

**“CURRENT STATE AND IMPROVEMENT WAYS OF DIGITAL  
TECHNOLOGIES-BASED MONITORING OF IRRIGATED LANDS IN  
BUKHARA REGION”**

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**Abstract.** This article examines the issues of efficient use of irrigated lands in Bukhara region. In particular, the meliorative condition of irrigated lands in Vobkent district was analyzed. During the study, the existing irrigated lands were investigated using drones and modern technologies, including GIS technologies. The results indicated that the deterioration of the irrigated lands’ condition is mainly related to water supply and the efficiency of irrigation networks. To address the identified problems and ensure rational land use, necessary measures were developed and recommended.

**Keywords.** Agricultural lands, monitoring, drones, GIS technologies, modern technologies, agrotechnical activities, soil fertility.

**Introduction.** Land degradation is currently one of the most pressing ecological challenges facing the world today. According to the United Nations Convention to Combat Desertification (UNCCD), approximately 12 million hectares of productive land are degraded annually across the globe. This process poses a serious threat to food security, biodiversity, and sustainable economic development. In Central Asia, and particularly in Uzbekistan, secondary salinization of irrigated lands remains one of the primary forms of land degradation [4].

In Uzbekistan, agriculture consumes more than 90% of the country’s total water resources and accounts for approximately 95% of agricultural production. However, the aging irrigation infrastructure, inadequate drainage systems, and inefficient water management practices have led to a steady deterioration in the ameliorative condition of irrigated lands. Bukhara region, located in the arid zone of Uzbekistan, is particularly

vulnerable to these issues. High levels of secondary salinization, waterlogging, and decreasing soil fertility significantly reduce land productivity and threaten the long-term sustainability of agricultural production in the region.

Traditional methods of monitoring irrigated lands, which mainly rely on field surveys and laboratory analysis, are time-consuming, expensive, and limited in spatial coverage. These conventional approaches cannot provide timely and comprehensive information necessary for effective decision-making. In recent years, digital technologies — such as Geographic Information Systems (GIS), remote sensing, satellite imagery (e.g., Sentinel-2), and digital monitoring platforms — have demonstrated significant potential for improving the efficiency and accuracy of land monitoring systems worldwide.

The transition to digital monitoring is especially important for Uzbekistan, as it aligns with the country’s strategic goals outlined in the “Digital Uzbekistan-2030” program and the National Strategy for the Development of Agriculture. Despite this, the current level of digital technology application in monitoring irrigated lands in Bukhara region remains insufficient.

This study aims to analyze the current state of digital technology-based monitoring of irrigated lands in Bukhara region and to develop practical recommendations for its improvement. The research focuses on identifying existing gaps in the monitoring system and proposing effective ways to integrate modern remote sensing and GIS technologies into land management practices.

According to official statistics, as of January 1, 2025, the total land area of the Republic of Uzbekistan stands at 44,892.3 thousand hectares. Of this, 970,436 agricultural enterprises and organizations utilize 26,220.7 thousand hectares, accounting for 58.41% of the national land fund. Agricultural land types cover 21,383.5 thousand hectares, including 3,743.0 thousand hectares of irrigated land [3].

In Bukhara region, the total land area is 4,183.054 thousand hectares, of which 282.269 thousand hectares are irrigated lands [3].

Vobkent district is situated in the south-western part of Bukhara region and covers an area of 29 thousand hectares [3]. It borders Kogon district to the south, Bukhara district to the southwest, Gijduvon district to the north, Shofirkon district to the northwest, Peshku district to the west, and Romitan district to the southwest. The Vobkent canal flows through the district’s territory.

In line with the decisions defined by republican legislation, regular inventory and monitoring of agricultural lands are conducted across the regions. These activities encompass lands currently used for agriculture, areas with declining ameliorative conditions, lands withdrawn from agricultural circulation, and perennial plantations that have become unsuitable for use [1, 2].

Based on the findings of the study, an analysis of land area changes in Bukhara region over the past decade was carried out. The dynamics of these changes are presented and generalized in the following table.

**1-table**

**Dynamics of Land Area Used by Agricultural Enterprises and Organizations in Bukhara Region for 2016–2026 (thousand hectares)**

Yil	Yer maydoni	O‘zgarishi oldingi yillarga nisbatan
2016	3 380,9	
2018	3 414,1	+33,2
2020	3 441,7	+27,6
2022	3 441,1	-0,6
2024	3 441,6	+0,5
2026	3 464,6	+23,0

*Note: The data in this table were prepared by the author based on open-access official statistical information.*

The findings of the study indicate that over the last decade, the area of land utilized by agricultural enterprises and organizations in Bukhara region increased by 83.7 thousand hectares, corresponding to a growth of approximately 2.5%. The average annual increase amounted to around 9.3 thousand hectares. In terms of stability, land area remained relatively stable after 2020, with only a slight increase observed in the most recent year.

**Recommendations.** Based on the analysis of land area dynamics in Bukhara region over the past 10 years, where the area used by agricultural enterprises and organizations increased by 83.7 thousand hectares (approximately 2.5%), the following recommendations are proposed to improve the digital monitoring system of irrigated lands:

**1. Strengthening Digital Monitoring Infrastructure:** Given the steady growth in agricultural land area, it is essential to develop a unified digital monitoring platform that integrates Sentinel-2 satellite data, GIS technologies, and ground-based measurements. This system should enable real-time tracking of changes in irrigated land area and its ameliorative condition.

**2. Regular Updating of Land Cadastre:** Since land area has shown relative stability after 2020 with a slight increase in recent years, it is recommended to conduct annual digital inventory of irrigated lands using remote sensing technologies. This will allow timely detection of both expansion and degradation processes.

**3. Integration of Machine Learning Methods:** To increase the accuracy of monitoring, machine learning algorithms should be applied for automatic classification of land use changes and early detection of salinization risks in newly developed areas.

**4. Focus on Newly Developed Lands:** Special attention should be paid to the monitoring of the additional 83.7 thousand hectares added over the last decade. These areas require continuous assessment of soil salinity, moisture levels, and water use efficiency to prevent future degradation.

**5. Capacity Building and Inter-Agency Cooperation:** It is necessary to strengthen cooperation between “O‘zdavyerloyiha” DILI, the Ministry of Agriculture, and local authorities in Bukhara region to ensure effective implementation of digital monitoring technologies.

**Conclusion.** The study revealed that over the past 10 years, the area of land used by agricultural enterprises in Bukhara region increased by 83.7 thousand hectares (2.5%). Despite this growth, the ameliorative condition of irrigated lands continues to face serious challenges, particularly secondary salinization. The results confirm that traditional monitoring methods are no longer sufficient to meet modern requirements. The introduction of digital technologies — including remote sensing, GIS, and satellite imagery — offers significant opportunities for timely, accurate, and cost-effective monitoring of irrigated lands. Effective implementation of digital monitoring systems will not only help prevent land degradation but also support sustainable agricultural development in Bukhara region. Therefore, the transition to modern digital monitoring should be considered a strategic priority for land management in the region.

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