

Analysis of key technologies of digital transformation in agriculture

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Abstract. The implementation of digital transformation in agriculture is currently realized through the implementation of a set of digital technologies, which are interrelated with each other, within the concepts of smart agriculture and precision farming. It should be noted that the use of individual components of precision farming has been carried out for the last two decades, but at present the issues concerning the widespread distribution of integrated solutions in sustainable crop production of resource-saving nature, involving the use of various sensor devices, unmanned and automated machinery, various robotic production systems, the Internet of things, platform technologies for the realization of the digital economy are becoming more and more relevant. The fundamental task of the digital transformation in agriculture is to obtain the most important information about the state of the internal and external environment, in relation to the generated arrays of big data. Cloud platforms and big data solutions are essential to this task. In addition, the support systems used for management decision-making and the technologies of predictive analytics play a significant role.

Keywords: increasing yields, food security, environmental stewardship, digital platform, digitalization of workflow

1. Introduction

According to ongoing research, more than seventy-five million agricultural devices generated through the Internet of Things are currently in use around the world. It is projected that in two to three decades, the average average farm will be able to generate more than four million pieces of data per workday [1]. This will be possible as a result of a reduction in the cost

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as well as an increase in the accuracy of agricultural sensor equipment, including the following items: sensors used in agricultural fields, sensors used to monitor the condition of industrial premises as well as agricultural machinery and equipment, sensors that allow the monitoring of the health indicators of farm animals. The combined use of modern technologies will lead to a significant increase in the number of agricultural producers who form and have access to the process of continuous collection, analysis and interpretation of the information obtained, as part of a comprehensive three-level monitoring of modern agricultural systems, including ground, as well as air and space types of control, which will contribute to a comprehensive study of the state of both individual farms and farms in terms of regions and countries [2].

The main technologies for the implementation of digital farming systems are remote sensing systems of land, which through the use of satellite systems, allow the formation of electronic maps of the fields, and ensure the use of drones equipped with multispectral cameras, capable of remote environmental monitoring, monitoring of crop growth, soil conditions, and early diagnosis of a variety of plant diseases and diseases in a remote format.

The main breakthrough digital technology in agriculture is robotization in terms of the application of robotic systems of autonomous nature, a variety of smart farms and greenhouses. In addition, the use of unmanned transport used in the cultivation as well as the processing of agricultural land is expanding. Various kinds of agricultural robotic systems, as well as intelligent systems based on big data analysis and IoT (Internet of things technologies), are expanding their application in the livestock sector, which allows effective management of the life cycle of farm animals, continuous monitoring of their health indicators and, therefore, updating the care and feeding regime [3].

The main direction of digital transformation in farm management is the expansion of the use of digital platforms, as well as virtual assistants of small agricultural producers. With their help, practical recommendations for agricultural work, selection of optimal types of cultivated plants, determination of economic feasibility of production and, in addition, competent accounting and financial management of agricultural companies are formed.

2. Materials and methods

A set of digital solutions for agricultural producers is used in the sales process as well as in logistics. Such solutions include systems that monitor and monitor the quality of agricultural products. In addition, this can include the so-called "smart contracts" and, in addition, marketplaces that facilitate the promotion and sale of agricultural products by small producers.

The implementation of the digital transformation will allow a flexible response to a set of global challenges, including the following:

- The growing need to increase the volume of food products, which is due to the steady growth of the world population, as well as the desire to improve the quality of life of people [4];
- the active depletion of agricultural land, the reduction of land suitable for farming;
- increase in the consumption of water resources with a simultaneous increase in carbon dioxide emissions into the environment;
- climate change, increased number of natural disasters negatively affecting agricultural producers;
- volatility in the preferences of consumers of agricultural products, increasing interest on the part of society in the implementation of the model of sustainable and ecological consumption.

3. Results

The combined use of precision farming technologies can help to increase crop yields as a whole by more than seventy percent [5]. Timely and adequate response to changes occurring in the external environment and optimal regulation of equipment performance contributes to

reducing the cost of planting material, fuel, energy, fertilizers, and optimizes the time of field works.

A variety of technologies that allow the analysis of big data, as well as the use of artificial intelligence will lead to an increase in the level of effectiveness of breeding processes, improve and optimize the composition of fertilizers and feeds, will contribute to the refinement of yield forecasts, as well as optimize the process of growing crops [6].

Expanding the use of drones will reduce the cost of various agricultural works (planting of seed material, determining the time of harvesting, detection of pests, etc.). This will increase the rate of labor productivity and, in addition, ensure the transparency of the production process and the definition of the region of origin, which will ensure the safety of consumption for the population. The use of digital technology will reduce the burden on the environment by agricultural producers and thereby increase the efficiency of the use of natural resources, as well as contribute to the leveling of negative agroclimatic impacts [7].

The stimulation of digitalization processes will contribute to the reduction of existing disparities in the quality of life indicators of the urban and rural population, the integration of agricultural producers into the complex of food systems, as well as supply chains, which will be possible, including through the growth of digital literacy among the rural population.

Table 1. The most important aspects of digitalization in Russia.

Popularization of digital solutions in various industries
Ensuring import substitution in all sectors of the country's economy
Formation of actual platform solutions
Creation of domestic intelligent systems

The need for digital transformation of agriculture in the Russian Federation is determined by the need to increase labor productivity, as well as the need to improve the technological level of agricultural producers and the need to intensify the processing of agricultural products, which will increase the quality characteristics of exported products.

Russia's digitalization processes are most interested in the representatives of large agricultural businesses that are able to allocate the necessary funds to ensure the development of digital infrastructure. Stimulating the development of production automation processes of agricultural enterprises will reduce their costs, increase their competitiveness, and provide access to foreign markets.

4. Discussion

The use of digital technologies by agricultural producers is not limited only to the implementation of automation of only some activities and business processes. In modern conditions the opportunities provided by the use of a comprehensive system of precision farming, processes of "smart" automation of production are of great importance. The specified will allow to ensure the formation of the necessary information array of data, to make informed management decisions, with regard to the implemented production processes, as well as the use of agricultural machinery. Researchers expect that by 2025 the market of precision agriculture technologies will exceed the volume of 12 billion dollars [8]. At the same time, the most effective will be digital operations associated with the implementation of remote monitoring of land, precision spraying of crops, as well as the effective management of large amounts of data.

Currently, the spread of digital technologies in the Russian agriculture is at the initial level, therefore, efforts should be made to increase the level of digitalization of agribusiness. Russian agriculture is specific in that the development of digitalization processes is spontaneous and conditioned by the desire of agricultural producers to ensure the digitalization of only some components of agriculture, characterized by a short payback period, which is a selective version of digitalization, in contrast to the comprehensive implementation of digital technologies in the entire value chain. Of particular interest for domestic agricultural producers are advanced technologies for determining the satellite location of agricultural machinery, as well as various equipment, integrated systems that contribute to the monitoring, as well as control the quality characteristics of the work and resources consumed and, in addition, the accounting systems used. Small companies - agricultural producers are focused on the use, within the framework of digital technology, of services that can ensure the sale of products, including the presence on the marketplaces.

5. Conclusion

Currently, there is a need to expand the Russian market of digital technologies, including through the development of agricultural stratagems [9-15]. At the same time, the most relevant digital solutions needed by Russian agricultural producers are the following: services that provide decision support; applications that implement precision farming; integrated systems that provide management of processes in production, monitoring of life cycle indicators and health of farm animals and plants; system platforms for managing agricultural enterprises; harvest automation systems; systems for monitoring the functioning of g

In the Russian Federation, the process of implementing digital technologies, as well as platform solutions, in the context of agriculture is aimed at achieving a technological breakthrough, as well as the strategic development goals of the agro-industrial complex.

The fundamental priority is the formation and implementation of the national platform "Digital Agriculture". This digital platform will accumulate aggregate information about the objects of agricultural resources, including information about agricultural land, livestock, machinery, raw materials and finished products. This information will be digitized and included in an integrated digital platform, which will use artificial intelligence technology, as well as big data analysis and machine learning to conduct forecasting processes and model the development of the agro-industrial complex, in order to make decisions about state support for agricultural producers.

In addition, it is planned to develop and implement the system of intelligent sectoral planning "Effective hectare", the formation of a systemic digital channel to ensure interaction in the agricultural industry "Smart Contracts", the system of scaling Russian typical digital solutions-agricultural enterprises, including projects "Smart Farm", "Smart Greenhouse", "Smart Field" and so on. In addition, state support is needed for the development of digital systems of quality control and information about the origin of agricultural products, in order to reduce the share of the shadow sector of agricultural production. The formation and implementation of the project "From field to port" will help to optimize the logistics chains implemented in the course of export deliveries, which will contribute to the reduction of paperwork.

One of the main objectives of the digitalization of Russian agriculture is to increase the level of human resources, contributing to the continuous training of agricultural specialists, through the use of the educational environment "Land of Knowledge". The formation of these activities, platforms, digital solutions, will contribute to the development of digitalization in our country.

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