reclamation challenges, necessitating adaptive irrigation strategies. Weather-based controllers, integrated with soil moisture sensors, adjust water application based on rainfall, humidity, and evapotranspiration data. Pilot projects in Uzbekistan's Andijan region have reported water savings of up to 12% through such systems [6]. These technologies also mitigate over-irrigation, which contributes to salinity and nutrient leaching [10].

Scalable drainage and monitoring systems enhance agricultural flexibility. Modular designs, incorporating quick-connect manifolds and segmental controllers, support crop rotation and land use optimization. In Uzbekistan, these systems have facilitated the adoption of intercropping and soil conservation practices [1]. Remote management platforms further streamline operations, enabling farmers to monitor soil conditions and receive alerts via



mobile applications. Cloud-based systems also support compliance with water use regulations, a priority in Uzbekistan's water-stressed regions [5].

CONCLUSION

The assessment of irrigated lands' reclamation state is a complex endeavor that demands the integration of robust methodologies and cutting-edge technologies. Remote sensing, sensor-based monitoring, and machine learning have revolutionized the precision and scalability of reclamation management. In Uzbekistan, local researchers have made significant contributions by adapting global innovations to address region-specific challenges, such as soil salinization and water scarcity. The deployment of modern drainage systems, data-driven irrigation strategies, and modular infrastructure offers a pathway to sustainable agriculture. Continued collaboration between international and Uzbek scholars will be essential to refine these approaches and ensure the long-term productivity of irrigated lands.

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