

Digitalization of agriculture

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Abstract—The growing population of the Earth means an increasing demand for agricultural products. By 2025, the United Nations projected a 70% increase in food production. The domestic agricultural sector faces the task of increasing labor productivity and competitiveness through the use of the latest scientific achievements and best practices. In his address to the Federal Assembly of the Russian Federation on March 1, 2018, the President of the Russian Federation called for effective use of the huge technological potential accumulated in the world, which allows to make a technological breakthrough and bring the economy to a new level. The article considers the need for the transition of the agricultural sector the digital economy

Keywords—*agriculture, digitalization, economy, Federal project, scientific and technological development*

I. INTRODUCTION

Now the survey of agricultural land with drones, analysis of the chemical composition of the soil on satellite images, programmable agricultural machinery associated with sensors in the soil –is the reality of the industry. And so today the main goal of innovation for farmers is to increase productivity and reduce losses.

Unfortunately, agriculture in Russia does not belong to the most innovative sectors, however, the agricultural sector is transformed under the influence of bio - and nanotechnology, varieties and breeds are improved by methods of genomics, manufacturers are moving from a product to a service model, integrate production and sales chains and adapt their products to the needs of a particular consumer. Digital technologies play an important role in each of these trends.

II. MAIN PART

Currently, our country has a low level of digitalization in all sectors of the economy and social sphere. To solve this problem, on may 07, 2018, the decree of the President of Russia "on national goals and strategic objectives of the development of the Russian Federation for the period up to 2024" set the task to transform all priority sectors through the introduction of digital technologies. These transformations will affect agriculture.

Today, the agricultural sector is a rapidly developing sector of the economy. Even during the crisis in 2015, this industry developed, and was almost the only one that showed a clear growth — 2.9% compared to the previous year. Although these coefficients are not only good prospects, but also hides a number of serious problems.

Noting the positive dynamics of indicators characterizing the state of the agricultural sector of the economy, the Government of the Russian Federation is making efforts to ensure favorable conditions for achieving food independence and increasing exports of food products and agricultural raw materials. The forecast of scientific and technological development of agriculture until 2030, developed by the Ministry of agriculture, provides for the transition to high-tech production of agricultural raw materials and products of greater processing depth.

In agriculture, a number of problems can be identified, such as:

- Lack of scientific and practical knowledge on innovative agricultural technologies
- Lack of necessary information and equipment
- No global price forecast
- Underdeveloped logistics, storage and delivery system

It can also be noted that only a small part of agricultural producers have sufficient financial resources for the purchase of new equipment, the use of modern IT - technologies.

The objectives of the agricultural digitalization program are:

- Provide comfortable conditions for agricultural areas. Namely, to equip housing for citizens living in rural areas, in order to attract young families and young professionals;
- Increase the number of jobs in rural areas;
- To attract local residents to significant projects in order to form a positive attitude to the countryside, to the rural way of life;

A number of problems hinder the implementation of the program, such as:

- Lack of financial resources for the implementation of information technology by most farmers. In the agricultural sector there is a negative trend, where there is a sharp division of income. Some farmers highly cost-effective, while other farms operate with a minimum return without having it is possible to use modern technologies.
- Shortage of qualified personnel. The Minister told the President that Russia needs to train a million IT specialists for the effective development of the digital economy. According to him, now Russia has 500 thousand

programmers. However, the digital economy requires specialists with competencies in the broad sense of the word: along with software developers, highly qualified specialists in various fields are required, who have "digital" knowledge, skills and experience [1,2].

- Insufficient development of digital infrastructure in the village.
- Imperfect regulatory framework. There is a Federal law "on the development of agriculture", adopted in 2016, but it needs to be changed.

There are six main directions of digital reform. The so-called "smart agriculture" includes "smart agricultural enterprise", "smart field", "smart farm", "smart greenhouse", "smart garden". It is believed that this program will affect not only the regulatory sector, but also the financial, insurance, logistics, education/ research and technology sectors.

But of course the main goal of digitalization is a significant increase in the efficiency and sustainability of agriculture. The following socio-economic changes are expected from the program:

- Growth of contribution to the economy at the end of the program to 5.9 trillion. rub;
- Export revenue increased to \$ 45 billion.
- Involvement in agriculture of workers of new professions;
- Increasing rural incomes

The main objectives of the program are:

- Creation of digital methods, technologies and technological tools that will allow to collect data from the fields, or rather data on plants, animals, soils and genetic material. For example, many expect 5G will become the foundational architecture for such developments as smart cities and smart agriculture [3];
- Introduction of digital tools for the use of information resources that improve the efficiency of agricultural production;
- Introduction of robotics in agriculture;
- Creation of new programs that simplify the process of lending and insurance, acceleration of state subsidies, simplification of document flow;

To date, the penetration of technology in the village is very low. It is very sad that the founders, owners, owners pay little attention to it. If farmers do not adapt to digital technologies, they will not be competitive.

Digital technologies open up new opportunities for high yields, saving resources, increasing profitability of enterprises. According to experts, the introduction of digital technologies can save up to 20-30% of the costs of agricultural enterprises. This is a huge amount of money nationwide.[4]

In terms of its penetration into agriculture, Russia ranks 45th in the world. Today, about 13-15% of Russian agricultural enterprises are able to engage in digitalization and commercialization of scientific and technical developments.

Two main aspects of the use of digital technologies in agriculture are increasing productivity and reducing losses. The inefficiency of agricultural production is still off scale: about 40% of production is lost at the stage from cultivation to processing, another 40% – during processing, storage and transportation. Much of the loss is due to natural conditions, but not all. It is believed that in agricultural production only 25-30% of the result depends on the person.

Much is determined by the weather, but the 30% that determines the person must be used completely. And digital agriculture allows us to do this. Agronomists are not yet ready to work with it, and the result of digitalization largely depends on the information that is entered in the fields. And in order to ensure the transparency of the economy, it is necessary to develop methods that "pull" users into work in the information system, as well as to ensure that automatically collected and entered data intersect. The untapped potential of the crop holdings in Russia is on average 20-25% of EBITDA.

The Internet of things became the accelerator of digital transformation of the industry, thanks to which automatically generated data from satellites, drones and various sensors began to flow to the management companies of agricultural holdings.[5] Thanks to the analysis of large data collected from sensors, which are equipped with agricultural machinery, manufacturers are already able to double production. Thus, the experience of application of system "Agrosargal" controlling the logistics of agricultural machinery with sensors 150 farms with a total area of more than 2 million hectares, the productivity can be increased by 100%, saving material assets by reducing their losses up to 50%, and the yield in some cases is increased by 10-15%.

As the volume of data increases, there is a growing need for quality data processing and for sound conclusions to be relied upon in making decisions. 40% of top managers of agricultural enterprises today are concerned with big data Analytics.

Nevertheless, the specialists of the service AgroNote, for example, build their solutions on the basis of retrospective monitoring: according to the remote sensing data accumulated since 1984, they allocate stable intra-field zones of fertility and prepare task maps for differentiated fertilization for "smart" agricultural machinery. This saves 10-15% of chemicals, increases grain yield and product quality, and reduces the pesticide load on the environment.

At the beginning of 2017, the Ministry of agriculture of the Russian Federation created an analytical center, where they intend to "decompose" the entire industry into standard projects, determine the parameters of the most effective of them and then promote the most effective models of farming. To do this, the Department is building an information platform that aggregates about 13 thousand indicators for agricultural enterprises. To date, the Ministry of agriculture has worked out the interaction of the Federal system with the IT systems of 16 regions.

These ministries are not yet complete, as not all manufacturers are ready to provide information. However, at the first stage it is enough to know who and what grows in this field. Combining this information with the data of agricultural research and satellite monitoring, the center is ready to give back to farmers "serious Analytics". Direct measures of state support for it in rural areas are not

provided, so the Department intends to develop services and provide manufacturers with data that they lack, and thus indirectly reduce their it costs.

This year, the Ministry of agriculture launched the state information system of seed traceability, which should reduce the gray market, reaching 40% today, and by strengthening control to improve the quality of seeds.

In addition, the Ministry intends to evaluate the it products used by agricultural producers and compile a "register of honor".

In the forefront of digital transformation are such large agricultural enterprises as agricultural holding "Rusagro", processing almost 1% of all agricultural land in the country. The digitalization of the company began with the introduction of a resource management system - today 1.5 thousand employees go into the field with tasks formed in SAP ERP.

Since much of the agricultural economy depends on natural conditions, it is necessary to respond to them correctly. To do this, Rusagro aggregates large data on the development of all crops, detailed information about the operation of equipment, the properties of hybrids and characteristics of fields, the state of the soil, the technologies used and weather conditions.[6] The data comes from its own weather stations and weather services, satellite monitoring and GPS-tracking, with control and measurement sensors in the fields.

By analyzing all the data collected, the company adjusts its production programs.

Rusagro is also actively implementing solutions related to the construction of forecast models based on weather data and vegetation data, and optimizing the technologies used. Huge reserves, has high-quality soil, so the holding is working on an algorithm for obtaining the ideal soil.

The end user is changing, it is important for environmental friendliness and safety. Competition between producers is also becoming tougher. Just wheat is not needed by anyone, wheat with a certain nutrient content and low pesticide content is needed.

Therefore, the company seeks to restore fertility without the use of aggressive technologies and use only the most innovative developments: equipment that does not violate aeration of the soil, precision farming systems that do not lead to the accumulation of pesticides in the final product.

Programmable agricultural machinery capable of putting the required amount of chemicals or fertilizers in the right place according to the points marked on the map, goes on autopilot with the specified characteristics, automatically adjusting to the conditions of the environment.

Further tasks of agricultural holding are connected with modeling, reengineering and digitalization of processes, up to automatic control of machines.

The influence of the human factor in Rusagro is systematically minimized. In particular, the company is testing machine vision technologies to assess the quality of sugar beet when deciding whether to send it for processing or long-term storage. Technology can significantly reduce losses.

The young company "Okraina", the main asset of which is the meat processing plant" Bogorodsky", initially chose a model of a high-tech enterprise that provides a stable quality of products.

The information system of the company has two basic principles: unique coding of each unit of production and traceability of the product to the batches of raw materials and semi-finished products. Each loaf of sausage or a pack of sausages receives an identifier-Product Individual Code, which is the point of entry into the quality control system and claims management in case of customer feedback.

The manufacturer has opened its own online store, through which passes about 1.5 thousand orders per day. The company entered into direct communication with customers, and as a result of this responsibility for the quality of products has increased significantly. If consumers have any complaints, then on the review left on the website with the PIC indication it is possible to track all way of a product from raw materials to a counter (or to the online buyer). And then find out the reasons that led to the claims, untwisting the chain to the exact place of the error and the name of the responsible technologist.

Registration of production operations is carried out at the place of their execution with the help of mobile devices. And in order to find out the cause of deviations in the technological process and avoid errors in the future, the it system includes a video surveillance system.

Analytics shows management the most important deviations in order to prevent errors. The abundance of data collected allows you to build predictive models. Now the "Outskirts" deepens the integration of information systems to trace the supply to the level of seeds and livestock.

In the structure of expenditure of Russian households, the share of food costs reaches 50%, so the level of consumption of agricultural products is quite limited. In combination with expensive loans and the fact that the purchase price of agricultural products is less than 20% of the retail, this limits the possibility of equipping with modern means of mechanization and automation of the mass of small farms that produce up to half of the gross product of the industry. Hence the low productivity and high unit cost of the product. In solving these problems, analysts see a huge potential for digitalization.

The cloud model is capable of breaking the vicious circle of low productivity and unavailability of efficient technologies. According to him, "uberization" is gaining popularity in the world – the use of complex agricultural machinery from a common pool with payment only for actually consumed power. A sharp increase in the level of equipment utilization provides a reduction in the cost per unit of time and production.

Another pain of the agricultural industry: up to 95% of marginality is eaten up by loans and long supply chains. Due to the high logistics costs and costs associated with the incorrect definition of demand, the margin of each of the links of resale does not exceed 5%, but the trade margin "on the circle" reaches 85%. End-to-end automation of sales, when producers are connected directly with sellers and retailers sell their products without the costs of warehouse, allows several times to reduce transaction costs and simplify the supply chain, intermediaries while maintaining the same

margins, but at the same time lowering the overall premium of up to 25-35%. A predictive management of the entire value chain, when all its participants will be able to predict the demand for their products with an accuracy of 85%, will significantly reduce the risks of lending to farmers and interest rates on loans.

The potential economic effect of digitalization of agriculture – an increase in agricultural consumption in Russia in monetary terms and a half times, which corresponds to the growth of the market by 4 trillion rubles., and productivity growth in three to five times.

Another option for the integration of sales chains is implemented by the international consumer cooperative "Agrarium", which intends to build an ecosystem for the development of agriculture on the basis of a platform using blockchain. It is expected that the blockchain platform will unite investors, farmers, processors, sellers and logistics services. The food token exchange will help to raise funds in the agricultural sector. The first is planned to release "meat" tokens "tied" to the farmed animals. 16 tokens will be tied to the chip of one animal. Later, there will also be "vegetable" and "grain" tokens. "Agrarium" presents its platform in China, Iran and Turkey, inviting agricultural producers to join the "digital artel".[7]

The world already has successful examples of building a technological ecosystem in the agricultural sector. In Brazil, a platform approach and an artificial intelligence system were used to bring together all participants in the agricultural production chain, including financial and insurance institutions. And the use of blockchain technology to control seeds and identify producers in this country has improved not only the quality but also the confidence in the ecosystem.

The key problem of Russian farmers is that at least some technologies become available only to large and medium-sized businesses. While not all farmers can use advanced solutions. However, digital tools will become cheaper, and the cloud is designed to make their use massive.

It is hoped that in the near future, many Russian farmers will also be able to use the potential of digitalization to achieve their goals, as the "first signs" do today.

Banks will also actively participate in the digitalization of agriculture. To speed up and simplify the design of banking products, it is planned to improve electronic platforms by the end of 2019, so that any individual can remotely issue a loan, Deposit or insurance services. In the future, this list is planned to be expanded.

The main participant in lending to agriculture is "Rosselkhozbank". To date, the Bank has already implemented projects related to the automation of processes and the development of digital technologies. One of the main projects is the development of a marketplace. Marketplace is an online electronic platform that provides products and services. This project will provide wide access to products and special offers of the Bank and will contribute to the implementation of the state program on digitalization of services for the population.

Initially, the initiator of the marketplace was the Bank of Russia together with market participants. This idea appeared in 2017. Currently, three client storefronts and five commercial banks have already joined the platform.

Information on transactions concluded through the marketplace is immediately transmitted to the Registrar of financial transactions, which guarantees their legal confirmation.

The purpose of creating an online platform is convenience for consumers, namely remote conclusion and execution of contracts, as well as access to a wide range of services and tools. Financial organizations will receive new distribution channels and a single channel for settlements using the usual services.

Also, the agricultural Bank is developing an opportunity for electronic identification of farmers in a Single system of identification and authentication in a Single biometric system. This will allow to provide package solutions for agribusiness (subsidy + credit + insurance).

III. CONCLUSION

Currently, other major Russian banks are joining the project. This will help to create a convenient and efficient platform for citizens. An Intelligent system of state support measures will be created with the personal account of the subsidy recipient.

End-to-end digitalization, allowing to radically restructure the entire process of production and marketing of agricultural products, makes it possible to reduce the retail prices of food products, while increasing the marginality of the business of agricultural producers and improve the quality of products. First, the unavailability of modern means of mechanization and automation for the vast majority of farms in Russia is the main reason for the extremely low productivity of labor, respectively, the high cost per unit of production. The transition from the model of sale to the ownership of agricultural machinery and automation equipment to the model of payment for their functions by actual volume or even the results of consumption, which is the basis of digital transformation, solves the problem of availability of equipment and, consequently, increase productivity. [8]

Since Russian farms start with a very low level of productivity, its increase can be up to 3-5 times. Secondly, digitalization through its cross-cutting nature allows information to link the needs of a particular end user and the capabilities of a particular agricultural producer, thus eliminating many unnecessary intermediaries, which now account for up to 80% of the cost in the retail price of the product. Together, these two factors will increase the volume of agricultural consumption in Russia in monetary terms by 1.5 times, that is, the effect of the growth of consumption will block the decline in retail prices, while the marginality of agricultural business will even grow, and the risks will decrease. The Park of tractors can increase by 300 thousand units, combines - by 200 thousand, and the consumption of fertilizers can grow by 9 times. In game theory, it is called the win-win model (games with a positive prize amount) - all participants in the digitalization process, including the end user, win.

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