Digital technologies for efficient farming

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Abstract. In modern conditions, agricultural producers must develop in digital technological formats, attract investment and highly qualified personnel, and work to improve the competitiveness of agricultural products and labor productivity. Using the example of agriculture in the Smolensk region, we consider options for using modern digital technologies that will lead to increased efficiency and competitiveness of enterprises. The project of a digital agricultural platform in the Smolensk region is proposed.

1 Introduction

Digitalization is spreading to various areas of the economy. This global trend has also affected the agricultural sector, which is the most conservative in relation to progressive technological developments. Today, life requires agricultural enterprises to develop in modern technological formats, attract investment and highly qualified personnel, and work to improve the competitiveness of agricultural products and labor productivity.

Digitalization of the agro-industrial complex has enormous potential. However, the percentage of use of modern digital solutions in the agro-industrial complex is extremely low. No more than 10-15 percent of Russian farmers use digital platforms.

The agro-industrial complex of the Smolensk region is trying to test scientific methods and modern tools that fit the definition of "smart", innovative, digital technologies. The pioneers of such innovations are large agro-industrial companies that can invest in new technologies, and some use separate elements of digital information technology systems. Examples of advanced agricultural enterprises in the Smolensk region are ZAO ZolotayaNiva of the Safonovsky district, JSC Smolenskaya for breeding work of the Smolensky district, and LLC Smolensk greenhouse complex of the Roslavl district.

Digital transformation of agriculture is part of the Federal strategy. To date, the Federal project "Digital agriculture" is being implemented within the framework of the national project "Digital economy". This project is aimed at modernizing and improving the efficiency of the agricultural sector, and also provides for doubling labor productivity in the agricultural sector of the economy by 2024. For the purpose of digital transformation of the agricultural sector, the following measures are planned: launch of a unified national digital platform in the agro-industrial complex, large-scale conversion to digital form of agricultural land, creation of a system for training highly qualified personnel for the agro-industrial complex.

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The introduction of "smart" technologies in agriculture solves several important tasks at the same time: control of agronomic and related operations, increasing economic efficiency as a result of more accurate rationing and analysis, and improving the level of agricultural planning. In addition, it increases the manageability and transparency of all processes in the agricultural sector.

Thus, the introduction of "smart" technologies in agriculture can significantly automate technological processes and, accordingly, minimize the human factor, which means: reduce the probability of errors occurring, reduce the burden on workers engaged in the main production, and improve the efficiency of agricultural labor.

The object of research is the agro-industrial complex of the Smolensk region.

The purpose of this study: to consider advanced options for the possible use of modern digital technologies in agriculture in the Smolensk region and to outline trends in development.

The goal is achieved through the following tasks:
1. Study the application of advanced digital technologies in agriculture.
2. Identify constraints to the development of digitalization of agriculture in the Smolensk region.
3. Develop measures for the introduction of digital technologies in the agro-industrial complex of the region.

2 Methods

The following research methods are used:
- method of analysis and synthesis;
- questionnaire method;
- method of expert assessments.

3 Discussion

In agricultural enterprises, digital transformation is necessary to ensure a technological breakthrough and achieve growth in agricultural productivity [1]. Digital transformation in the agricultural sector can be implemented through the introduction of modern digital technologies and advanced platform solutions.

The technological and digital lag between the Russian agro-industrial complex and foreign agricultural markets is only getting worse. According to research [2-5], the digitalization of the agro-industrial complex in Russia is seriously lagging behind developed countries. For comparison, in the US, Germany and the UK, the share of it specialists from the total number of employees in the agro-industrial complex exceeds 4 percent, while in Russia this figure is only 2.4 percent.

Let's consider the options for using modern digital technologies, which have been sufficiently studied in the scientific literature, and will lead to increased efficiency and competitiveness of agricultural enterprises.

1. Digital platforms for obtaining agricultural consultations.

The digital platform for managers of agricultural enterprises makes it possible to view the results of all conducted agricultural activities by examining reports uploaded to the portal. The digital platform allows agricultural consultants to monitor the state of an unlimited number of fields without being physically present. Also, agricultural consultants can draw conclusions about the conducted agrotechnical measures and their impact on the studied crops (thanks to biomass maps) [6].
Currently, the service "Agroclub" has become the largest agricultural ecosystem for all involved in the agro-industrial complex – these are rural producers and suppliers, producers of seeds, fertilizers, and plant protection products. Under this platform, Agroclub has developed a special mobile application that allows users to unite in a single network for communication of interests, exchange of experience, consulting support, and even trade. This application allows you to track the news of agricultural policy, find out the weather forecast on the required field, in real time and from specific users to get the necessary information on prices for crops, seeds, fertilizers, pesticides, fuels and lubricants, and other, and on the basis of this independently make effective management decisions [7].

2. Accurate Agrochemistry and weather conditions with digital service.

Working with the service is simple: a farmer gets into a tractor with a phone or tablet and drives out to the field. Next, the phone or tablet display shows the current and recommended speed at which the farmer needs to move to make the necessary dose of fertilizer. The submitted data is pre-processed and provided in a clear and visual form that does not require additional explanations [8, 9]. On this portal, you can record the fertilizers or seeds you have applied and calculate the necessary expenses, as well as use recommendations for sowing and harvesting. The portal displays the current weather in the form of air temperature, cloud cover, precipitation, wind direction and speed on a specific field, and also has historical weather data and weather forecast for five days ahead [10].

3. Modern digital technologies in animal husbandry.

Modern digital technologies in animal husbandry are mainly robotic devices with sensors and radio frequency identifiers, United by a single infrastructure, which allow performing production processes with minimal human intervention. It could be:
- image processing and assessment of the animal's exterior (machine vision);
- automatic weighing;
- "smart feeding": mixing of various feed components, distribution and dosing in a group or individual way;
- automatic monitoring of physiology and "smart" development of animals: wearable sensors and biosensors implanted in animals to measure body temperature, monitor behavior, detect stress, determine acidity, etc.
- automatic disease control: microphones and sensors track respiratory infections in animals based on sound characteristics and cough localization [11].

4. Automated quality control of agricultural products.

The largest goat farm in Russia – Lukoz Agroholding – is engaged in the production of whole goat milk and its processing, uses automatic quality control of milk MilkoScan. This automatic control speeds up the analysis of milk quality and makes it as cost-effective as possible. The quality of raw materials for the production of natural dairy products is determined using the device in just 30 seconds. During this time, the automatic milk quality control device is able to simultaneously measure 19 indicators, including fat, density, acidity, casein, lactose, and many other indicators of milk [12].

5. Digital technologies of agricultural cargo transportation.

In the spring, during the sowing of crops and in the fall, during the harvest, many agricultural producers have a problem with cargo transportation: there is a massive lack of equipment and new purchases are not expected in the near future. In many agricultural enterprises, technical means are quite old, almost every year machines fail, and replacement with new units of equipment, in sufficient volume, does not occur [13, 14]. Tariffs are acceptable, especially in the off-season, and the purchase of new equipment for enterprises becomes an inefficient option. At the same time, there is a problem of lack of channels for informing drivers about the availability of orders, so trucks can stand idle at the enterprise, not assuming that they are needed in a neighboring farm, or the cars travel a long distance to work [15]. With the help of modern digital technologies, you can easily solve all these
issues, that is, drivers can choose an order that is suitable for both location and price online and are guaranteed to receive the specified payment within a short period of time [16].

6. Automation of economic results and risks.

Every day agriculture becomes more and more high-tech industry: information comes from special devices located in fields, on farms, from agricultural machinery, satellites, weather stations, etc. All the collected information is accumulated, and a global information field is formed, with which you can find errors and notice shortcomings in the application of agricultural technologies [17]. Such errors and comments allow you to make the right management decisions that reduce risks to a minimum and increase the profitability of agricultural production. The final goal, to achieve which Analytics from devices is used – is to increase the efficiency of the distribution of production resources in agricultural enterprises and to achieve an optimal ratio between income and expenses [18].

Income and expenses directly depend on crop yields, sales processes, and market conditions. Risk factors are everything that negatively affects the profit of an agricultural enterprise. There are a lot of risks in agriculture, including specific ones, such as weather conditions, locust infestations, seasonal diseases for animals, etc [19]. Before making a decision, you need to know exactly what risks it will involve and what the price of each such risk is. In other words, farmers need to understand how much they will lose if their fears come true. Therefore, much attention should be paid to economic analysis, which examines in detail all factors that affect crop productivity, animal productivity, the market situation, and also takes into account operational risks, including the human factor. For example, when making a decision about the distribution of fields for crops, you can look at the ratio of risk and return. You can sow a more risky crop in terms of yield, but it will have a low risk in terms of volatility of quotations on the stock exchange.

Today, Digital Agro LLC is the leader of the Russian market of IT solutions and services for agriculture. The company's priority activity is to develop and provide digital technologies and ecosystems that can reduce costs by up to 15 percent and increase the profitability of agricultural production by up to 20 percent [20].

The most famous system "Agrosargal" planning system, online monitoring and management of agricultural business. Includes five basic products:
- equipment monitoring;
- assistant agronomist;
- subsidies, reporting and Analytics;
- open agricultural University land of knowledge;
- digital agriculture [21].

This system is intended for managers of agricultural enterprises, agronomists, accountants, financiers, lawyers and the entire production chain.

Thus, the scientific background of agricultural scientists has shown that it is necessary to provide a convenient digital ecosystem for all participants of the agro-industrial complex and transfer all processes in the agricultural sector to the "digital". This will prevent possible losses, increase labor productivity and maximize profits from each hectare of agricultural land.

4 Conclusions

1. In the course of our research, we determined that the following are the limiting factors for the development of digitalization of agriculture in the Smolensk region. First, there are serious problems in the region with communicating information about modern digital technologies. Employees of the agricultural sector are so immersed in their current work that most often they do not even know what digitalization will give them, how the process of implementing software is going on, and how much the cost of production of the resulting
agricultural products will decrease. This means that farmers do not have enough information about the advantages of digitalization, they doubt the functionality of technologies and the reliability of modern equipment. Secondly, managers of agricultural enterprises are reticent about modern technologies because of their high cost. Third, there is insufficient mobile Internet coverage on the territory of the Smolensk region, and without mobile communications and the Internet, there can be no question of digitalization. Fourth, in addition to specific constraints, there are also common factors for the entire agro-industrial complex, such as lack of financial resources and human resources.

2. In Smolensk region there is only the elements for the realization of digital enterprises in the agricultural sector. The penetration of "smart" technologies into the industry is not large-scale. In this regard, it is too early to talk about any comprehensive implementation of digital technologies at enterprises. It is easier for agricultural enterprises to work extensively and improve mechanization, rather than invest in information technology. However, experts agree that the return on investment in this area should be as fast as possible. In order to switch to digital, we need to develop new rules and standards that will consistently regulate the entire process. It is necessary to encourage farmers to introduce "smart" technologies, to develop co-financing of expenditures in the form of subsidies for innovation. All this will have a positive impact on the transition to the widespread use of information technologies.

In the Smolensk region, not all farmers are open to implementing advanced digital solutions, there is still an element of distrust on the part of market players, so not all enterprises are ready to share information and upload it to the General system. A push in this direction could be given by the state, which would provide the necessary infrastructure in exchange for statistics and Analytics on land use. This state of Affairs will allow for the emergence of digital operators exclusively for agriculture, which will aggregate data into a single space. All this will reduce the cost of the service.

3. For effective farming in the Smolensk region, it is necessary to form a center for the implementation of digital technologies. Such a digital agricultural platform can be the Smolensk state agricultural Academy, which will combine all the systems of the Ministry of agriculture of the Russian Federation, the Department of agriculture and food of the Smolensk region, data from the Federal state statistics service and the standard Protocol for data exchange with private platforms (Fig. 1). Smolensk state agricultural Academy has the necessary resource potential in the form of highly qualified personnel and sufficient material base. The digital agricultural platform will provide more reliable and timely data for farming in the region, increase the efficiency and competitiveness of agricultural enterprises in the Smolensk region.

Fig. 1. Digital agricultural platform project in the Smolensk region.
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