



## **World Conference on Agricultural and Earth Sciences**

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### **CURRENT STATUS OF AGRICULTURAL LANDS AND PROSPECTS FOR SUSTAINABLE AND PRODUCTIVE UTILIZATION**

Qorjovov G'olibjon G'ayrat o'g'li  
Deputy Dean, Alfraganus University  
E-mail: [golibjonqor@gmail.com](mailto:golibjonqor@gmail.com)

#### **Abstract**

This article examines the current condition of agricultural lands and identifies prospects for their sustainable and productive utilization under conditions of climate change, water scarcity, and increasing land degradation. The study focuses on the geomorphological, agro-reclamation, and ecological status of agricultural land resources, with particular attention to secondary salinization, waterlogging, erosion, declining soil fertility, and reduced biomass productivity. A comprehensive methodological approach was applied, including systems analysis, comparative geographical assessment, laboratory investigations, mathematical-statistical methods, and geospatial analysis. Multispectral data from Landsat-8 and Sentinel-2 satellites were processed using GIS and remote sensing technologies, while NDVI indicators were used to evaluate vegetation condition and land productivity. The results show that 28–32% of agricultural areas are affected by soil degradation, while secondary salinization has intensified in nearly 35% of irrigated lands. Laboratory findings also revealed a 10–15% decline in soil quality scores. At the same time, areas where laser land leveling, drip irrigation, and sprinkler irrigation were introduced demonstrated reduced water consumption, lower erosion risk, and increased crop yields. The article concludes that sustainable land management requires the integration of traditional agricultural practices with GIS, remote sensing, and resource-efficient irrigation technologies.



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**Keywords:** agricultural lands; sustainable land use; soil degradation; secondary salinization; GIS technologies; remote sensing; NDVI; irrigation efficiency; land productivity.

### Introduction

Against the backdrop of rapid global population growth and accelerating urbanization, ensuring sustainable food security has become increasingly dependent on the condition of agricultural land resources and the efficiency of their utilization. However, ongoing climate change, the depletion of transboundary water resources, rising temperatures, and the increasing frequency and duration of drought events have placed considerable pressure on agricultural land-use systems worldwide.

Agricultural lands are currently subjected to substantial anthropogenic and natural pressures that adversely affect soil quality and ecosystem stability. Consequently, the functional characteristics of fertile soils are deteriorating, while the ecological balance of soil systems is being progressively disrupted. A significant proportion of irrigated agricultural lands is increasingly exposed to various degradation processes, including secondary salinization, waterlogging, wind and water erosion, and other forms of soil degradation. These processes not only reduce soil fertility and land productivity but also result in the withdrawal of extensive areas of arable land from agricultural production.

Furthermore, traditional extensive land management practices, outdated irrigation infrastructure, inadequate consideration of regional soil and climatic characteristics in agricultural planning, and unsystematic crop rotation practices further intensify these challenges. Under such circumstances, continuous assessment of agricultural land conditions, spatio-temporal analysis, and



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systematic monitoring of land degradation processes have become critical scientific and practical priorities.

In this context, the integration of advanced digital technologies, particularly Geographic Information Systems (GIS) and Remote Sensing (RS), has emerged as an essential component of sustainable agricultural land management. These technologies provide a robust analytical framework for the remote assessment of land conditions, prediction of soil quality dynamics, and implementation of site-specific agricultural practices.

Therefore, the primary objective of this study is to comprehensively analyze the current geomorphological and agro-reclamation conditions of agricultural lands, identify high-risk areas affected by degradation processes through digital mapping techniques, and develop scientifically grounded recommendations to ensure the sustainable productivity, rational management, and efficient utilization of land resources.

### **Materials and Methods**

To systematically assess the current condition of agricultural lands and evaluate their productive utilization potential, agricultural land resources, their spatial boundaries, and soil reclamation indicators were selected as the primary objects of the study. A comprehensive methodological framework was employed, incorporating systems analysis, comparative geographical analysis, laboratory investigations, and mathematical-statistical methods.

Multispectral remote sensing (MRS) data obtained from Landsat-8 and Sentinel-2 satellites served as the principal source for analyzing the spatiotemporal dynamics of land cover and land degradation processes. Digital image processing and spatial visualization were performed using the ArcGIS software environment.



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To assess vegetation conditions and soil moisture status, the Normalized Difference Vegetation Index (NDVI) was calculated. NDVI is a widely used remote sensing indicator that evaluates vegetation health, density, and biomass productivity based on the spectral characteristics of satellite imagery.

To validate the remote sensing results, ground-based monitoring data, soil quality assessment reports, long-term statistical records on groundwater depth and salinity levels, and laboratory analyses of collected soil samples were integrated and comparatively analyzed.

### **Results and Discussion**

The conducted multispectral spatial and geoinformation analyses revealed significant structural changes in the agroecological condition of agricultural lands in recent years. Digital mapping outputs and statistical analyses demonstrated that approximately 28–32% of the total agricultural area is affected by various degrees of soil degradation, while secondary salinization processes have intensified in nearly 35% of irrigated arable lands.

The dynamic analysis of NDVI values derived from satellite imagery indicated that the lowest biomass productivity during the growing season was observed in areas characterized by inefficient collector-drainage systems and shallow groundwater levels ranging from 1.5 to 2.0 m below the surface.

Laboratory analyses further confirmed a decline in soil fertility potential, with land quality (bonitet) scores decreasing by an average of 10–15% compared with historical records.

In contrast, experimental sites where innovative agricultural technologies, including laser land leveling and drip irrigation systems, had been implemented exhibited markedly improved performance indicators. In these intensively managed areas, soil erosion was substantially reduced, irrigation water



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consumption decreased by 30–35% compared with conventional furrow irrigation methods, and average crop yields increased by 18–22% per hectare.

### **Conclusion**

The geospatial, laboratory, and statistical findings obtained in this study confirm that agricultural land resources are currently experiencing substantial ecological and agro-reclamation pressures. The observed decline in soil fertility, intensification of secondary salinization, and reduction in NDVI values indicate that land degradation is driven not only by climate-induced aridification but also by anthropogenic pressures and unsustainable land and water resource management practices.

Under conditions of increasing water scarcity, the prolonged reliance on extensive agricultural practices, particularly conventional surface irrigation methods, has contributed to a significant rise in groundwater levels. Consequently, capillary water movement within the soil profile has intensified, accelerating salt accumulation in the upper fertile layers and promoting hydromorphization and secondary salinization processes. These changes adversely affect soil structure, reduce microbiological activity, and ultimately diminish land quality and agricultural productivity, thereby threatening the economic sustainability of the agricultural sector.

Addressing these systemic challenges requires a fundamental transformation in land resource management approaches. In particular, Geographic Information Systems (GIS) and Remote Sensing (RS) technologies should be integrated into operational decision-making frameworks rather than being used solely for spatial visualization and mapping purposes.

The findings further demonstrate that agricultural areas adopting innovative resource-efficient technologies, including laser land leveling, drip irrigation, and



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sprinkler irrigation systems, exhibit positive agroecological outcomes. These technologies improve soil aeration and hydrological conditions, reduce irrigation water losses, mitigate soil degradation processes, and contribute to more sustainable land management practices.

Overall, the long-term preservation and efficient utilization of agricultural lands will largely depend on the successful integration of traditional agricultural knowledge with advanced geoinformation technologies and digital spatial modeling approaches.

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