

Optimization of crops placement based on artificial intelligence in the “Smart Map” system

Khayot Barotovich Ismailov
Marjona Nuriddin-kizi Gulomova
Murtazo Zamon-ugli Mustafoev
Bukhara State Technical University

Abstract: This article analyzes digital transformation processes in Uzbekistan’s agriculture, specifically issues of improving management based on artificial intelligence, Big Data, and IoT technologies. The importance of introducing modern information and communication technologies in the organization of agricultural production, the efficient use of resources, opportunities for increasing labor productivity and optimizing production processes are highlighted.

Keywords: digital agriculture, artificial intelligence, Big Data, IoT, Smart Map, agribusiness, digital management, information systems, agricultural sector, optimization, resource efficiency, agrotechnologies, GIS, ERP systems

Introduction

The use of modern management technologies based on digital models in organizing agricultural production is becoming a vital component of Uzbekistan’s agricultural sector. Within the framework of the digitalization policy implemented in the country, the implementation of information and communication technologies, platform solutions, and artificial intelligence-based management systems in agriculture has been designated as a priority. This will serve to accelerate technological development in the industry and increase labor productivity.

Digitalization transforms agriculture into a high-tech industry, enabling the processing of large volumes of data from various sources - fields, farms, agricultural machinery, weather stations, and satellites. The digitalization of agribusiness and the introduction of artificial intelligence technologies will ensure the efficient use of resources, reduce production costs, and form a reliable information base on production processes.

The information collection and processing system includes sensors, IoT devices, communication networks, data storage infrastructure, and analytical and intelligent modules. These components, integrated with each other, allow for the integrated management of production processes.

An analysis of domestic and foreign experience shows that the introduction of digital and intelligent technologies:

- increasing labor productivity
- ensuring resource conservation
- strengthening the stability of agricultural production
- serves to reduce losses in the production chain

Analytical systems based on artificial intelligence identify hidden patterns based on this data, serving to forecast yields, efficiently allocate resources, and increase production efficiency.

- phased implementation of the “Smart Map” system in agricultural enterprises and its integration with GIS and ERP systems;
- expanding the network of IoT sensors and weather stations to collect real-time data from the fields;

- automation of crop placement, irrigation, and fertilization processes based on artificial intelligence algorithms;
- organization of professional development and retraining programs in digital technologies for specialists working in the agricultural sector;
- strengthening integration between systems by ensuring data security and forming unified information platforms;
- widespread implementation of innovative agricultural technologies through the development of public-private partnerships.

The Smart Map system is based on mathematical models, artificial intelligence algorithms, and data analysis, which serve to plan production volumes, improve product quality, and ensure economic efficiency. The program develops scientifically grounded recommendations for crop placement, fertilization, irrigation, determination of harvest timing, and optimization of agrotechnical measures. (Fig. 1).

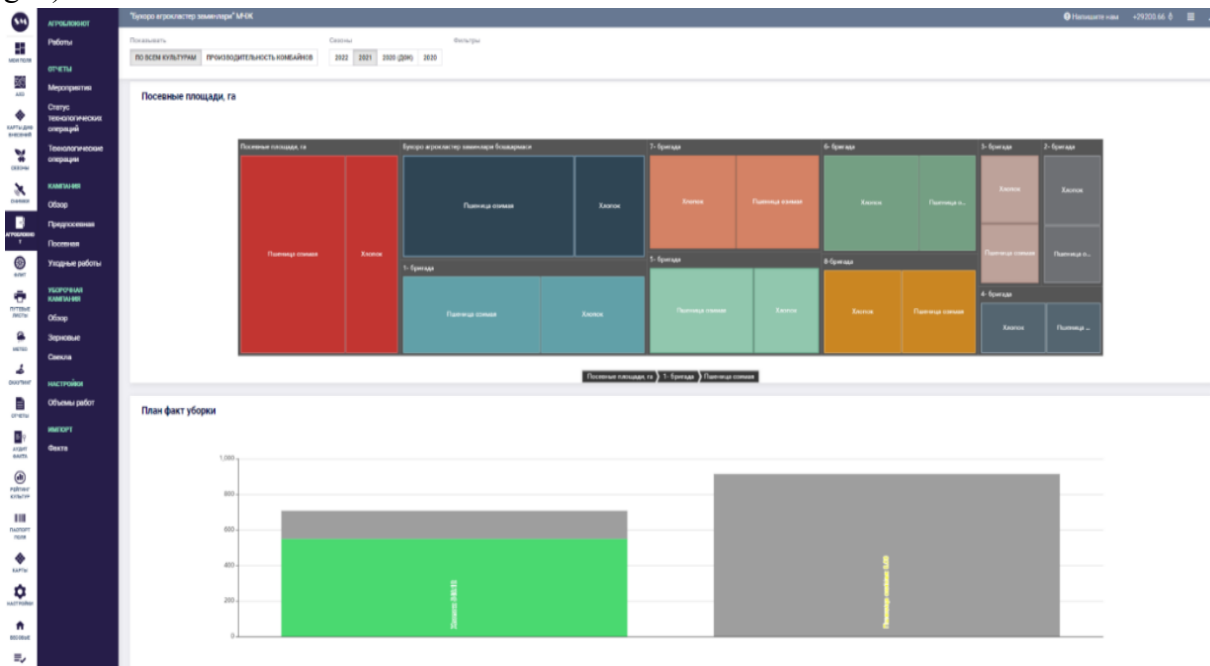


Figure 1 Crop placement module in the Smart Map system

In the process of making management decisions in agriculture, artificial intelligence-based systems analyze real-time information flows and propose optimal solutions, taking many factors into account. The development of cloud technologies and unified information platforms will increase the efficiency of data exchange and strengthen integration between farms and other clusters.

Furthermore, the introduction of digital and intelligent technologies in agriculture will reduce errors related to the human factor, automate production processes, increase productivity, and ensure economic efficiency. In particular, systems based on the Internet of Things (IoT), artificial intelligence, and robotics are becoming an important driver of innovative development in agriculture.

In general, the introduction of management systems based on digital and artificial intelligence technologies is of great importance in increasing the competitiveness of Uzbekistan's agriculture, strengthening its investment attractiveness, and ensuring its sustainable development.

The "Field History" module, created using Big Data technologies, is an important information base for agricultural production management. Through this module, long-term data on crop rotation, yield indicators, soil condition, applied agricultural technologies, and climatic conditions are systematically collected and analyzed for each field. (Figure 2)

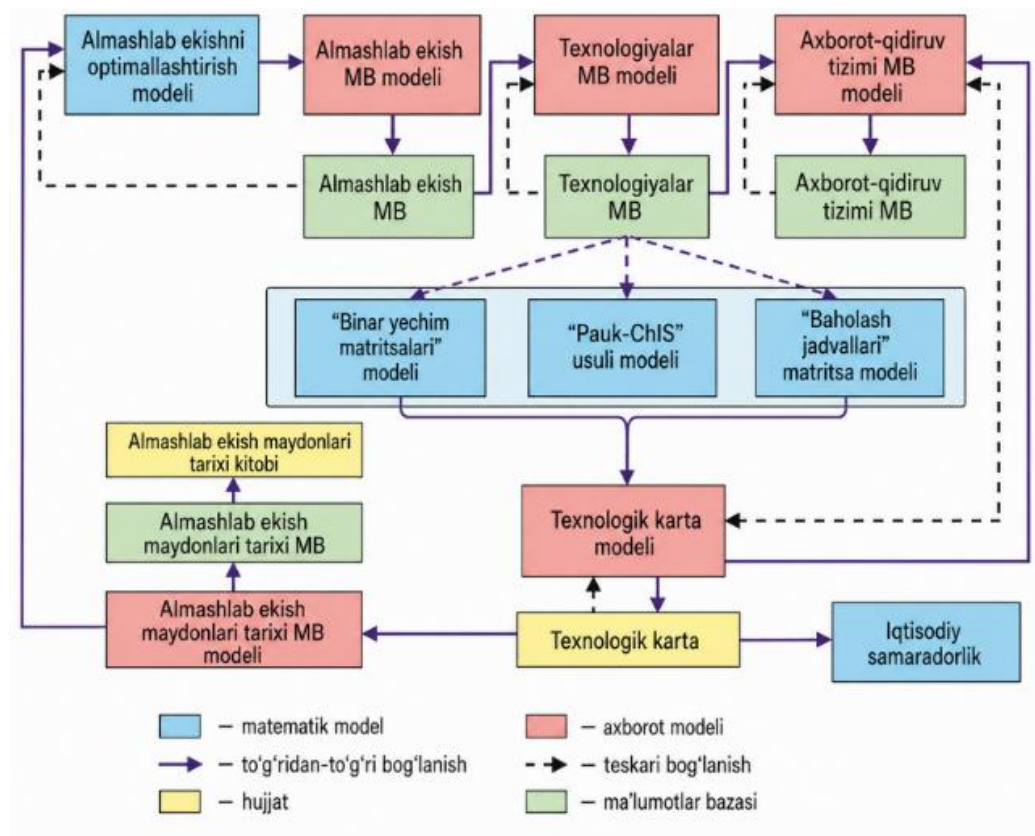


Figure 2 - Simulation of integrated AIS management

Bukhara Agroklaster is a leader in implementing digital technologies, utilizing ERP systems, geographic information systems (GIS), and artificial intelligence-based platforms to manage production processes. Through these systems, it is possible to plan resources, coordinate work processes, and increase production efficiency.

Research indicates that the implementation of digital technologies in agriculture, particularly artificial intelligence, Big Data, and IoT solutions, is a crucial factor in increasing network efficiency. Optimizing crop placement based on the “Smart Map” system allows for the rational use of land resources, precise planning of agrotechnical measures, and increased yields.

Additionally, digital management systems will enable comprehensive control of production processes, data-driven decision-making, and early risk forecasting. As a result, resource conservation is ensured in the agricultural sector, production costs are reduced, and product quality is improved.

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