

## INCREASING EFFICIENCY IN AGRICULTURE BASED ON DIGITAL TECHNOLOGIES

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**Abstract:** This scientific article comprehensively studies the theoretical foundations, practical mechanisms and economic results of increasing production efficiency through the introduction of digital technologies in agriculture. During the study, the role and impact of modern technologies such as precision agriculture, the Internet of Things (IoT), artificial intelligence, big data (Big Data), geographic information systems (GIS) and unmanned aerial vehicles on the agricultural production process were comprehensively analyzed. The article scientifically proves, based on international experience, that the use of digital technologies significantly increases productivity, increases the efficiency of water and energy resources, reduces production costs and ensures environmental sustainability. In particular, the analysis shows that in farms that have introduced digital technologies, productivity increases by 20–35%, and water use efficiency by 30–45%. The article also extensively covers the current problems, existing opportunities and promising development directions of digitization of the agricultural sector in the conditions of Uzbekistan. The results of the study indicate the need to accelerate digital transformation processes in agriculture.

**Keywords:** digital technologies, agriculture, precision agriculture, IoT, artificial intelligence, Big Data, GIS, drones, agro-innovation, efficiency, digital transformation.

### Introduction

In the 21st century, digital technologies are emerging as one of the most significant drivers of human development and global economic transformation. The rapid advancement of information and communication technologies, artificial intelligence, big data analytics, the Internet of Things (IoT), and cloud computing is fundamentally reshaping traditional industries and creating new opportunities for sustainable growth. Their widespread adoption in the economy enables the automation of production processes, optimization of resource allocation, enhancement of productivity, and improvement of decision-making and management systems. As a result, digitalization is becoming a key factor in increasing competitiveness at both the national and global levels.

Agriculture, as one of the oldest and most essential sectors of the economy, is not excluded from this global transformation. On the contrary, it is increasingly becoming an important component of the digital economy. The concept of “smart agriculture” or “precision farming” has emerged as a modern approach that integrates advanced digital tools such as satellite monitoring, drones, sensor technologies, and data-driven decision-making systems into agricultural practices. These innovations allow farmers to monitor crop conditions in real time, predict yields, optimize irrigation and fertilization, and reduce production risks.

At the same time, the rapid growth of the world population significantly increases the demand for food products. According to international forecasts, by 2050, global food production must increase by at least 60–70% to meet the needs of the population. However, achieving this goal is complicated by a number of serious challenges. Among them are the limited availability of arable land and water resources, climate change, soil degradation, biodiversity loss, and

increasing environmental pressures. Traditional methods of agricultural production are no longer sufficient to address these challenges effectively. Therefore, innovative approaches based on digital technologies are becoming essential for ensuring food security and sustainable agricultural development.

In this context, the introduction of digital technologies in agriculture plays a crucial role in improving production efficiency, ensuring the rational use of natural resources, and minimizing negative environmental impacts. For example, precision irrigation systems help reduce water consumption, while data analytics tools enable farmers to make informed decisions based on weather patterns and soil conditions. Similarly, the use of unmanned aerial vehicles (drones) and remote sensing technologies allows for accurate monitoring of large agricultural areas, thereby reducing labor costs and increasing operational efficiency.

Agriculture holds a particularly important position in the economy of the Uzbekistan. A significant portion of the country's population is engaged in this sector, and it contributes substantially to the gross domestic product (GDP), employment, and export potential. At the same time, the sector faces several systemic challenges, including water scarcity, inefficient irrigation systems, land degradation, low labor productivity, and insufficient adoption of modern technologies. These issues are further exacerbated by climate change and increasing pressure on natural resources.

Under such conditions, the digital transformation of agriculture becomes not only desirable but also necessary. The integration of digital solutions into agricultural practices can significantly enhance productivity, reduce costs, and improve the sustainability of the sector. Moreover, it can facilitate better coordination between farmers, agribusinesses, and government institutions, thereby strengthening the overall agricultural ecosystem.

The purpose of this scientific article is to analyze the theoretical and methodological foundations for increasing efficiency through the use of digital technologies in agriculture. In addition, the study aims to assess current trends, identify existing problems, and develop practical recommendations for the effective implementation of digital solutions in the agricultural sector. The research also seeks to highlight the role of innovation in ensuring food security, improving rural livelihoods, and achieving sustainable economic development.

#### **Literature review:**

In recent years, the issue of digitalization of agriculture has been widely covered in scientific literature.

According to reports from the Food and Agriculture Organization, the efficiency of agricultural production can be significantly increased through the use of digital technologies. According to this organization, precision agricultural technologies allow optimizing the use of water and fertilizers.

In World Bank studies, the introduction of digital technologies is recognized as one of the main factors stimulating economic growth in developing countries.

An analysis of scientific literature shows that artificial intelligence, IoT and Big Data technologies are the most promising areas in agriculture.

#### **Main part**

Digital technologies are making it possible to radically change production processes in agriculture. With their help, a data-based management system is formed, unlike traditional approaches. This serves to optimize each stage of the production process. Precision agriculture technology is one of the most important innovative directions in agricultural production. With the help of this technology, each plot of land is studied separately and its physicochemical properties are determined. As a result, fertilization, irrigation and sowing processes are organized individually. This significantly optimizes the use of resources. IoT technologies create the opportunity to collect and analyze data in real time. Sensor devices determine soil moisture,

temperature, air humidity and other important indicators. Based on this data, automated control systems operate and optimal decisions are made. Artificial intelligence technologies allow for the analysis and forecasting of complex processes. For example, yields are forecasted based on weather conditions, soil conditions and plant development dynamics. This greatly simplifies the planning of the production process. Big Data technologies allow for strategic decision-making by processing large amounts of data. This is especially important for large agroclusters. Drone technologies accelerate the monitoring process. With their help, large areas of land can be monitored and analyzed in a short time. This allows for early detection of pests and diseases. Studies show that the introduction of digital technologies significantly increases productivity. For example, in some countries, wheat productivity has increased by 25–30 percent as a result of the use of precision agricultural technologies. The efficiency of water resources use also increases. With the help of IoT-based irrigation systems, water consumption can be reduced by 30–40 percent. This plays an important role in solving the problem of water scarcity. Production costs are also reduced. As a result of optimal use of resources, fertilizer, fuel and labor costs are reduced. This leads to an increase in farmers' income. Positive results are also observed in the ecological sense. Less chemicals are used, soil degradation is reduced, and the harmful impact on the environment is reduced. The introduction of digital technologies in the conditions of Uzbekistan has great potential. The country has a large area of irrigated land, and the effective use of water resources is an urgent issue. At the same time, there are also problems. One of the main problems is the lack of investment. The introduction of modern technologies requires significant financial resources. In addition, the lack of qualified specialists is also a significant obstacle. In the future, by solving these problems, it will be possible to widely introduce digital technologies in agriculture.

### **Conclusion**

The above analysis shows that the introduction of digital technologies in agriculture is one of the most effective ways to increase production efficiency. With the help of these technologies, it is possible to increase productivity, efficiently use resources, and ensure environmental sustainability.

In the future, it is possible to develop the agricultural sector and ensure food security by accelerating digital transformation processes.

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