Digitalization and automation of the agricultural sector

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Abstract. The research is aimed at studying the necessity and readiness of the agricultural sector for digital changes. New opportunities offered by digitalization to the agricultural sector have been identified. Creating final value for the consumer of the agricultural sector is complicated. Automation allows you to optimize each component of the process, as well as the overall results. Legal positions of optimization of digital changes in the agricultural sector in Russia are studied. The factors hindering the introduction of digital technologies in the agricultural sector in Russia are considered in detail. The structure of the implemented national platform for digital state management of agriculture "Digital agriculture“ is considered. Seven main directions of digital development of agriculture are presented. The analysis of the created catalog of digital technologies in the segment of agriculture is made. Digital technologies in the agricultural sector that are in steady demand are identified. We consider popular technologies that were at the peak of expectations, and then reached the plateau of productivity. New digital trends that are changing the agricultural industry have been studied.

1. Introduction
The first paragraph after a heading is not indented (Bodytext style). Digitalization makes fundamental changes in all areas of activity, changing existing business models in order to increase their efficiency by converting them to a new format [1]. Digitalization and automation of agricultural processes are now strategically necessary, aimed at strengthening their positions in the market, increasing competitiveness and increasing the satisfaction of society's needs. Digitalization can provide a new incentive to trade in agricultural and food products by connecting suppliers from the private sector to new markets. At the same time, digitalization of the agricultural sector will provide States with new opportunities to control and comply with standards [2].

In 2010, there were about 20 high-tech companies operating in the world in the field of agriculture, in 2013-2016 there were 1300 new technological solutions, and a new investment segment of AgroTech emerged [3].

The set of actions that a company takes to provide its products and services to the market, or the process of creating final value and value for the consumer, consists of the following blocks:

- Raw materials (this includes fertilizers, seeds, vitamins, agrochemicals, feed, medicines);
- Production (includes vegetables, fruits, dairy products, cereals);
- Primary processing processes, transport component, traders (this section includes primary processing of products, transportation and storage, biofuels, traders);
- Processing and food production processes (this block contains food, dairy products, meat, pastries, drinks and snacks);
• Wholesale and retail segment and distribution (represented by a network of large and small stores);
• End users of agricultural products.

This value chain of agricultural products requires a lot of effort related to the implementation of each block, which is increasingly solved with the help of automation and the latest industry digital solutions.

2. Materials and methods
This study was based on diverse research in the field of digital economy in General and digitalization of the agricultural sector in particular statistical materials, national regulatory framework, departmental projects, and case studies were used. The object of the study was the agricultural sector. The subject of the research is the processes of digitalization and automation of this sector. The purpose of this study was to systematize and process information sources, which made it possible to identify the problems of digitalization of the agricultural sector and ways to solve them. General logical research methods were used: analysis, abstraction, generalization, and induction.

3. Results
First of all, it is necessary to identify the factors that prevent the introduction of digital technologies in the agricultural sector in Russia:

• The inability to apply a unified approach to standardizing the processing of information about agricultural land, natural factors, resources, and sales opportunities for agricultural products;
• Lack of coordinated actions of state and local authorities in planning the development of agriculture;
• Shortage of digital specialists in the industry;
• Lack of effective incentives for agricultural production;
• Lack of legal regulation of interagency interaction;
• Lack of digital platforms;
• Lack of modern training programs to train specialists in the use of modern innovative technologies in agriculture;
• Lack of financial resources necessary for the introduction of high-quality information technologies in most agricultural producers;
• Uneven development of digital infrastructure in rural areas;
• Taking the third place in terms of agricultural land area among the countries of the world, Russia lags far behind in key performance indicators, such as output per employee, productivity.

The basic factor hindering the penetration of digital technologies in agriculture is the weak network coverage in rural areas, which is typical not only for Russia, but also for a number of European countries [4].

Given the current situation, the Russian Federation actively supports and encourages the development of digital technologies in the agricultural sector. The law provides for the need to develop and implement competitive domestic technologies in the agricultural sector by 2026 [5]. The departmental project "Digital agriculture" focuses on the development of the digital economy of the Russian Federation. The development of the agricultural sector involves the digital transformation of agriculture, which includes three main stages [6].

The first stage provides for the introduction of the national platform for digital state management of agriculture "Digital agriculture". This platform will include six sub-platforms that provide for the digitalization of the following areas of agriculture:
• Land use and land management;
• Product traceability;
• Agrometeorological;
• Collection of industry data;
• Information support and provision of services;
• Storage and distribution of information materials.

This platform needs to be created in 2020-2024. The purpose of the platform:

• Search and analysis of specific problems that hinder the development of digital technologies in the agro-industrial complex of Russian regions,
• Identification of significant and promising digital technologies for the sector;
• Accumulation of data of Federal Executive authorities on agricultural land for their subsequent accounting, monitoring and analysis.

The second stage provides for the creation of the module "agro-Solutions", integrated into the platform of digital state management of agriculture. The creation of this module will increase labor productivity, reduce the share of unit costs of enterprises for business administration, and optimize the material costs of agricultural products by 20%.

The third stage is aimed at implementing continuous training of specialists in the agricultural sector to master the competencies of the digital economy. The project of digitalization of the agricultural sector provides for the creation of an industry-wide electronic educational environment "Land of knowledge", aimed at remote training of specialists of agricultural enterprises. Thus, within the framework of this project, information on all production processes in the field of agriculture will be collected and accumulated.

The agricultural sector is one of the most vulnerable, as it depends on weather and natural phenomena, it is necessary to take into account the seasonal nature of business, and in agriculture it is not possible to structure all business processes in advance.

The main task is multiple automation of all stages of the production cycle to minimize losses, increase business efficiency, and improve resource management. Subsequent automation is aimed at a higher level of digital integration; it affects the organization of agricultural business, which can lead to changes in the profitability and competitiveness of products and companies. Integration of the necessary data with various intelligent applications that process it in real time provides results of analysis of multiple factors and justification for further actions.

4. Discussion

The agriculture business in Russia has reached a certain maturity, as evidenced by the stabilization of the level of investment in agriculture and the growth of competition among agricultural producers. The share of the information and communication technologies segment was 3.2%, ensuring the development of agriculture in 2019 was 3.2% [7]. The number and quality of digital technologies is increasing. It is necessary to highlight the increased use of data collection, storage and processing systems. Data from satellites, sensors, operational and transactional systems are actively used. Decision-making in the agricultural segment is associated with many probabilistic positions, which is associated with large layers of information, and also requires high-quality processing of this information and reliable conclusions that serve as the basis for decision-making. The need for rapid collection and processing of heterogeneous and diverse information creates a demand from agriculture for industrial analytical systems and in-depth Analytics. It is possible to identify seven main areas of digital development of agriculture: "Digital agriculture management", "Digital land use", "Smart field", "Smart garden", "Digital greenhouse", "Smart farm".
In the Russian Federation, a catalog of digital technologies in the agricultural sector is being formed as of February 2019, it includes more than 500 solutions formed in the following areas [8] (Table 1).

**Table 1. Catalog of digital technologies in the agricultural sector.**

| Digital technology                                      | Quantity |
|---------------------------------------------------------|----------|
| Technologies and robotic equipment for crop production  | 151      |
| Technologies in the energy supply of agricultural production | 6        |
| Technologies and robotic tools for animal husbandry      | 156      |
| Technologies aimed at ensuring the reliability of equipment for the needs of agriculture | 33       |
| Digital technologies and robotic equipment for the food industry | 7        |
| Networking and training of scientific personnel for the digital transformation of the industry | 4        |
| Software for crop and livestock production               | 140      |
| Technologies in crop breeding and seed production        | 5        |

According to the survey results, the demand for modern technologies in crop production is as follows: crop monitoring, crop quality monitoring, yield planning, differentiated spraying, and differentiated fertilization. In animal husbandry, the most popular technologies are monitoring the health of the herd; monitoring the quality of livestock products; monitoring livestock complexes, taking into account such indicators as feeding ration, milk yield, weight gain, body temperature, activity; creating databases of the production process; automation of microclimate regulation.

It should also be noted that there is a preference for using systems for collecting and processing information [9].

Today, we can note several technologies that were at the peak of expectations, and then reached the plateau of productivity:

- Food eCommerce;
- Gene modification;
- Drones and Autonomous transport;
- Smart sensors and IoT;
- Precision and predictive farming;
- Alternative protein sources.

All these technologies in one form or another are already used in agriculture, but there are also new trends that are changing the industry.

These technologies include:

- Reduction and transparency of the supply chain (implementation of the farm-to-table concept and blockchain technology),
- Digitalization of all processes and implementation of decision support systems for agronomists,
- AI and data - driven projects.

5. Conclusion
The production paradigm that dominated the global agro-industrial complex in the 1960s and 70s has changed significantly. At the moment, it represents a convergence of information technologies, new materials and nanotechnologies, energy, biotechnologies and transport systems. Although innovative solutions are not yet mandatory [10], the Russian agricultural sector is developing in line with global
trends that shape the values of recent years and the near future: responsible consumption, resource sharing, and process delegation. A characteristic feature of trends is their visibility for the end user. The introduction of innovations in production directly affects the sphere of product sales, becomes a value for the user and an advantage in the market. In the near future, the Russian agro-industrial complex will have to solve a whole package of diverse tasks: from digital transformation and reducing logistics losses to finding new markets and expanding export potential multiple times.

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