Assessing the Potential of the Digital Economy in Agriculture

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Abstract. Today Russian agriculture is one of the most stable and dynamically developing branches of economy. Huge labour and material resources have been accumulated in this sector. Agriculture employs almost 6% of the country's human resources, which produce 4.5% of the gross domestic product. The main resource that determines the prospects of agricultural production are land resources, the size of which Russia ranks third in the world. This huge potential has been underused to date. The reason for such position of the industry is backward material and technical base, insufficient level of human resources development and almost complete absence of digitalization. At the same time, there are huge opportunities for modernization of the industry. The country's food security and development of export potential make agriculture a high-tech industry capable not only of providing food for itself but also for many countries around the world. They can create opportunities to introduce innovative developments that did not exist before and stimulate managerial decisions. The article deals with problematic issues of the development of digitalization of agriculture in the context of expanding the scope of information technologies. It shows the bottlenecks that hinder the wide spread of the digital economy in agriculture. An overview of government programs aimed at the dissemination of information technologies is given. The dynamics of development of innovative technologies in the agro-industrial complex of Russia, their dependence on the investments made, is shown. The main directions of digital transformation of agriculture and scientific and technological development in the field of "smart agriculture" are highlighted.

1. Introduction

Domestic rural producers, long enough after the collapse of the Soviet Union, did not have the conditions to make full-fledged investments based on modern information technologies and efficient technical equipment. But even today there are factors that hinder the implementation of digitalization processes in the agricultural sector in Russia.

First of all, it is necessary to highlight the high level of deficit in the sectorial labor market of specialists capable of effectively working with innovative technologies [1]. Now agrarian universities have actively joined the solution of this problem and they began to train specialists in information technology. But this work requires quite a long time, which is counted as 4-5 years.

Another problem is the lack of incentives for manufacturers to produce products with guaranteed consumer qualities. This task becomes irrelevant in conditions of uncertainty at various stages of product promotion. For today there are no stably functioning national and international information systems providing the digital control over advancement of production [2].

The following problem is connected with high prices of import developments, dependence on...
fluctuations of rates of world currencies and decisions of foreign countries on imposition of sanctions or other trade restrictions with low level of development of the domestic market of digital developments and technologies.

These problems are compounded by internal reasons that hinder the innovative development of the industry. In particular, these are the lack of long-term forecasting and planning in the use of land resources of the country as a whole and land resources for agricultural production, lack of data on cadastral registration of land plots used in agricultural production.

Today, the task of creating national information systems and digital platforms that provide agricultural producers with a set of cartographic material of the required scale, containing the following digital information, is highly relevant:

- reliable information on authenticity of products of seed and livestock breeding, forages, fertilizers and plant protection product;
- a detailed map of agricultural land with indication of the agricultural technical condition of the soil cover;
- price, demand and supply forecasts;
- objective and operational analytics for repair and logistics of agricultural machinery and equipment spare parts;
- operational recommendations on the need to start or stop the processes of soil tillage, planting and tillage of crop production, harvesting, animal care;
- calculation of economic efficiency of implementation of through digital technologies taking into account further maintenance, personnel costs, etc.;
- availability, condition and use of land reclamation systems.

Thus, today the process of digitalization of agrarian economy of the country is only at the initial stage and requires solving a whole layer of interrelated tasks. However, these problems can be solved by transforming the technological base of agrarian production, transferring it to a digital platform [3].

2. Conditions, materials and methods of research

The current level of digitalization of domestic agriculture causes serious concern due to the lack of scientific and practical knowledge about modern innovative agricultural technologies and methodology, the lack of a global forecast of the prices of agricultural products, the lack of information technology and equipment, as well as underdevelopment logistics, storage and delivery, which leads to high production costs. Today, only individual agricultural organizations and farmers have the financial capacity to purchase new equipment and use digital equipment and platforms. Research material received from statistical sources, publications of domestic and foreign authors, reports of line ministries and departments show a high urgency of investigated problem and importance of its decision. The potential of digital agriculture in Russia can be estimated by applying various approaches and methods, including statistical and graphical methods, comparative analysis, forecasting methods, mathematical modeling.

3. Analysis and discussion of results

In recent years, starting from 2016, because of the mechanisms of state support for the agro-industrial complex (AIC), within the existing financing, the volume of funds for the purchase of agricultural machinery at reduced prices has almost tripled (up to 5.2 billion rubles), the industry is being re-equipped [4]. At the same time, weak export potential leads to a decrease in investment in fixed capital, savings on purchased and supplied equipment do not meet the requirements for connecting to telemetry platforms and controlling the Internet of things.

At the same time, Russia is almost ready for domestic agricultural producers to enter the foreign market, especially with products of high added value. Absence of processes compatible with high production requirements accepted in the markets of foreign countries can lead, as the domestic market is saturated, to crisis phenomena in domestic industries with high potential and dynamics of rapid growth: dairy farming, pig breeding, poultry farming, sugar production, fat and oil industry.
The development of agriculture in Russia in recent years under the embargo on the import of a number of products has identified some industry problems that need to be addressed [5]. Agriculture in Russia is an integral part of the agro-industrial complex and the program "Digitalization of Agriculture" should provide participants with an opportunity to use broadband mobile communication, information technology and equipment of domestic instrument-making (tags, controllers, sensors, control elements) for a significant increase in the efficiency of agriculture.

According to the expert assessment, the rural commodity producer has to make more than 40 different decisions during the year in limited periods of time. Many of these solutions can be optimized on the basis of information technology and have a positive impact on the economy of the enterprise [6].

It should be noted that great attention is paid to solving the problem of digitization of agrarian sector of the country's economy. Thus, the Decree of the President of Russia "On National Goals and Strategic Development Tasks of the Russian Federation until 2024" of May 7, 2018 sets the task of transforming priority sectors of the economy and social sphere, including agriculture, through the introduction of digital technology and platform solutions [7].

In addressing this task, it is necessary to bear in mind a number of specific features of agriculture that lead to the active use of information and communication technologies (ICTs) in it:
1. There are many factors that determine the results of the production process: natural and climatic, soil, biological, economic and social. And most of them are highly volatile in time and space. This leads to significant management costs at the level of a particular farm.
2. The multitude and territorial dispersion of economic entities significantly complicates management decisions on a sector scale.
3. Intensive and multilateral intersectoral linkages of agriculture with enterprises of other spheres of the agro-industrial complex, large number of farm partners- suppliers of resources and buyers of products.

According to the estimates of the Ministry of Agriculture of Russia, the use of digital technologies in the agro-industrial complex allows to increase the profitability of agricultural production due to point optimization of costs and more effective distribution of funds. According to the calculations of scientists, the introduction of digital economy with a complex approach will reduce costs by at least a quarter [8].

At the same time, according to the Federal State Statistics Service in 2018, the amount of ICT costs in the section "Agriculture, hunting and forestry" was 0.85 billion rubles, or 0.2% of all ICT investments in all sectors of the economy. This is the lowest indicator by sector, which indicates a low digitalization of domestic agriculture, but this figure emphasizes that the industry has the greatest potential for investment in ICT technologies.

The information technology market size in agriculture is developing rapidly. For example, while in 2006, according to the All-Russian Agricultural Census of 2006, 12.9% of agricultural organizations had access to the Internet, in 2016, the All-Russian Agricultural Census of 2016 (hereinafter referred to as ARAC 2016) showed that access to the Internet had 61.2%. In 10 years, Internet coverage of agricultural enterprises has increased 5 times. For comparison, the volume of production in agricultural organizations during this period has increased 1.75 times.

However, there is still an uneven use of digital technologies by categories of farms. According to the results of the ARAC 2016, the share of small agricultural organizations, for which the Internet is available, is 55.4%, micro-enterprises - 44.2%, farms and individual entrepreneurs - 24%, household plots - 21.8%.

The world practice and examples of successful domestic agricultural commodity producers show that application of modern digital technologies allows to form the optimal soil-agrotechnical and organizational-territorial conditions, ensuring the entire life cycle of the agricultural system significant increase in productivity, an output on 1 worker, to lower material inputs for fuel and lubricants, the electric power, soil protection products, plants, environment, pay and other types of expenses [9].

Digitalization of land management is capable not only to provide territorial and organizational-industrial base of key elements of an agroindustrial complex, but also to provide legal regulation of land
relations, and also an objective cadastral estimation of land resources and other real estate in agriculture for progressive development of market relations in this sphere of economy.

Of course, simultaneously with the solution of technological issues it is necessary to train personnel for these innovative technologies. According to the calculations of scientists, it is necessary today to prepare no less than 90 thousand experts for digital agriculture in Russia [10].

The potential for the development of digital agriculture can be predicted based on an industry development analysis in recent years. In the agricultural sector innovative technologies are developing quite actively, as shown in Table 1. In recent years the share of agricultural products produced using such technologies has accordingly increased to 17%. At that rate, by 2030 one third of the produced agricultural products in our country will be produced on the innovation platform.

| Years | Number of acquired innovative technologies and programs, units | Number of shipped innovative products, billion rubles. | Share of innovative products in gross agricultural output, % |
|-------|-------------------------------------------------------------|------------------------------------------------------|------------------------------------------------------------|
| 2010  | 21267                                                       | 1243,71                                              | 10,1                                                       |
| 2011  | 40646                                                       | 2106,74                                              | 11,7                                                       |
| 2012  | 31639                                                       | 2872,91                                              | 12,8                                                       |
| 2013  | 33280                                                       | 3507,87                                              | 14,1                                                       |
| 2014  | 28705                                                       | 3579,92                                              | 13,9                                                       |
| 2015  | 24361                                                       | 3843,43                                              | 15,4                                                       |
| 2016  | 64914                                                       | 4364,32                                              | 16,8                                                       |
| 2017  | 79825                                                       | 5109,32                                              | 17,1                                                       |

Table 1. Dynamics of innovative technologies development in the Russian agro-industrial complex.

It should be noted that the development of production in agriculture is not involve only investments in fixed capital of the industry, but also investments in the socio-economic development of rural areas. Analysis shows that these two factors are determinant in the development of agrarian regions. Growth rates of gross regional product (GRP) practically follow investment growth rates (see Figure 1).

![Figure 1. Influence of growth of investments on production.](image-url)
The correlation analysis showed that investments in agriculture have the greatest positive effect in the first 3 years after the investment. In the second year after the investment the maximum return is already achieved, and within 3 years the investment in new agricultural technologies practically pays off. Subsequently, the investment effect starts to decrease, but the positive result is observed on average for almost 15 more years.

First of all, such parameters of investment development of agrarian regions are associated with innovative character of transformation of their activity, introduction of intellectual resources and digital economy. Such investments are characterized by fast return.

According to our rough estimates the volume of production in the agro-industrial complex of the country due to introduction of innovative technologies can be doubled and this potential is able to raise agrarian regions to a higher level, thus reducing the gap in socio-economic development of territories. Innovative development with effective management will also give a significant impetus to other sectors of the economy.

4. Conclusions
The purpose of the digitalization of agriculture is to achieve a significant increase in efficiency and sustainability of its functioning due to fundamental changes in the quality of management, as well as in technological processes and decision-making processes at all levels of the hierarchy, based on modern methods of production and further use of information about the state of controlled elements and subsystems, as well as the state of the economic environment of agriculture.

The synergy effect of the digital transformation of agriculture through the introduction of digital technologies and platform solutions will lead to:

- formation and continuous replenishment of large databases (Big Data) on agricultural resource objects (land, farm animals, agricultural machinery);
- involvement of Russian regions in the process of reasonable digital industry planning of agricultural production;
- reducing costs of agricultural production and food;
- reducing the share of material costs of agricultural producers in the unit cost of production;
- labor productivity growth in agricultural enterprises;
- increasing investment in the purchase and introduction of digital technologies and digital products, including domestically produced products;
- growth in the number of "smart farms" that have implemented and are using complex digital agricultural solutions.

Socio-economic effect can be roughly estimated by the following parameters:
- growing contribution to the economy of the agro-industrial complex in 2024 - up to 5.9 trillion rubles;
- growth of export earnings in the future up to $45 billion a year;
- formation of new knowledge-intensive productions, involvement of employees of new professions in agricultural production;
- increasing the income of rural workers to 90% of the average economy.

In addition, as a tool for increasing labor productivity in agriculture and maximizing the profit of the industry's enterprises will become the creation, dispatching and aggregation of data flows for creating end-to-end chains from agricultural production to consumption with deep integration into related sectors of the digital economy.

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