

MODERN APPROACHES TO MANAGING LAND AND WATER RELATIONS IN  
AGRICULTURE

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**Abstract**

This thesis analyzes modern approaches to managing land and water resources in agriculture. Through systems based on digital monitoring, IoT sensors, GIS, and artificial intelligence, irrigation and fertilization plans are optimized. Smart irrigation and agroecological practices ensure efficient resource utilization, increase productivity, and strengthen ecological sustainability. Integrated management systems contribute to the socio-economic development of the region.

**Keywords**

agriculture, land and water management, smart irrigation, GIS, IoT, artificial intelligence, agroecology, ecological sustainability

Efficient management of land and water resources in agriculture is one of the key factors in ensuring ecological sustainability and food security. Uneven distribution of water and land resources, weather variability, and intensive agricultural practices can lead to a decline in soil fertility. For this reason, modern approaches are based on integrated management systems and aim at resource conservation, increasing productivity, and ensuring ecological safety.

First, digital land management (Precision Agriculture) technologies are widely applied. This approach enables real-time monitoring of soil moisture, mineral composition, and crop growth stages through satellite imagery, drones, and ground-based sensors. The collected data are analyzed with the assistance of artificial intelligence. As a result, irrigation and fertilization plans are individually optimized for each field area, allowing significant savings in water and land resources.

Second, smart irrigation systems (Smart Irrigation Systems) serve as the central tool for effective water management in agriculture. These systems automatically adjust irrigation intensity based on soil moisture levels, weather forecasts, and crop type. For example, drip irrigation and subsurface irrigation technologies can reduce water waste by 30–50% and prevent the risk of soil salinization.

Third, integrated water and land management systems (Integrated Water and Land Management) involve comprehensive monitoring of land and water resources. In this framework, rivers, canals, artificial reservoirs, and irrigation networks are controlled as a single unified system. With the help of Geographic Information Systems (GIS) and remote sensing technologies, data on water flows and soil conditions are transmitted to a centralized platform. This not only ensures optimal resource allocation but also minimizes environmental risks.

In addition, biological and agroecological approaches play an important role in land and water management. Practices such as crop rotation, cover cropping, and mulching with organic materials enhance the soil's water retention capacity and reduce erosion processes. At the same time, efficient use of natural resources ensures the long-term sustainability of agricultural systems.

Effective management of land and water relations in agriculture can be achieved through modern technologies. Systems based on digital monitoring, IoT sensors, GIS, and artificial intelligence help optimize irrigation and fertilization. Smart irrigation and agroecological

practices reduce water waste and soil salinization while increasing productivity. Integrated management systems ensure fair distribution of resources. At the same time, it becomes possible to maintain ecological sustainability, contribute to the socio-economic development of the region, and preserve natural resources for future generations. Modern approaches harmoniously combine efficiency and environmental safety in agriculture.

## References

1. Sulaymonov, M.. Efficient use of water resources through smart irrigation systems: Uzbekistan experience — analysis of modern irrigation technologies and water conservation. green-eco.uz
2. Abdullayev, A., & Karimov, A. (n.d.). The importance of smart irrigation systems in water conservation — increasing water efficiency through IoT and smart systems. muhandislik-iqtisodiyot.uz
3. Ro‘ziyev, S.. Innovative approaches to improving the efficiency of water resource use in Bukhara region — scientific analysis of digital monitoring and automation. green-eco.uz
4. Ziyotov, U. A.. Water-saving irrigation technologies for groundwater in arid regions — scientific overview of water-saving technologies. Научные журналы [Scientific Journals]
5. (n.d.). Sources of irrigation water, their hydrological assessment and ecological safety — fundamentals of water resources monitoring and ecological evaluation. worldlyjournals.com
6. Karar, M. E., et al.. A Pilot Study of Smart Agricultural Irrigation using UAV and IoT-Based Cloud System. arXiv
7. Kunt, Y. E. . Development of a Smart Autonomous Irrigation System Using IoT and AI. arXiv
8. Pargo, T. A., et al.. Smart and Efficient IoT-Based Irrigation System Design. arXiv
9. Binayao, R. P., et al. Smart Water Irrigation for Rice Farming through the Internet of Things. arXiv
10. Food and Agriculture Organization (FAO). Water-saving irrigation techniques in agriculture — global water-saving irrigation technologies. Научные журналы [Scientific Journals]
11. General overview of the introduction of technologies and digital systems in agriculture — land resource management based on digital technologies. dgeconomy.tsue.uz
12. State documents on Uzbekistan’s water management strategy and the introduction of “smart water” systems — concepts of integrated management and monitoring. Старый Госкомитет [Former State Committee]