Digitalization in Agriculture

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Abstract. The article discusses the conditions for the introduction of digital technologies This study is aimed at studying the importance of digitalization for ensuring the competitiveness of the agro-industrial complex of the Russian Federation. The article deals with the theoretical and applied issues of innovative development of the sector. The stages of digitalization implementation in the agro-industrial complex of Russia are analyzed. Methods of modernization of traditional agricultural systems are revealed. General recommendations for the development of digitalization in the agro-industrial complex have been developed.

1. Introduction

Today, the Russian agro-industrial complex is facing a number of challenges – the increase in globalization processes, economic sanctions, the consequences of the pandemic, which necessitates the renewal of strategic goals and focus on the innovative way of development of the sector. Digitalization allows to achieve the creation of agricultural ecosystems and contributes to the strengthening of links between related industries (food, processing, chemical, etc.) Digitalization is a new trend in the agro-industrial complex, which has replaced informatization and computerization. The fundamental documents of the digital transformation of the Russian economy are the "Strategy for the Development of the Information Society in the Russian Federation for 2017-2030", approved by Presidential Decree No. 2032 of May 9, 2017, and the program "Digital Economy of the Russian Federation", adopted by the Decree of the Government of the Russian Federation No. 1632-R. 2 of July 28, 2017. For example, in China and the United States, the popularity of online farm sales increased in 2020. The creation of new logistics channels for the transportation of agricultural products allows any small and medium-sized entrepreneur in the field of agriculture to become an online merchant, as the demand for fresh eco-products increases.

On the basis of mass implementation of the digitalization approach, it is possible to achieve high efficiency of the agro-industrial sector and a competitive position in the market. Digital platforms have the potential to fundamentally change the way knowledge is processed, transmitted, accessed, and used. For farmers, digitalization will provide a qualitatively new opportunity for decision-making, which will potentially lead to radical changes in the management of farms.
2. Relevance
Currently, digitalization is considered to be a key factor in the progressive development of national economies. The competitiveness of the domestic agro-industrial sector critically depends on the success of the introduction and implementation of digital technologies. It should be noted that this sector of the economy has historically been less innovative than most other Russian industries.

3. Problem statement
General problems of innovative development of agriculture, including the use of digitalization, were reflected in the works of V. P. Bauer, M. Ayaz, A. Mansour, etc. The works of Iu Iu Butyrin, S. B. Ognivtsev, E. A. Skvortsov, T. A. Shcherbin, N. N. Yurin and other Russian scientists are devoted to the problems of state support for the development of agriculture. Despite the extensive study of the features of innovative development of agriculture in the works of scientists, it is necessary to identify the factors that affect the introduction of digitalization in agriculture and assess its significance.

4. Theoretical part
At present, the activities of all sectors of the economy can no longer be imagined without digital technologies. A necessary condition for the digitalization of economic sectors is the achievement of a high level of informatization and automation. Agriculture is a strategic industry for Russia, with a high export potential. The development of agricultural production in Russia and the improvement of the efficiency of agricultural production to the world level is impossible without the introduction of advanced (digital) technologies.

Agriculture is one of the most technologically conservative industries, and so far it has not been digitalized enough. This is the situation not only in Russia, but in the world as a whole. The agro-industrial complex has a great potential for the introduction and development of digitalization.

It cannot be said that digitalization has not yet been introduced into the agro-industrial complex, the history of the stages of digitalization can be presented as follows (Fig. 1).

![Figure 1. Stages of digitalization of the agro-industrial complex [1].](image-url)
Over the past few years, the interest in smart technologies in the agro-industrial complex has been growing all over the world. The experience of foreign countries, which occupy leading positions in the world economy, indicates the need for a rapid increase in innovative technologies with the use of artificial intelligence. Competitive high-tech transformation of the domestic agricultural industry requires the introduction of digital technologies in production. Agricultural production has its own specific features, which dictate the widespread use of digital technologies, as in no other sphere of the national economy. The main arguments in support of the digitalization of agricultural production are the need to fulfill the following problematic tasks associated with lagging behind the advanced countries of the world (Fig. 2). The digital economy, consumer demand for electronic resources and the development of new technologies have a direct impact on the development of agriculture in our country.

![Diagram](image)

**Figure 2.** Prerequisites and objectives of the introduction of digital technologies in agriculture.

However, the transition from the traditional form of agriculture requires significant costs, which means that without additional funding and government support, the sector does not have sufficient resources for further development.

One of the main problems hindering the development of digitalization of agriculture can be called the lack of appropriate infrastructure in the conditions of regional inequality. A significant obstacle to the digital economy is the shortage of human resources. According to some estimates, currently the domestic agriculture needs more than 90 thousand qualified IT specialists (Fig. 3).
As of 2020, according to a study by Statista, a German company in the field of market and consumer data, Russia ranks 43rd in the digital competitiveness rating with a value of 59.95%. This rating reflects the ability of countries to implement and explore digital technologies that lead to changes in government practices, business models, and society as a whole.

![Problems hindering the digitalization of agriculture](image1)

**Figure 3.** The main problems hindering the introduction of digitalization in agriculture in Russia.

Based on the structure of investments in the agribusiness sector, one can judge current trends and be able to predict future trends (Fig. 4).

![Structure of global investments in Agribusiness at the end of 2019](image2)

**Figure 4.** Structure of global investments in Agribusiness at the end of 2019, million $.

Based on the data presented, it can be said that the greatest potential in the agro-industrial sector will have monitoring technologies, remote control of equipment, a network of connected smart objects that collect data and exchange information using cloud data, without direct human intervention, as well as biotechnology. The Internet of Things is an effective tool for reaching a new level of digitalization in agriculture. However, Russia occupies only 1.5% of the world's Internet of Things, and this figure is lower in the agro-industrial complex.

Despite the fact that at the moment the share of digitalization in the agricultural sector is relatively small, it is expected that this indicator will grow in the near future. During the pandemic, investors'
interest in online sales of agricultural products, the marketplace, and biotechnologies has increased, which has an impact on attracting farmers to digital transformation and increasing competition in the industry.

5. Practical significance
In our time, there is much more qualitatively useful and convenient information about what is happening on farms and in agribusiness, this information is becoming more accessible in digital form, timely and less expensive. Sustainable technological advances in agricultural knowledge have potentially significant implications for agriculture and agribusiness. Advances in crop genetics and animal husbandry can increase farm productivity and improve the quality of agricultural products.

Specific tools for achieving farm efficiency are discussed below. First, you need to collect data from farms.

Today, remote sensing is an innovative source of information. The action is carried out by satellites that collect data on the ground cover, the state and health of crops, weather conditions and soil conditions, crop yield estimates, and subsequently provide all this information to farmers, as well as agribusiness and other industry observers.

Drones collect even more detailed information at the field level, including monitoring and identifying crop diseases, monitoring soil moisture, and providing images for use in setting property boundaries and for many other purposes.

Digital tools are transforming the way we manage knowledge and information about the agro-industrial complex at all levels. At the level of farms and agribusinesses, a significant increase in the availability of knowledge and information, as well as the ability to manage and use it, is an important factor for significant productivity and economic efficiency gains.

At the level of higher government bodies (Ministry of Agriculture), the development of digitalization allows state support programs and policies for agriculture to be more effective, adaptable and targeted.

Cloud-based farm data management systems are a kind of CRM in the agricultural industry. The software extracts weather data by integrating data from multiple sources, tracks location using GPS for economic planning of agricultural machines, their tasks and performance. Having received comprehensive data on farms, the software will help managers implement a number of initiatives aimed at communication with customers, working with supply chains and other irreplaceable functionality that offloads activities, which is important for small and medium-sized businesses.

This functionality is successfully implemented in the innovation space in China, in the form of a digital village pilot project aimed at developing the modernization of rural areas remote from large cities. According to preliminary estimates, this will reduce the significant gap between urban and rural areas, as well as introduce a digital economy in remote regions. The project will expand the use of broadband wholesale Internet, mobile network, new generation Internet and digital TV.
Digital tools are important not only to help farmers and participants in the agro-industrial segment use technical knowledge and information, but also to enable agricultural actors to overcome barriers (isolation, asymmetric information, etc.) and become much more effective participants in the domestic market.

6. Conclusions
The tools discussed in the article modify agriculture and agribusiness both in Russia and around the world. They increase productivity, stimulate the growth of value added and income in agriculture, and increase the flow of investment into the industry.

Global challenges create growth points for the Russian agro-industrial sector in the form of not only threats, but also opportunities. Legal regulators, scientific and technical organizations, agricultural and food producers should take active adaptation measures and make effective use of the emerging potential. Actors should clearly identify emerging global trends, existing strengths and weaknesses, flexibly apply development strategies, and effectively interact with market participants on a wide range of issues.

Thus, an increase in the digitalization index of the agricultural and food sectors will allow the formation of new knowledge and technologies, which in turn will have a positive impact on the competitive markets.

Note that as a general principle, for large tables font sizes can be reduced to make the table fit on a page or fit to the width of the text.

7. References
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