Digital potential of the Russian agro-Industrial complex based on the results of technological innovations

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Abstract. The article analyzes the current state of innovation activity and the fundamental features of technological development in the agricultural sector of the economy, identifies barriers and prerequisites for the transition to digital transformation, and demonstrates the results of the introduction of domestic technological innovations. In the context of modern realities, innovations are becoming a fundamental component of the development of the national economy. The process of digitalization for the agro-industrial complex is due to the urgent need to increase the efficiency and sustainability of its functioning through radical transformations of managerial efficiency by technological processes and decision-making processes at all levels of the hierarchical ladder, based on innovative approaches to production and the subsequent application of information data on the state of controlled elements and subsystems and forecasting their potential adjustments, as well as economic conditions in the agricultural sector. The practice of a global scale and the experience of authoritative domestic agricultural producers illustrate that the use of modern technological solutions contributes to ensuring optimal soil, agrotechnical and organizational and territorial conditions, which make it possible throughout the full life cycle of agricultural products to contribute to an increase in yield and labor productivity, reduce material costs for fuels and lubricants (F&L), electricity, plant protection products (PPP), wages and other types of expenses, maintaining soil fertility and preserving the environment. Increasing and stimulating innovative and technological activity in the agro-industrial complex will also increase production volumes, increase the competitiveness of domestic agricultural products, eliminate the problem of import substitution and increase the level of profitability of agricultural enterprises.

1 Introduction

The agro-industrial complex occupies a key position in the Russian economic system due to its significant role in the process of ensuring food security. The modern agricultural sector of Russia is one of the most steadily progressing sectors of the national economy, and the

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production of some types of agricultural products shows record historical indicators [1, 2, 3]. To date, Russia, in accordance with the fundamental criteria of the Food Security Doctrine, has overcome the indicators of dependence on imports for the most important varieties of agricultural products. This fact is confirmed by the fact that there is an intensive geometric increase in the volume of exports of such types of agricultural products as wheat, poultry meat and aquatic biological resources. At the same time, the agro-industrial complex of the Russian Federation is characterized by weak technological support, there is a long-term trend of low productivity and wages, the production of many types of products is used on the basis of imported technological solutions, equipment, raw materials, seeds and agrochemicals. Further increase in efficiency and ensuring the necessary level of competitive potential of the country's agro-industrial complex is possible only by increasing labor productivity and reducing production costs [4, 5].

Scientific research and progressive international experience demonstrate that only the digital transformation of the business model of agro-industrial production mainly contributes to increasing the competitive advantages of agriculture and activating the industry to the transition to a dynamic course of development. This process not only provides a significant increase in added value due to the use of technical, technological and organizational solutions, but also makes it possible to equalize production and sales risks, more quickly adapt to the constant transformation of external conditions and factors, and thereby increase crop yields and increase the level of livestock productivity with almost equal resource costs per unit of production [6, 7].

Fundamental and applied scientific and technical reforms and achievements implemented in recent years, the reactualization of modern global challenges, such as structural-political, organizational-managerial, socio-economic, production and technological, environmental-resource, institutional and legal, have initiated the formation of prerequisites for the transition of the domestic agro-industrial complex to a radically new stage of its development [8, 9]. The transitional transformations recorded in the current period of time are so dynamic and large-scale that in the coming decade they will be able to radically modify the appearance and environment of the progression of the agro-industrial complex of Russia, the mission of which in modern conditions goes beyond the simple production of food products [10].

The fundamental prerequisites for the process of digital transformation of the Russian agro-industrial complex are:

- increase in the amount of information data that needs to be processed in order to make rational management decisions;
- strengthening information exchange;
- popularization of the Internet of Things (IoT) technology as an automated system for obtaining data in real time [11].

The digital development of the Russian agro-industrial complex is facilitated by a certain tool, expressed in the consistent transformation of the socio-demographic situation in the country. This is manifested, first of all, in the increase in the duration of the life cycle, which provokes the need for an increase in labor productivity, an escalation of international migration, intensive growth of the urban population and a rapid decline in the rural population, a shift in values and a change in the way of life. The need to pursue a digital transformation policy is due to the transition to new models of functioning of agricultural facilities based on digital technologies, which significantly increase the efficiency and quality of management decisions [12].

2 Materials and Methods

The methodological tools are based on the works of Russian scientists and specialists in the field of digital transformation of the agro-industrial complex of Russia, materials from
periodicals, reports of research organizations, research by the Ministry of Agriculture of the Russian Federation, the consulting company Yakov & Partners and the National Research University Higher School of Economics. The research process was based on the application of systematic and integrated approaches to the subject of study through the use of economic, abstract-logical, comparative and expert research methods.

3 Results and Discussion

In the ranking of digitalization of the global agro-industrial complex, according to the results of 2022, Russia took eighth place, ahead of China and India. The top five are the United States, Australia, Canada, Israel and Germany. The indicator of digitalization of the agro-industrial complex in different countries is shown in figure 1.

![Indicator of digitalization of the agro-industrial complex in different countries according to the results of 2022](image)

**Fig. 1.** Indicator of digitalization of the agro-industrial complex in different countries according to the results of 2022.

A study conducted by the consulting company Yakov & Partners showed that the domestic agro-industrial complex lags far behind the main players on the world stage in terms of the level of digital innovation: Israel by nine times in terms of the degree of integration of digital tools by agricultural producers; seven times in terms of the weighted average volume of private investment; three times in comparison with the number of enterprises implementing digital solutions.

In order to increase the productivity of the agro-industrial complex, Russia needs to approach the level of digital penetration of the leading agricultural powers. According to the forecast of the consulting company Yakov & Partners, by 2030, digital modernization is guaranteed to increase labor productivity in the domestic agricultural sector by 15.6%, increase production volumes from 3 to 5%, reduce the cost of production from 5 to 20%, and also provide agricultural producers with additional profit in the amount of about 800 billion rubles annually. In addition, by 2025, against the backdrop of the widespread use and application of artificial intelligence, there will be a significant increase in gross value added (GVA) in crop production and animal husbandry by 25% and 13%, respectively [13].

Currently, the largest domestic agro-industrial holdings are actively engaged in the introduction of innovative technologies and digital products in their activities. Such enterprises apply artificial intelligence algorithms to optimize the management of sowing and harvesting processes, perform the function of satellite monitoring of farmland, implement
management systems for agricultural enterprises and equipment, conduct diagnostic analysis of the state of plants and animals, develop and improve technologies in the field of precision farming, and also acquire automated and robotic technological systems [14]. However, there are very few enterprises like this in percentage terms – only 12% of companies in the agricultural sector fully exploit artificial intelligence technologies, and the remaining 37% are considering the possibility of integrating them in the future. Meanwhile, Russia has a sufficient number of breakthrough digital innovations of its own production. This argument is supported by the statistical registration rate of more than 220 startups in the MVP (Minimal Value Product) stage for 2022, among which 24.2% belong to the field of biotechnology, 11.9% to the field of precision farming technologies, and 9.6% to unmanned aerial vehicle (UAV) technologies [15]. Nevertheless, the slowdown in the process of digital development is associated with a set of objective obstacles and barriers:

- Lack of awareness in the field of digital technologies (digital infrastructure is rapidly undergoing evolutionary development, and therefore it is necessary to be fully prepared for constant learning and adaptation, the main problem is that in Russia there are no exhibitions of digital agricultural solutions for companies in the agricultural sector, while all over the world this is a huge trend movement);
- Conspiracy of promising digital products (in order to maintain competitive advantages, some enterprises prefer not to publicly disclose information about their high-tech developments);
- Inaccessibility of the Internet (the introduction of technological innovations in agriculture, which increase the efficiency of work and the quality of products, requires a stable and fast Internet connection, which remains a significant problem for rural areas. Lack of access to the network is a major obstacle to the collection of data on weather, soil or plant conditions);
- Low prestige of the profession (during the period of complex information transformation, part of the population has prejudices and erroneous stereotypes about working in agriculture, not emphasizing the importance of this area of activity for society);
- Shortage of personnel (the agrarian sector of the economy is systematically improving in the technological aspect, in accordance with which there is a need to attract more competent specialists in the field of the latest technologies. However, due to the lack of a sufficient number of educational programs and training courses, it leads to a shortage of highly qualified personnel);
- Lack of autonomous test sites (agriculture is characterized by a long period of testing hypotheses and adapting new technologies. In most cases the latest Russian technological products are tested according to all standards in France or Israel);
- Bureaucratic hurdles in obtaining subsidies (the process of applying for cash financing requires the applicant to fill out a huge amount of documentation, provide information about the business and confirm the need for an information technology solution. However, in some cases, applicants face incomplete information about specific subsidiary programs or documents to be provided) [16].

Most often, at the initial stages of integration of innovative and technological products, including in the agro-industrial complex, their efficiency and functionality are ambiguous. Nevertheless, the use of digital technological solutions in all areas of the Russian agro-industrial complex has already become a key factor in maximizing its efficiency. The results of the introduction of domestic technological innovations at the enterprises of the agro-industrial complex of Russia are presented in table 1.
Table 1. Results of implementation of domestic technological innovations at the enterprises of the agro-industrial complex of Russia.

<table>
<thead>
<tr>
<th>Agricultural company</th>
<th>Description of the company's activities</th>
<th>Location of the company</th>
<th>Implementation results</th>
</tr>
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<tbody>
<tr>
<td>Damate Group of Companies</td>
<td>A Russian agricultural holding company that implements projects for the production and processing of turkey, duck, lamb, and milk has integrated an automated video monitoring system. The system performs the function of round-the-clock remote control of cattle by means of computer vision. Based on the knowledge base formed over several years, the system analyzes and forecasts the amount of meat, milk and offspring obtained, as well as provides recommendations for optimizing production processes.</td>
<td>Penza</td>
<td>1. Reduction of the time to determine the moment of birth of the calf to a few minutes. 2. Reduce theft and accounting errors by up to 100%. 3. Increase in livestock productivity from 10 to 15%.</td>
</tr>
<tr>
<td>Agriculture Production Artel (Cooperative) Kuzminsky</td>
<td>The company's predominant field of activity is dairy cattle breeding and raw milk production. The company uses a robotic system for milking and feeding cows. The system uses sensors to identify each cow. As soon as the animal needs to be released from milk, it is moved to an area where the system attaches the teat cups in real time using a camera and machine learning algorithms.</td>
<td>Moscow region</td>
<td>1. Increase milk production from 11 to 17%. 2. Increase the life cycle of cattle. 3. Increase in the percentage of animals suitable for robotic milking from 87 to 99.6%. 4. Reduce the cost of robotic systems by 40% compared to analogues.</td>
</tr>
<tr>
<td>AFG National Group of Companies</td>
<td>A vertically integrated agro-industrial holding in Russia, formed on the principle of &quot;from field to counter&quot;. He has integrated digital technologies related to Big Data into his production: field monitoring, sensors on agricultural machinery, digital area mapping using drones, field battery weather stations, climate control systems in vegetable and fruit storages, digital systems for accounting for work, consumption of fertilizers and plant protection products (PPP), remote control of irrigation installations, devices that detect vulnerabilities during harvesting and subsequent transportation of crops.</td>
<td>Krasnodar Krai</td>
<td>1. Reduce planting time by 20%. 2. Increase the accuracy of measurements in field work by 30%. 3. Increase in profitability by 10-25%.</td>
</tr>
<tr>
<td>EkoNiva Group of Companies</td>
<td>Vertically integrated holding, the largest producer of raw milk in Russia and Europe. He has developed the EkoCrop application for crop production, with the help of which agronomists are given the opportunity to obtain objective information about each field, the work carried out there, the resources spent and the results. The company also uses RFID animal identification technology, DairyComp 305 and Pocket CowCard herd management programs, as well as its own.</td>
<td>Voronezh</td>
<td>1. Increase in average daily milk yield by 45%. 2. Reducing the daily update of information throughout the farm to 20 minutes. 3. Reduce the distribution of daily tasks from 5 to 2 minutes.</td>
</tr>
</tbody>
</table>
4 Conclusion

Conducting an assessment analysis of Russian agriculture through the prism of digital tools, it is possible to identify three fundamental aspects: a localized range of measures in the field of digitalization, a lack of qualified digital workers at the enterprises of the agro-industrial complex, and the focus of digital government solutions on the control of farmers instead of development. Taking into account the current peculiarities, Russia will not be able to realize its existing potential to the fullest. In this regard, the consulting company Yakov & Partners has developed some recommendations to increase the degree of digital development of the domestic agro-industrial complex:

1. Development of a platform for data processing, storage and management decision-making based on them. It is necessary to cooperate with information flows, create a unified workspace for employees and increase the transparency of business processes for management, which, in turn, will allow the use of all modern technological solutions for working with data, maximizing the effect of usefulness.

2. Formation of an integrated data bank in the agro-industrial complex. In order to realize the potential of digitalization of the agricultural sector, farmers need not only to rationally use their own data, but also to pursue a policy of exchanging them with other industry players.

3. Adjusting the trajectory of the program of the Ministry of Agriculture of the Russian Federation from the standpoint of digitalization in the interests of expanding support for small and medium-sized farms. Large agricultural holdings can introduce digital technologies without any state interference in this process, while it is extremely difficult for small and medium-sized farms in modern conditions to do without any support from the state.

Thus, the digital transformation of the agro-industrial complex contributes to the reorganization of the activities of its participants, and also leads to the formation of modern business models in the industry. With the help of digital technological solutions, these business processes generate alternative sources of income based on accurate and systematized information about the state of production processes and the external environment.

For agricultural enterprises, the effect of the introduction of digital technologies is manifested in a significant improvement in the quality of planning and management, a reduction in the total cost of collecting, processing and integrating public information data and services, simplifying access to state support measures, increasing labor productivity and increasing the qualification level of personnel.

Digitalization will allow public authorities to carry out systematic strategic planning and elastic management of the industry on the basis of relevant, complete and reliable information resources, the formation of a scientific and technical foundation for innovative knowledge.
and technologies of a publicly available nature to transfer the agricultural sector of the economy to a fundamentally different level of development from the current one.

For the end consumer, the process of implementing digital innovations should have an impact on reducing the cost of products, improving their quality parameters, as well as expanding the product line of the Russian agro-industrial complex, including organic.

References


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