Automation, robotization of agriculture in Russia

Aybika Beksultanova[1*], *Petmat* Dzhankhotova[1], and *Saida* Shardan[2]

[1]Chechen State University named after A. A. Kadyrov, Grozny, 32, Sheripova A. st., 364024, Russia
[2]North Caucasian State Academy, 85, A, Krasnoarmeyskaya st., Cherkessk, 369001, Russia

Abstract. In recent years, the topic of digital transformation has become increasingly relevant for most Russian companies that include issues of digitalization of business processes in their strategic development agenda. Currently, digital transformation has become a sought-after tool for creating business conditions adequate to the COVID-19 pandemic; achieving sustainable development of the company in conditions of uncertainty; reducing the cost of developing new products and the time of their introduction to the market; implementation of modern approaches to the formation of new qualities of the company and its compliance with the trend of constant acceleration of scientific and technological progress. Russian companies have realized the importance and advantages of digital transformation: the number of companies implementing a systematic approach to digital transformation and implementing them within the framework of a special strategy has doubled over the past two years. The logical consequence is the growth of digital maturity of companies. The article systematizes global trends in the spread of digital technologies in the field of agriculture. Based on statistical observation data, quantitative results of the use of digital technologies in agriculture are presented. The purpose of this article is to identify the problem of low use of digital technology in agriculture. The current state of the use of digital technologies in this industry is shown, as well as recommendations on measures to support the digital transformation of industry in the current conditions are given.

1 Introduction

The deployment of the digital revolution on a global scale is increasingly immersing us in a new reality [8]. The variety of technical and technological innovations that change our lives has increased many times in the last decade, and in the most diverse areas of human life [9]. When it comes to digitalization, first we mean the infrastructure, hardware and software, the list of Internet platforms and offers [10].

For a long time, agriculture has not been a business attractive to investors due to the long production cycle, exposed to natural risks and large crop losses during cultivation, harvesting and storage, the inability to automate biological processes and the lack of

* Corresponding author: adamovaaybika@mail.ru

progress in increasing productivity and innovation. The use of IT in agriculture was limited to the use of computers and software mainly for financial management and tracking commercial transactions. Not so long ago, farmers began using digital technologies to monitor crops, livestock and various elements of the agricultural process. One of the most promising areas for improving the efficiency of agricultural production management is the use of information systems based on geoinformation technologies. Such systems allow you to solve the following tasks:

- Information support for decision-making.
- Planning of agrotechnical operations.
- Monitoring of agrotechnical operations and the condition of crops.
- Crop yield forecasting and loss estimation.
- Planning, monitoring and analysis of the use of equipment.

The "robotization" of production is particularly relevant for large farms. By flying over fields, drones with the help of cameras and sensors allow farmers to see in real time what each plant looks like, how the ripening process of agricultural crops is going on and how the color of the soil changes.

"Agricultural" drones allow you to create electronic maps of fields in 3D format, calculate the Normalized Difference Vegetation Index (normalized Vegetation Index) in order to effectively fertilize crops, inventory the work carried out and protect farmland [1].

2 Materials and methods

The work contains the results identified in the framework of published reports and analytical materials of international organizations, specialized analytical publications, data from foreign and Russian news agencies, as well as interviews and articles by leading analysts and experts. The purpose of this article is to identify the problem of low use of digital technology in agriculture. To achieve the goal, the following tasks are defined:

- To study the impact of the digital economy on the development of agriculture.
- To study the digital technologies used in agriculture.
- To consider the risks that inhibit the full use of technology.
- To offer recommendations for eliminating the problems that constrain the digital transformation of agriculture in Russia

Methods of the performed research:

- Theoretical and empirical methods.
- Descriptive methods.
- Method of graphical illustration of data.

3 Results

As of 2021, there are a large number of domestic IT developments on the market, which are mainly separate, local software products built on their platform for various specific business processes, most often for one or more strategic partners. In addition, quite often these products are at the pilot stage, and there are not so many complete solutions offering a ready-made complex product.

Software solutions. This group includes Russian software developers, with the help of which you can:

- Combine equipment from various manufacturers, automate processes, collect analytics - Beac, Geomir. This also includes Cognitive Pilot, a Russian developer of artificial intelligence systems for unmanned control of agricultural machinery. They equip the

harvesters with sensors, after which they begin to harvest their own crops, make up their route and go around obstacles.

- ExactFarming - the service includes the ability to create a map by manually entering coordinates.
- AgroMon is a mobile application and web service for farm management.
- SmartAgro is an enterprise management system with a built-in agroanalytics module.
- Sky Scout is a unified management system of the agronomic service of agricultural enterprises. Provides a complete picture of the state of crops based on data collected both manually and automatically.
- Digital Agro (part of Uralchem), Agrosignal. A software and hardware complex for monitoring equipment, technological processes, processing and converting telemetry data, as well as conducting all economic activities of the company in a single digital circuit.
- Magrotech is a company that collects information about the characteristics of the field and provides a yield forecast based on a matmodel.
- Polydon Agro is a versatile application with up-to-date product information and a mixing calculator.
- Own farming - a service from the Rosselkhoznadzor with an emphasis on ecommerce. The service allows you to buy seeds, fertilizers, agricultural products, agrochemicals and even agricultural machinery. In addition to goods, you can also get services here.
- PhosAgro trading platform is a website for the company's customers, where you can calculate the quantity of products and order it.

Equipment and machinery. These are manufacturers of tractors, combines, harvesting equipment — for example, Rosselmash, Kirov Plant. In 2019, a joint venture between Cognitive Technologies and Sbera, Cognitive Pilot, was organized, which develops unmanned vehicles, in particular agricultural machinery and agrobots. So, an autopilot for a combine harvester was created, using video surveillance, a geo-positioning system and route management, a similar system for tractors is in development.

UAV. Another important criterion for the development of the digital agriculture industry is the use of high-tech machinery and equipment. The use of UAVs in agriculture allows farmers to obtain more accurate data on the state of crops, soil, etc. compared to other technologies, such as remote sensing of the Earth, sensors/sensors in fields and agricultural machinery.

Vertical farms. The direction of vertical farming has received significant development in recent years, which involves growing products indoors in a confined space (for example, in urban conditions) with a controlled environment and the use of modern digital technologies – sensors, sensors, photonics, etc., often combined with hydro, aero and aquaponics systems - allowing to automate production processes. However, it is worth noting that the main products of these farms are crops that are difficult and expensive to grow outdoors in Russia, such as arugula or spinach, berries for year-round sale.

Figure 1 shows a graphical interpretation of data on the use of digital technologies.

The global market for precision farming technologies will exceed $12 billion by 2025, and the highest growth rates (more than 14% per year) are demonstrated by solutions in the field of precision spraying, remote field monitoring and enterprise big data management. The global market for mobile services for managing small farms is growing — it is expected to reach $2.9 billion in 2021. For example, in India, more than 2 million farmers have joined the agrobot in a few months.

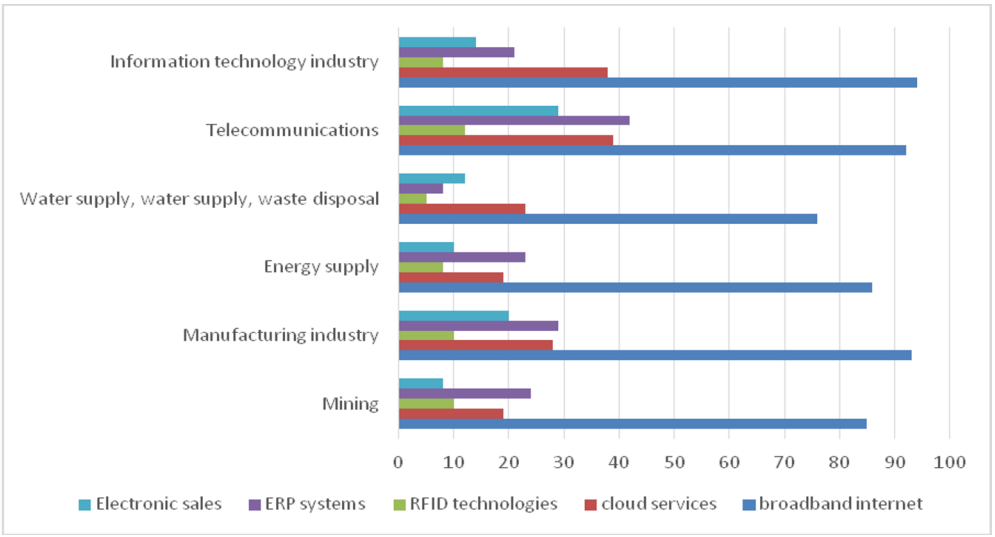

Fig. 1. The use of digital technologies in enterprises in 2020 [2].

By 2026, the Russian market of digital technologies in agriculture is expected to grow 5 times, including through the support of agrotech startups. Among the most popular solutions are: decision support systems, precision farming applications, production management systems, plant and animal health control; user interfaces and unified platforms integrating various management tools of an agricultural enterprise, including those based on a cloud environment; automated systems for harvesting and ensuring the activities of livestock farms; intelligent supply chain analysis and management systems[4].

The priority in the field of digitalization of agriculture in Russia at the state level is the creation and implementation of the national platform "Digital Agriculture". It is assumed that all data on objects of agricultural resources (agricultural land, working and productive livestock, agricultural machinery), agricultural raw materials and finished products will be digitized and included in the digital platform (their digital profiles have been created). Then, on the basis of these data, with the help of AI technologies, machine learning, big data analysis, forecasting and modeling of the development of the agro-industrial complex will be carried out in order to support decision-making [5], the elements of which, among other things, is a system that allows:

- To make a sowing plan.
- To provide a report on the allocated subsidies and their use.
- To conduct financial analysis of the enterprise (small, medium, large) agricultural business.
- Evaluate the competitive advantage of the enterprise.
- Aanalyze data from weather stations.
- Study information about the state of the soil.
- To select a crop for sowing. • to assess the risks of yield loss.
- To obtain information about climate risks[6].

4 Discussion

Thus, it can be concluded that the highest level of intensity of the use of digital technologies is characteristic of the information technology and telecommunications industry.

The need for digital transformation of the industry is caused primarily by low labor productivity, technological lag behind competing countries and the need to develop deep processing of agricultural products to increase and improve the quality of exports.

There is a lag in the digital transformation of agriculture in comparison with the leading countries and even other sectors of the economy of our country, which is explained by the difficulties for digital business and the use of innovations and, as a result, the low level of use of digital technologies by business structures. Each of the above possible directions of digital transformation may face risks that hinder their full use, for example:

- Imperfection of the regulatory framework in the field of digital transformation, constraining investment in the industry:
  - Regulated rules for the use of UAVs.
  - Lack of rules regulating the quality of soil condition data and the frequency of their collection.
  - Lack of methods for the formation of standards (technical standards or GOST standards) for the development of digital counterparts of the product and the consumer.
  - The absence of rules governing the use of personal data of consumers for the purpose of personalizing nutrition, ensuring the level of their safety. - the absence of regulations on the handling of food waste and packaging.
- "Abuse" of technologies and related new opportunities, with unauthorized use of other people's information, using other people's resources, etc., risks are increasing cybercrime — hacking of IoT devices ("Internet of Things"), attacks on mobile devices and financial mobile applications as part of the infrastructure of remote banking services (RBS) and payment systems, attacks on smart contracts, etc..
- Changes in regulation in the world, stop factors at the level of regional systems due to "collective security", "green trend".
- Insufficient infrastructure to process data in real time – broadband high-speed Internet anywhere, including mobile + data storage and computer power to support robotic and high-precision technology.
- Lack of regional/rural personnel with IT knowledge.

Digitalization can create additional difficulties for small farmers: in the competitive struggle they will have to face new technologies that can provoke price increases in conditions of increasing market concentration.

Speaking about the introduction of digital technologies in agri-food systems, many aspects should be taken into account: these are the requirements for policy formation and management, limited access to funds, limited digital skills of a number of participants, as well as the need to overcome existing digital gaps that limit access to infrastructure and information [3].

And despite the fact that Russian enterprises – some faster, some slower - are moving towards the creation of digital productions,

it will not be possible to reverse the situation only by their forces. To overcome the existing gap, we need support at the state level, investments in innovation, the development of appropriate infrastructure, markets, and human capital [7].

In order to eliminate the issues constraining the digital transformation of agriculture in Russia, it is necessary:

- Gradual improvement of the regulatory framework in order to eliminate barriers to the use of advanced technological solutions and create a system of incentives for their implementation.
- Improvement of the education system to meet prospective staffing needs, development of proposals to change career guidance and educational standards, including clarification of existing educational programs, including specialized secondary and

vocational. Popularization of the "professions of the future", changing career guidance activities.

- Creation of testing grounds, including on the basis of agricultural universities, for testing of technical solutions, testing of fundamental and applied research, experimental design developments in the field of digital transformation of agriculture.
- Improvement of state support measures, subsidizing agricultural producers equipping production processes with domestic IoT sensors and equipment control systems. Formation of proposals for farmers and cooperative entities, including to stimulate the transition to technologies that reduce the carbon footprint, including in the production of agricultural and food products for export markets, as well as in the production of packaging and logistics.
- Improvement of approaches to stimulate the development of domestic technologies for preserving and ensuring the security (cybersecurity) of data.
- Transformation of the Competence Center for the Digital Transformation of Agriculture of the Federal State Budgetary Institution "AC of the Ministry of Agriculture of Russia" into an interdepartmental Center for the coordination of the introduction of digital technologies in agriculture, in order to coordinate efforts for the digital transformation of the industry.
- Creation of an industry organizational, expert and analytical association for the formation of proposals to stimulate the introduction of digital technologies, etc., including within the framework of financial support to ensure the performance of the functions of federal state bodies, the provision of services and the performance of work.

5 Conclusion

From all of the above, it can be concluded that the use of modern technological solutions and the use of digital platforms can improve product quality, reduce communication time, reduce non-production costs and thereby increase the competitiveness of the Russian agro-industrial complex.

There are also a number of negative factors hindering the full use of digital technologies. In order to eliminate constraints on the digital transformation of agriculture, the state needs to improve the regulatory framework, the education system to ensure promising staffing needs, measures of state support for this area, subsidizing agricultural producers, improving approaches to stimulate the development of domestic technologies, data preservation and security.

At the same time, it is obvious that the ICT sector is going to be restructured in the near future with the strengthening of the market position of Russian business. In the near future, the Russian market of digital technologies in agriculture is expected to grow. But in the conditions of increased external pressure on high-tech industries, continuing uncertainty and a multitude of managerial forks, any forecast can only be scenario-based.

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