Research on digitalization processes in agriculture

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Abstract. The study of the process of transformation of agriculture is a relevant topic due to the need to identify factors slowing down the development of the digital agriculture model. The purpose of the article is to determine the comprehensive development of digital technologies in organizations operating in the agriculture sectors of the Russian Federation. The results of the study showed that there are significant digital gaps in the implementation of digital technologies by agricultural organizations. The lack of integrated use of digital technologies leads to the impossibility of forming a digital model of agriculture, since a gap arises between systems that automatically collect information about the condition of plants and animals and systems of robotic equipment and automatic correction based on artificial intelligence technologies.

1 Introduction

Digital transformation of the economy involves the comprehensive introduction of digital technologies at the stages of production and distribution of products. The main task in implementing digital transformation programs for industries is to obtain positive effects. Comparative assessments of the implementation of digital technologies in sectors of the economy of Russian Federation show that agriculture is one of the sectors with the smallest share of organizations that have introduced digital technologies into their work. At the same time, the authors [1,2] note that the following technologies can be actively used in the production of agriculture products:

- robotization in the use of unmanned vehicles for processing fields;
- unmanned technologies used to assess the condition of products;
- artificial intelligence technologies for generating solutions in algorithmic complexes;
- technologies for collecting and processing big data for training artificial intelligence, etc.

Scientists’ estimates allow us to conclude that the use of digital technologies in agriculture is highly effective [3, 4]. When forming a digital agriculture model, it is necessary to ensure the creation of an integrated system capable of controlling the full cycle of production of crop and livestock products. Digital agriculture is a system that combines automated collection of information about the condition of plants and animals, robotic equipment and complex automatic correction based on artificial intelligence technologies [5, 6]. The purpose of the

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2 Materials and Methods

The methodology for assessing digitalization processes in the agricultural sector includes a consistent assessment of the level of use of software and digital technologies by organizations.

The availability of representative data in a modern statistical observation system limits the possibility of this study in accordance with the following observed indicators values, Figure 1. At the same time, the description of the composition and technical characteristics of software and digital technologies can be expanded depending on the objectives of the study.

Research hypotheses

Testing of research hypotheses is carried out during the implementation of the following algorithm of actions.

The first stage of implementation of the algorithm for assessing digitalization processes in the agriculture sector involves the creation of an information base on the use of software technologies and digital technologies by organizations. The information is contained in the statistical reference book “Indicators of the Digital Economy”, table 12.16 “Use of special software in company business processes” and table 13.2 “Use of digital technologies in organizations by type of economic activity”.

H1: The use of software by organizations characterizes the level of digitalization of agriculture.

Indicators for assessing the use of software by organizations:

- electronic document management systems
- reference legal systems
- electronic financial settlement systems
- information security software
- procurement management systems
- software for accessing databases through global information networks
- sales management software
- warehouse management software
- training programs
- ERP systems
- CRM systems
- production management software

H2: The use of digital technologies by organizations characterizes the level of digitalization of agriculture.

Indicators for assessing the use of digital technologies by organizations:

- cloud services
- technologies for collecting, processing and analyzing big data
- digital platforms
- data centers
- geographic information systems
- Internet of Things systems
- RFID technology
- artificial intelligence technologies
- industrial robots / automated lines
- additive technologies
- digital twin technologies

Fig. 1.
3 Results and Discussion
As can be seen in Figure 2, the share of organizations using software systems in agricultural organizations increased compared to 2021, but did not exceed the economic average. The figure also shows that the technologies whose functioning may underline the collection of data for a digital model of the functioning of an agricultural organization are extremely small. The share of organizations using ERP systems is 16.9%, CRM systems is 14.8% and the share of organizations using production management software is 17.1%.

Next, we present the data on the results of assessing the specific share of organizations using digital technologies by type in the agricultural sector and in the economy as a whole, Figure 3.
As can be seen in the figure, there are significant digital gaps in the implementation of digital technologies by agricultural organizations. The lack of integrated use of digital technologies leads to the impossibility of forming a digital model of agriculture, since a gap arises between systems that automatically collect information about the condition of plants and animals and systems of robotic equipment, as well as automatic correction systems based on artificial intelligence technologies.

4 Conclusion

The results obtained confirm the research hypothesis about the need for comprehensive implementation of software and digital technologies to form a digital agriculture model. To solve this problem, it is necessary to intensify domestic IT and digital technologies developments and introducing financing programs. An example of the development of a digital model of agriculture is a robotic workflow system operating on the basis of artificial intelligence and RTK technology [7]. This approach requires uninterrupted operation of the Internet or large coverage of the territory with a satellite signal. By processing an array of data, uninterrupted high-tech functioning in the production chain of an agricultural product is ensured, which makes it possible to increase profitability, achieve financial stability indicators and prevent unprofitability of organizations in the industry.

A competent analysis of existing data for the industry as a whole makes it possible to take into account such complex parameters when forecasting as weather conditions, seasonality, geographical features of agricultural land, the need and amount of mineral and vitamin fertilizing, the need for additional treatment of land against pests and diseases in crop production, the need for medicines in livestock farming.

The development of a digital agriculture model is necessary to create the sustainability of the economy of the Russian Federation and ensure stable output of agricultural products. The formation of decision-making algorithms in determining the directions of digital transformation allows us to ensure a natural increase in the efficiency of the entire production and distribution chain, taking into account trends in manufacturability and import substitution.

References

1. R. Abbasi, P. Martinez, R. Ahmad, The digitization of agricultural industry – a systematic literature review on agriculture 4.0. Smart Agricultural Technology, 2(2022)
2. W. Purcell, T. Neubauer, K. Mallinger, Digital Twins in agriculture: Challenges and opportunities for environmental sustainability. Current Opinion in Environmental Sustainability, 61(2023)
5. I.L. Kovalev, Implementation of information and communication technologies based on satellite navigation systems in the agricultural and industrial complex of Belarus: problems and prospects. Resources and Technology, 14(2)