Digital technologies as a factor in agricultural development

L.I. Minnegalieva*, N.A. Svalova, A.V. Korkin

Ural State University of Economics, Yekaterinburg, Russia

Abstract. The article examines digital technologies as a factor in agricultural development. The authors reveal the concept of digital technologies, describe in detail their main directions, which are actively implemented in practice. The use of unmanned aerial vehicles is analyzed with conclusions about their advantages and disadvantages at the moment. Particular attention is paid to the legislation of the Russian Federation, which is at the stage of the formation of certain areas of digitalization of agriculture. The problems of applying digital technologies in practice are revealed and options for solving them are proposed. The authors analyze in detail the mechanism of application of blockchain in the agricultural chain, ranging from the farmer to the end consumer of products, taking into account the experience of foreign countries. The conclusion justifies the conclusion about the direct dependence of agricultural development on the introduction of digital technologies.

1 Introduction

In Russia, there are a number of legislative acts that partially regulate the use of digital technologies in agriculture. For example, the Federal Law "On the Development of Agriculture" establishes the general principles of state support for the agricultural sector, separate regulations regulate data protection, cybersecurity and intellectual property.

In 2023, a strategic direction was approved in the field of digital transformation of the agro-industrial and fisheries sectors of the Russian Federation for the period up to 2030 (Order of the Government of the Russian Federation of 23.11.2023 N 3309). The main goal set for the country is to automate processes in agriculture, collect and analyze data to make informed decisions and increase productivity. Within the framework of the Digitalization of Agriculture program, the main tools for transforming the agricultural complex are Smart Farm, Smart Field, Smart Herd, Smart Greenhouse, Smart Processing [1].

In many foreign countries, special laws and regulations are also being developed and adopted to regulate the use of digital technologies in agriculture. For example, the European.* Corresponding author: larissa5@mail.ru

© The Authors, published by EDP Sciences. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).
2 Materials and Methods

To conduct the study, an analysis of existing research, statistics and expert opinions on the use of digital technologies in agriculture was carried out. Examples of successful implementation of digital innovations in Russia and foreign countries were studied.

Currently, digital technologies are being actively introduced into agriculture, since food security and the sovereignty of our country as a whole depend on the level of agricultural development. The ongoing changes in the global and domestic food markets, due to rising prices and a reduction in the product range, also require optimization of the costs of budgets and the country and each farmer separately, the use of modern technologies to optimize the production of natural products.

Among the already implemented digital technologies, the following are distinguished:

- unmanned aerial vehicles and combine control by means of drone;
- robotic milking and feeding on the farm;
- digitization of fields with geo-referencing of soil samples, including from space images, in order to obtain a map on soil fertility and terrain;
- no-tillage agriculture with geo-referencing of soil sampling site;
- energy-saving automated ventilation control and climate control of microclimate parameters for productivity of agricultural processes;
- precision farming system including GPS Glonass global positioning technologies;
- accounting 1C:ERP system allowing to implement finance and management accounting, production management and supply chain management;
- direct deliveries through the Dropshipping system, ensuring full automation of business processes (direct deliveries of products from the manufacturer to the buyer);
- blockchain technology that allows you to track goods in the interests of increasing the efficiency of the risk management system.

For the effective use of digital technologies, public-private interaction should be closer and aimed at creating a common information structure.

3 Results and discussion

To achieve maximum efficiency in agriculture, it is extremely important to have up-to-date and accurate data on the area of the land plot, its relief and soil features. The use of unmanned aerial vehicles (UAVs) is one of the simplest and most effective ways to collect such information. In a matter of minutes of flight, you can get comprehensive data on the studied territory, create ortho-fuel and a 3D model of the area. This allows the farmer to have full control over all agricultural processes and make timely decisions. According to the research company Ocean Report, the global agricultural drone market in 2022 amounted to $13.59 billion, and by 2030 it will reach $64.5 billion with an annual growth rate of 24.3%.

Modern UAVs have the following functions:

- assessment of the quality of crops and identification of their death;
- determination of the size of the dead crop area;
- valuation of land plots to conclude transactions;
- identification of defects in crops and problem areas;
- Time


• monitoring of sowing and crop rising plans;
• identification of deviations in the food chain.

When using UAVs in agriculture, both advantages and disadvantages can be distinguished (clearly presented in Table 1).

Table 1.

<table>
<thead>
<tr>
<th>Advantages of UAVs</th>
<th>UAV disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed of research and data processing</td>
<td>Special permission to fly required</td>
</tr>
<tr>
<td>Machining accuracy</td>
<td>Shooting accuracy depends on the person</td>
</tr>
<tr>
<td>Online analysis</td>
<td>Constant software updates</td>
</tr>
<tr>
<td>Covering a large area in a short period of time</td>
<td>Limited time flight</td>
</tr>
<tr>
<td>Detailed control of any work</td>
<td>Battery capacity is not unlimited</td>
</tr>
<tr>
<td>Saving time</td>
<td>Use around the clock</td>
</tr>
<tr>
<td>Reusability</td>
<td>Remote control</td>
</tr>
<tr>
<td>Saving on human resources</td>
<td></td>
</tr>
</tbody>
</table>

In agriculture, UAVs perform various operations (Table 2).

Table 2.

<table>
<thead>
<tr>
<th>UAV operations</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerial photography</td>
<td>This technology is used to identify and eliminate problem areas of the land plot, such as crop loss, the appearance of empty places, etc.</td>
</tr>
<tr>
<td>Video filming</td>
<td>Such a survey saves the farmer time and financial resources, allowing him to take timely measures when monitoring the sowing plan and crop production.</td>
</tr>
<tr>
<td>3D modeling</td>
<td>This application allows you to track the level of moisture and drainage of the soil of the land plot, create topographic maps, and land reclamation.</td>
</tr>
<tr>
<td>Thermal imaging</td>
<td>Makes it possible to determine the timing of differentiation of growth points, which directly affects the yield and preservation of productive properties of plants.</td>
</tr>
<tr>
<td>Laser scanning</td>
<td>This technology makes it possible to analyze a land plot in hard-to-reach places, difficult weather conditions.</td>
</tr>
<tr>
<td>Spraying</td>
<td>Is effectively used to influence substances not on the whole land plot, but its parts, excluding the ingress of various chemicals on healthy plants.</td>
</tr>
</tbody>
</table>

The most promising area for the development of digital technologies in agriculture is the creation of autonomous drones that perform various tasks without human intervention. This allows you to save time, human resource, but at the same time achieve accuracy and efficiency of agricultural work. In the context of a special military operation, restrictions and rules are introduced that regulate the use of drones in various regions of our country. Agricultural producers need to constantly monitor legislation and obtain appropriate permits, UAV flight licenses.

In agriculture, UAVs are used in several modes:
- manual mode: the UAV is controlled through the remote control using the front video camera, 080 (2024) E3S Web of Conferences 537, 08011 (2024) SDEA-2024 https://doi.org/10.1051/e3sconf/202453708011
independent mode: aircraft software devices are used for flight by assigned flight path and altitude.

Semi-automatic control: automatic flight without human intervention.

The geographic information system (GIS) can solve the problems of control, analysis and almost complete planning of all types of agricultural activities. Planning and conducting digitization of agricultural land includes determining the boundaries and area of land, creating electronic maps with information about agricultural land in the context of the farm and the area, as well as combining them into a single database.

When digitizing agricultural land, an electronic field contour is created in agronomic accounting systems in electronic form. The owner can see electronic maps of their fields. These maps provide a ton of opportunities that can be useful. The main advantage of field digitalization is to clarify the actual boundaries and determine what area the owner actually handles.

The data may not reflect the actual area being treated. The main advantage of digitalization of fields is to clarify the actual boundaries and determine what area is used in agriculture.

Today's successful development of agriculture cannot be imagined without the use of modern technologies. For precision farming, electronic maps are needed. An inventory of agricultural land gives an idea of the state of the soil, allows you to determine its type, see zones with the presence of erosion, overgrown with trees and shrubs. Regular inventory provides a detailed description of the fields based on indicators such as potential yields, the effectiveness of applied fertilizers and pesticides, the presence of pests and weeds. The inventory identifies areas of the field where technological operations are performed with errors. Satellite imagery over the past few years has led to the identification of fertility zones and the creation of an electronic field passport.

Optimum power supply system, remote monitoring of vegetation and timely detection of diseases – here achievements of introduction of digitalization in agriculture. These technologies become irreplaceable assistants to the agronomist, the powerful tool which is used by heads of the agricultural enterprises for effective management and planning. Evident display of all production sites taking into account their geographical location is provided with electronic maps of fields. Cards are in the systems of monitoring and they can be used even in mobile applications. Cards can be unpacked entirely or separate parts.

Blockchain technology is widely used in various sectors of the agricultural industry, which makes it possible to effectively track and record financial transactions and related documentation, as well as track the supply of goods from the farmer to the end consumer. This integration allows you to securely store data related to each stage of the supply chain, including the time and place of transactions, customer preferences and other relevant information. Both sellers and consumers can use this system, which allows them to better understand the origin of the products they purchase. In addition, the use of blockchain technology ensures the accuracy and reliability of recorded data, transparency of the agricultural business throughout the economic cycle, which in turn facilitates the verification and overcoming of the possibilities of alternative tracking methods, such as QR codes [5]. Moreover, setting up artificial intelligence algorithms requires not only technical knowledge, but also an understanding of the unique characteristics and needs of each agricultural enterprise [6].

In 2016, Agri Digital pioneered the first agricultural products deal using blockchain technology in Australia. Thereafter, many prominent traders such as Cargill, Grain Corp and Louis Dreyfus adopted this innovative technology for their supply chains. In addition, large retail companies such as Walmart, in collaboration with IBM, have initiated projects involving the distribution of animal products from China to the United States and mangoes.
from Mexico to the United States. These efforts demonstrate the growing interest in blockchain technology among industry leaders. More and more companies around the world are starting to integrate this technology and even accept payments in cryptocurrencies such as Bitcoin and altcoins.

Successful adoption of blockchain technology in agriculture depends on the participation of all stakeholders in the supply chain, including farmers, energy suppliers, processing, transportation, logistics organizations. The introduction of big data into a blockchain-based platform can significantly save on costs, reduce transaction costs, improve existing business models, and this, in turn, affects the pricing policy of agricultural products [7].

The introduction of digital technologies in agriculture also requires the availability of personnel who would have an equally high level of training both in the agricultural sector and in the field of IT technologies. However, our country has half the number of IT specialists working in agriculture than in countries with a traditionally developed agro-industrial complex [8].

In this connection, additional training programs are being opened on the basis of universities, distance learning programs are being introduced, privileges are being created for IT specialists from the state (preferential mortgages for housing, deferral from the army, etc.).

4 Conclusions

In today's world, digital technologies play an increasingly important role in agriculture, contributing to its competitiveness. The wide range of use of digital achievements in the agricultural sector of the country's economy shows the direct dependence of agricultural development on the introduction of digital technologies.

Digital technologies are used not only in the modernization of agricultural production itself, but also concern the supply chain, storage, transportation and sale of products to the consumer. However, there are also challenges associated with access to digital technology for small farmers, the need for staff training and data protection. The active participation of the state in the form of taking measures to develop digital technologies in agriculture confirms that this direction is one of the main ones for maintaining sovereignty and developing the economy as a whole.

Acknowledgments

The authors express gratitude to the Ural State Economic University for the assistance provided in writing the article.

References

1. M.V. Demchenko, A.A. Berdnikova, Legal regulation of the use of artificial intelligence technologies in entrepreneurial activity in the agro-industrial complex. Economy and law, 9, 34-45 (2022)

2. N.P. Voronina, Legal support of digitalization of agriculture. Law and digital economy, 3, 20-26 (2021)

3. I.A. Voitko, Direct budget subsidies as a factor in the sustainable development of agricultural production of the Republic of Belarus. VESCI NATSYANALNAI AKADEMI NAVUK BELARUS. GRAY AGRARIAN NAVUK, 61(2), 080-080 (2024)


