

Special aspects of digital transformation in agriculture sector of economy

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Abstract—The role of the agricultural sector of the Russian economy in the innovative development of the national economy is shown in this article. The results of agrarian reforms in our country and their impact on the rise in the efficiency of production are presented. Basic comparative characteristics of domestic and foreign agricultural production are given. The problems of the development of Russian agriculture and its potentialities are shown. The peculiarities of digitalization of the agricultural sector of economy are highlighted which are associated with the sluggishness of investments, insufficient level of information infrastructure development in rural areas, and unfavorable international situation. Delayed influence of investments on the increase of production in agriculture has been proved on the basis of official statistical data. Particular attention is paid to the lack of specialists in information technologies and their training in educational institutions. The trends for the development of informatization and digital technologies in agriculture of our country are revealed in conjunction with the level of provision of rural population with digital communication and informatization. The main directions of digital transformation in agriculture are highlighted and the growth reserves of the domestic agricultural sector are shown based on growth pattern implementation. It is concluded that it is possible to fully ensure the food security of the country by means of its own products and significant increase in exports of agricultural products.

Keywords—*digitalization of economy, information technologies, transformation of agriculture, innovative investments.*

I. INTRODUCTION

Innovative development of agro-industrial complex is inseparably associated with the use of modern information technologies, automation and production robotization. In the context of globalization and the deepening of inter-industry relations, the agricultural sector has become the basic link that forms growth trends for related industries, therefore, digitalization of agriculture is of the most essential importance for increasing the efficiency of production and processing of products.

It should be noted that agricultural production in our country has a huge development potential based on improving the effective use of land, labor, and biological resources. In order for these resources to be used to the full, it is necessary to improve production technologies

and develop a management system based on high-level information systems. The key point of these systems is the processing of large amounts of quantitative data; results of their analysis allow to increase production activities efficiency, to improve technological solutions and production material base, to develop systems for processing, storage, sale and delivery of finished products to consumers.

It should be noted that the international political situation is mobilizing our country for significant changes in the agricultural sector. In order to cope with the existing and future threats to food security, it is necessary for Russia to transform its agricultural sector and to set it on an innovative development track based on the digital economy.

As practice and experience of developed foreign countries shows, increased use of information technologies in the agricultural sector can significantly improve agriculture efficiency. Today, information technologies are actively involved in agricultural production, ranging from crop planning, automation of top dressing and digital crop modeling, to the calculation of balanced rations for animals and birds [1-2].

Thanks to digitalization of management functions and creation of “smart” production in agriculture, there is not only production increase, but also costs reducing – material, financial, and labor ones. Finally, the quality of products grows and the efficiency of economic activities of rural producers increases.

II. RESEARCH FINDINGS

Even today we observe the first results of the innovative development of the agricultural sector of economy. For example, the yield of such strategically important products as wheat and barley has increased more than one and a half times since 2000, and our country has become a reliable exporter of grain.

At the same time, in certain parameters, Russia lags behind the leading world economies significantly. For example, our output of crops is 3-4 times less than compared with the USA and Germany, and the volume of agricultural production per worker is dozens of times less than in developed countries. If in the USA agricultural products are produced in the amount of 180 thousand

dollars per year for each agricultural worker, in Russia this parameter is only 8 thousand dollars [3].

The development of digital agriculture is strongly supported by the mechanism of government support for the agro-industrial complex, primarily, the state program for agriculture development and regulation of the markets for agricultural products, raw materials, and food. Today, active re-equipment of the industry upon different directions is carried out. Thus, within the framework of allocate funding, the amount of funds for agricultural equipment purchase at preferential prices (up to 5.2 billion rubles) has been increased almost three times, and livestock facilities are being re-equipped.

According to the Ministry of Agriculture of Russia, today approximately 3% of the gross output of this industry is produced using on new technologies based on digitalization [4]. As can be seen from Table 1, this process has been actively increasing in recent years.

TABLE I. DYNAMICS OF THE DEVELOPMENT OF INNOVATIVE TECHNOLOGIES IN THE AGRICULTURAL SECTOR OF RUSSIA

Years	The number of acquired innovative technologies and software products	The number of produced innovative goods, products, and services, billion rubles.
2010	21267	1243.71
2011	40646	2106.74
2012	31639	2872.91
2013	33280	3507.87
2014	28705	3579.92
2015	24361	3843.43
2016	64914	4364.32
2017	79825	5109.32

At the same time, it should be noted that the share of innovative technologies is still insignificant at the primary stage of the agro-industrial complex; it figures up to only one-tenth of all innovative products in the industry. An essential part of digital technologies today is attributed to the processing and production of food.

One of the peculiarities of the agricultural sector of economy is its inertia with respect to investments. As the calculations show and as can be seen from the correlogram (Fig. 1), the greatest effect of capital investments in agriculture development becomes visible only during the third year of investment. Therefore, one should expect that these innovative investments in the agricultural economy which are today carried out in this sphere will give the most tangible result only in the early 20s of this century. This aspect should be taken into account in agriculture digitization concept development.

Correlation coefficients

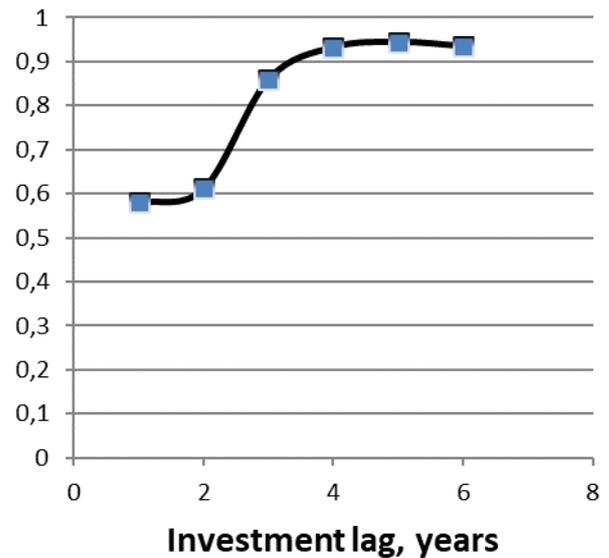


Fig. 1. Correlogram of the efficiency of investments in AIC

Another peculiarity of the agriculture sector digitalization today is the acute shortage of personnel in this development area. Only a few agrarian universities turn out specialists in information technologies, none of these universities implements training programs in production robotization. Calculations show that at least 90 thousand specialists need to be trained for creating digital agriculture in our country [5].

It should be noted that the use of information technologies in agricultural economy is the main force of innovative development not only in the production sphere but also in raising the standard of living for rural population. A vivid example of information system development in our country is the level of digital (mobile) communication among the population. Today, Russia is the world's leader in terms of communication tools: on average, there are two telephone numbers for each person in the country. At the same time, in rural areas, there is a slight lag in this parameter which has determinately reduced in recent years (Fig. 2).

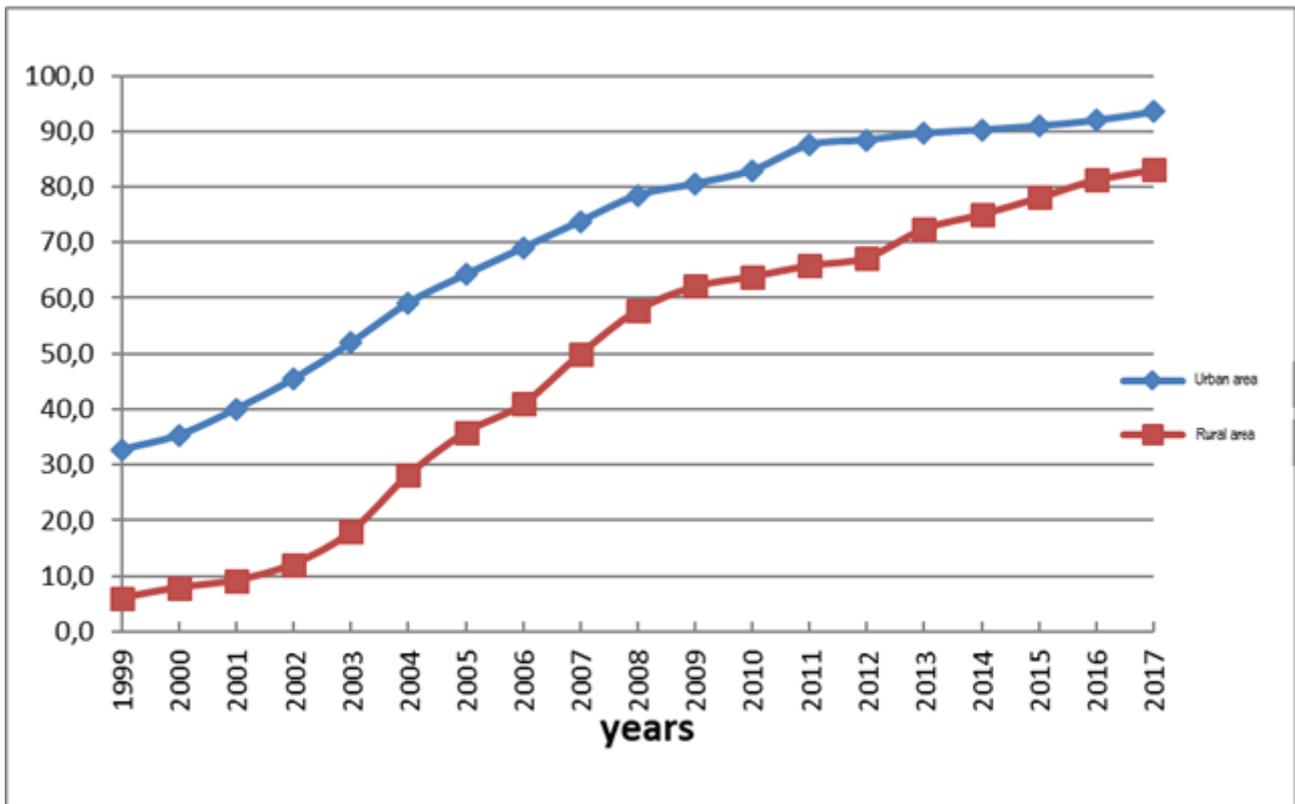


Fig. 2. Level of communication digitalization in Russia, %

The relationship between digitalization level for the area and its production parameters is confirmed by the results of the correlation analysis presented in Table 2. This table shows that there is a direct relationship between the gross regional product (GRP) and the level of Internet development in the region, as well as the number of personal computers.

At the same time, there is an inverse relationship between GRP and agriculture share in GRP. This feature is typical, as a rule, for countries with backward agriculture. This table also shows the inverse relationship between the share of agriculture and the level of Internet use. This fact once again confirms the lag of the agricultural sphere in terms of informatization.

Partly, the informatization lag of agrarian sector is due to its specific character with the focus mainly on traditional information processing technologies, to the level of development of digital communications infrastructure in the countryside, as well as to the significantly low incomes of the rural population of the country. Rosstat data confirm the close correlation of digitalization level with the economic well-being of the region [5].

Unfortunately, the current level of our agriculture digitalization is at the initial level: the lack of scientific and practical knowledge of innovative technologies, the lack of accurate forecasts for agricultural prices, as well as underdeveloped logistics, storage, and delivery systems lead to high production costs.

There are very few agricultural goods producers in Russia who have financial possibility to purchase new equipment, use equipment, and information technology platforms. The costs for information and computer technologies (ICT) under the section “Agriculture, hunting and forestry”, according to Rosstat, amounted in 2015 to only 4 billion rubles what is 0.34 percent of all ICT investments in all sectors of economy; in 2017 it was 0.85 billion rubles, that means, 0.2 percent. This is the lowest indicator by all sectors which shows low digitalization of Russian agriculture. However, these figures mean that the industry has the greatest potential for investment in ICT technologies.

TABLE II. CORRELATION MATRIX

	Gross Regional Product (GRP) per capita	Share of agriculture in GRP	Internet use
GRP per capita	1		
Share of agriculture in GRP	-0.48080961	1	
Internet use	0.19847226	-0.26528725	1
Number of personal computers per 100 workers	0.02916016	0.11619795	-0.02403622

In order to carry out rapid transformations, and within the implementation of the Strategy for information society development in the Russian Federation for 2017-2030 approved by the Decree of the President of the Russian Federation No. 203 as of May 9, 2017, the Government of the Russian Federation adopted the state program “Digital Economy of the Russian Federation” [6, 7] planned until 2024, where special attention is paid to the agricultural sector of economy.

Transformation of agriculture in the Russian Federation during implementing this program should include digitization of the following most promising spheres:

- making a set of technologies and methodology of digital agriculture in order to efficiently use available resources for the implementation of economically justified, optimal technologies that increase the profitability of agricultural production, guarantee production possibility and processing of agricultural products [8];
- implementation of a management platform for producers for contributing to the creation of modern production organization schemes, for allowing efficient use of producer’s resources: energy, personnel, financial resources, sales channels, and marketing tools;
- implementation of platforms for objective monitoring and management of transport and logistics infrastructure in agricultural production;
- creation of innovative farm units as platforms for practicing new technologies and training;
- implementation of the “Internet of things” platforms for managing tractors and combines, greenhouses, agricultural equipment, material flows, energy consumption and so on, from purchase to writing-off;
- application of information technologies for digital analysis of soil structure, composition, and condition, monitoring of crops for increasing yields and predictive analysis of crop, preventing the spread of pests, diseases, etc.;
- development of equipment and technologies for differentiated application of fertilizers and chemicals for digital and precision farming systems based on electronic databases of digitized soil maps, taking into account the peculiarities of each field section;
- creation of mathematical models for optimizing crop rotations in different regions, taking into account the specific character of production;
- approbation, analysis, and implementation of digital technologies for saving organic farming management which can be applied at all production stages (direct and strip planting, differential fertilization, controlled transport of equipment, effective harvest and post-harvest logistics, etc.);
- integration of management decisions based on analytical digital tools in order to stop inefficient land use, control and monitoring of the use of land resources by analyzing big data;

- integration of information systems of supervisory authorities (Rosselkhoznadzor, Rospotrebnadzor) and veterinary services into a public-private digital platform with the goal of direct integration of control and supervision systems into business management systems for economic entities in order to identify and trace animals and add the whole livestock production cycle in end-to-end digital chains;
- digitalization of livestock farming and the use of information technologies at all stages of breeding, use and selling animals to ensure high quality, including that for the export of livestock products;
- development of digital technologies in breeding and genetics, accelerated breeding and production of new varieties of plants and animal breeds adapted to the specific soil and climatic conditions of regions, with high potential for yield, productivity, resistance to diseases and damage by pests, along with the organization of seed growing and breeding centers in the regions;
- assistance in the development and implementation of new educational programs and training standards for the innovative technologies of digital agriculture in the system of professional and additional education, providing a set of measures for the transfer of knowledge and technologies on saving agriculture and biotechnology in agricultural production.
- making databases and procedures for the creation of information systems for tender, purchase, export and import management concerning agricultural products.

All these directions are supposed to be combined into a single information network of the digital agricultural economy of the country which should be managed at the state level [9-11].

Implementation of this program will help the development of the new agricultural technological policy of Russia and the growth of related industries. It will help to optimize the use of mineral fertilizers and chemical plant protection products, to reduce environmental impact, to develop seed growing and breeding centers and, in general, to optimize the life cycle processes of the agricultural sector through the digitalization of processes.

At the same time, there are plans to implement new educational standards in training programs of agricultural professional educational organizations, as well as in upgrade training courses, in the professional service programs of agricultural consultants.

III. CONCLUSIONS

Digital economy in agriculture will allow the implementation of agricultural growth model of the twenty-first century taking into account the peculiarities of the Russian Federation and focusing on both the domestic and foreign markets [10]. This will provide an opportunity to increase production growth of the main product group aimed at both export demand and import substitution and will ensure the sustainable development of Russian agriculture.

Opportunities for modernization of this industry are great. The need to ensure the country’s food security and

export potential development turn agriculture into a high-tech industry which is capable of not only providing food for its country, but also of significantly increasing the export of products, as well as creating opportunities for implementation of new innovative developments and stimulating management decisions that can provide the population with quality and safe products.

According to experts, in the case of full-scale use of the capabilities of modern digital platforms for management at all production levels, Russia has a significant reserve of increasing the efficiency of agricultural production (about 3-5 times) and the potential for industry turnover growth at least twice due to the implementation of digital processes and technologies in crop and livestock production and increase in labor productivity.

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