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THE MECHANISM OF DIGITAL TRANSFORMATION OF AGRIBUSINESS IN RUSSIA

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Abstract

The analysis of publications of Russian and world scientists on the issues of digitalization of various sectors of the economy demonstrated a wide range of author's approaches to the sequence, speed and scale of the introduction of IT technologies, and also spectacularly showed the backlog of agriculture and the agroindustrial complex in the direction of introducing innovations. The purpose of the paper is to develop measures to accelerate and improve the efficiency of digital transformations in agriculture, the formation of the digital agricultural sector of the Russian economy. Research methods: monographic, logical, abstract-logical, computational-constructive, statistical-economic and comparative analysis. The main results of the study: the organizational and economic mechanism of digital transformation of an agricultural organization is proposed. The mechanism is a three-stage modernization process (starting, transit, terminal stages), implemented through organizational (management, administration, legal and regulatory support) and economic (costs, calculations, budget financing, subsidies) elements. Final conclusions: the development of the agroindustrial complex on the basis of the proposed mechanism will increase the efficiency and competitiveness of the products of Russian enterprises in the international market.

Key words**:** *agribusiness, digital transformation, mechanism, Russia*

INTRODUCTION

At the present stage of development, digitalization is a determining factor in the efficiency and competitiveness of activities, the organization of relationships with customers, service and supply organizations, and, accordingly, the success of the entire business of the enterprise. In Russia today, various digitalization projects are being implemented in many sectors of the economy and the agroindustrial complex (AIC), which requires the transformation of traditional methods of production and economic activity [10]. Among such state projects in the field of digitalization of the economy: the Strategy for the Development of the Information Society in the Russian Federation for 2017-2030, the Strategy of Scientific and Technological Development of the Russian Federation, the National Program "Digital Economy of the Russian Federation", the National Technological Initiative (NTI) and the National Project "Science" [9, 3]. In the agricultural sector, the Ministry of Agriculture of Russia has been implementing the Departmental project "Digital Agriculture" since 2020. At the same time, in the process of studying the works of Russian and world scientists devoted to the digitalization of various sectors of the economy, agriculture and the agro-industrial complex as a whole, differences in the author's approaches to the sequence and breadth of innovation implementation and a common understanding of the term "digitalization of agriculture" were revealed. In a general sense, the digitalization of the agroindustrial complex can be defined as the process of integrating digital technologies (Artificial Intelligence (AI), the Internet of Things, unmanned technologies, Big Data, robotics, Data Science and others) into various elements of the activities of agricultural, processing, marketing, supplying and servicing organizations to create consumer value of products, starting from production planning and ending with the satisfaction of consumer demand. At the same time, the analysis of data on the level of digitalization of various sectors of the country's economy demonstrates that the development of digital technologies in Russia

corresponds to the global average, and in some indicators is ahead of some developed countries [4]. But at the same time, agriculture lags far behind the leading industries in terms of digitalization, which opens up broad prospects for the introduction of information technology or IT. In this context, the purpose of the paper is to develop a unified organizational and economic mechanism for digitalization of the agro-industrial complex to improve the efficiency and organization of these processes taking place at the regional level. This mechanism should be considered as a dynamic process, including the main stages of its implementation and involving bifurcation in organizational (management, administration, legal and regulatory support) and economic elements (calculations, costs, budget financing and subsidies), as well as various levels of implementation of the proposed activities [2, 15]. Such a mechanism assumes a targeted purpose for implementation at the level of agribusiness management bodies, agricultural, processing, marketing, supplying and servicing enterprises of the regions [11]. And the result of the implementation of the mechanism in practice by reducing the costs of commodity circulation will create prerequisites and conditions for improving the efficiency of enterprises and the competitiveness of agricultural products. All of the above make the solution of the issue of streamlining the processes of introducing information technologies into the practice of enterprises through the development of a single universal mechanism for digitalization of the agroindustrial complex the most relevant and timely.

MATERIALS AND METHODS

When preparing the article, data from the Ministries of Economic Development, Agriculture, Science and Higher Education of the Russian Federation, the Federal State Statistics Service of Russia, information from higher educational institutions and scientific institutes around the world were used. The works of world scientists on various organizational and economic aspects of digitalization of various sectors of the economy, such as D. Tapscott [18], N. Lane [8], M. Smith, J. Beyley, E. Brynjolfsson [17], L. Margherio [12], R. Kling, R. Lamb [6], T. Mesenbourg [13]. Monographic and logical methods were used to study the theoretical and methodological foundations of digitalization of enterprises' activities. The study of the current state of information technology development of individual sectors of the Russian economy was carried out on the basis of statistical and economic analysis, as well as by the method of comparative analysis. The determination of the directions of digital transformation of the activities of agroindustrial enterprises was carried out using abstract-logical and computational-constructive methods.

RESULTS AND DISCUSSIONS

Currently, the processes of digitalization of the economy are actively underway in Russia, while one of the important obstacles is the high level of shortage of information technology specialists. In the whole country, the total number of people employed in professions related to the intensive use of information and communication technologies (ICT) in 2019 amounted to 8,598 million people. But among all types of economic activity in Russia, agriculture is still in last place in terms of the number of employed IT specialists (Table 1). According to the Ministry of Agriculture of Russia, there are half as many of them as in other countries with a traditionally developed agricultural sector. According to experts, the modern agricultural sector needs about 90 thousand IT specialists [7]. And without sufficient knowledge and experience of working with IT technologies, it is impossible to fully use software or hardware solutions, comprehensively reveal their potential, and, therefore, get the expected economic effect. Therefore, companies are forced to attract specialists from other industries who do not have experience in the AIC. This also contributes to the great popularity of outsourcing among agricultural enterprises, which prefer to transfer all digitalization activities to specialized information technology companies.

Table 1. Employed in professions related to intensive use of ICT, by type of economic activity in Russia in 2019 (in % of the number of employed)

Indicators	ICT specialists, %	Other specialists who use ICT intensively, %	Total specialists working in ICT, %
Information and communication activities	42.3	10.4	52.7
Financial and insurance activities	5.4	42.0	47.4
Professional, scientific and technical activities	6.1	30.9	37.0
Public administration and military security; social security	1.7	22.2	23.9
Energy supply	2.2	9.8	12.0
Wholesale and retail trade	0.9	11.1	12.0
Real estate transactions	1.0	11.0	12.0
Education	0.6	9.2	9.8
Manufacturing industry	2.6	5.7	8.3
Construction	0.9	6.2	7.1
Activities in the field of culture, sports, leisure and entertainment	1.3	5.5	6.8
Mining	1.8	4.9	6.7
Water supply, sanitation, organization of waste collection and disposal	1.8	4.6	6.4
Health and social services	0.7	5.2	5.9
Transportation and storage	1.3	4.0	5.3
Activities of hotels and catering establishments	0.3	4.3	4.6
Agriculture, forestry, hunting, fishing and fish farming	0.3	2.2	2.5
Total by industry	**2.3**	**9.7**	**12.0**

Source: Compiled by the authors according to the Higher School of Economics (HSE) [1].

Due to the significantly increased interest in digitalization at both the public and private levels in recent years, Russia's gross domestic expenditures on the development of the digital economy increased from 3.6% to 3.7% of Gross Domestic Product (GDP) from 2017 to 2019 – up to 63.34 billion US dollars. At the same time, the internal costs of organizations for the creation, distribution and use of digital technologies and related products and services increased from 1.9 to 2.2% of GDP, amounting to $38.62 billion [1]. Household spending on the use of digital technologies and related products and services increased from 1.3% to 1.5% of GDP, amounting to $24.71 billion.

Table 2 shows the structure of expenses of organizations and households in Russia for various elements of digitalization of business and everyday life.

Table 2. The cost structure of organizations and households in Russia for the creation, distribution and use of IT and related products and services in 2019

Purpose	Structure, %
Organizations	
Acquisition of machinery and equipment related to digital technologies	44.4
Acquisition of software, its adaptation and revision	24.5
Payment for telecommunication services	18.7
Research and development	0.8
Acquisition of digital content	0.6
Employee training related to the introduction and use of digital technologies	0.2
Other internal costs for the introduction and use of digital technologies	10.8
Total	**100**
Households	
Payment for telecommunication services	59.9
Purchase of mobile phones, smartphones	13.4
Acquisition of digital content	11.0
Acquisition of television and audio equipment	6.5
Acquisition of computer equipment and office equipment	5.2
Expenses for the operation and repair of ICT equipment	4.0
Total	**100**

Source: Compiled by the authors according to the HSE [1].

It can be noted here that organizations in 2019 had the largest share of the costs of purchasing fixed electronics, and taking into account the shortage of semiconductor products, partly caused by the COVID-19 pandemic, in 2020–2021 their share should increase significantly. In second place are the costs of acquiring intangible assets in the form of various programs, and in third place are the costs of communication services. At the same time, the latter occupy more than half of the structure of household expenditures on the use of digital technologies. Then, just like for organizations, there are costs for mobile "hard" and entertainment "soft", respectively.

In general, today Russia occupies an average position in the world community in terms of the level of digital technology development, and even outstrips some developed countries in some indicators. Data from the Higher School of Economics (HSE) indicate that Russia (32) occupies an average position in the business digitalization index (for comparison, Romania has a value of this indicator of 27, Finland – 52) [1]. The same applies to the presence of websites in organizations: in Russia – 49% of enterprises maintain their own website, and in Finland – 96%. The main indicators of business digitalization in organizations of various sectors of the economy (Table 3) demonstrate that the telecommunications sector, trade, manufacturing, IT, hotel business and catering are leading in the business digitalization index.

Table 3. Indicators of business digitalization in organizations of various sectors of the Russian economy in 2019

Types of activities	Business Digitalization Index	Percentage of organizations with broadband Internet access, %	Providing employees with mobile devices to access the Internet:		Internet usage in organizations (% of all organizations)		The share of organizations using cloud services, %	The share of organizations using RFID technologies, %
			% of the total number of organizations	% of the total number of employees	for purchases	for sales		
Entrepreneurial sector, total (average)	**32.2**	**86.0**	**47.1**	**5.0**	**20.1**	**14.6**	**29.1**	**8.2**
Telecommunications	44.5	92.0	58.8	16.9	30.4	28.1	42.4	13.9
Wholesale and retail trade	39.2	90.0	56.8	9.2	18.2	21.7	37.8	9.0
Manufacturing industry	35.8	90.4	52.7	2.8	21.6	19.6	27.6	12.0
Information technology industry	35.6	95.7	57.2	21.7	24.0	11.4	38.3	9.1
Activities of hotels and catering establishments	34.1	81.5	47.1	3.5	26.4	20.7	35.5	11.9
Energy supply	30.2	87.4	47.7	3.2	34.2	13.1	20.9	8.7
Mining	29.4	82.6	51.2	3.1	16.8	8.7	20.7	12.2
Transportation and storage	29.3	80.8	44.6	3.3	23.0	11.7	22.9	11.1
Professional, scientific and technical activities	26.6	85.2	37.6	6.2	–	–	24.4	4.8
Construction	25.3	78.1	44.4	2.8	16.6	8.6	22.3	6.4
Water supply, sanitation, organization of waste collection and disposal	24.9	78.8	35.2	2.5	24.7	10.6	24.1	4.3
Real estate transactions	23.8	78.8	28.5	3.8	17.7	7.1	21.7	4.1

Source: Compiled by the authors according to the HSE [1].

The same sectors, with the exception of the last two, are ahead of the rest in terms of Internet availability. They, as well as the mining sector, are leading in providing employees with mobile devices. At the same time, according to the share of employees among the entire staff provided with mobile devices, enterprises in the field of information technology and telecommunications are out of competition. Energy and telecommunications companies most often use the Internet for purchases, the latter, as well as trade enterprises, hotels and catering, also lead in sales via the Internet. In Russia, 29% of organizations use cloud services, in Finland – 65%, and in France – 19%. Cloud technologies are most widely used by communication, IT, trade enterprises, hoteliers and restaurateurs. In terms of the use of wireless RFID technologies (Radio Frequency Identification), South Korea is the leader, where 46% of organizations use them, in Finland – 23%, and in Russia and the UK (8% each) wireless technologies have not yet found wide application. So, in our country, even in the leading telecommunications sector, only 13.9% of enterprises use them, followed by mining, processing, hotel organizations and catering.

If we consider in more detail the dynamics of the use of Internet technologies in the organizations of the Russian business sector (Table 4), it can be noted that all indicators have increased over 5 years. The share of enterprises using cloud technologies, broadband Internet, websites and servers has increased most significantly.

Table 4. Dynamics of the use of network technologies in organizations of the Russian Federation in 2015–2019 (as a percentage of the total number of business sector organization)

Indicators	Years					Change in 2019 to 2015 (+/–)
	2015	2016	2017	2018	2019	
The Internet	85.3	85.7	86.1	89.5	89.6	4.3
Broadband Internet	78.9	80.5	81.6	86.0	86.0	7.1
Servers	53.8	56.7	55.5	59.9	60.6	6.8
Website	41.4	43.4	44.0	48.7	48.5	7.1
Cloud services	18.4	20.5	22.6	27.1	29.1	10.7
Broadband Internet with access speeds ≥100 Mbit/s	9.1	9.0	9.3	10.4	11.2	2.1

Source: Compiled by the authors according to the HSE [1].

As a result, it can be noted that today there are active processes of digitalization of many sectors of the Russian economy, but the agroindustrial complex and agriculture are still in the rearguard of these trends. The current situation requires the formation of a set of effective measures to activate and streamline the processes of information technology implementation, one of which is the development of an organizational and economic mechanism for digitalization of the AIC at the regional level.

At the moment, in the Russian practice of digital transformation of the economy, there is no single proven organizational and economic mechanism for the transition of regional agribusiness to information technologies. In the process of digitalization of the agricultural sector, a significant role is assigned to public-private partnership, since the solution of such a large-scale task is impossible on the initiative of only one of the market participants, it will affect all levels with the involvement of private and public resources [14]. Comprehensive support by the authorities of the activity of agricultural organizations in the direction of the implementation of relevant projects (or startups) is especially relevant at the initial stages in the form of propaganda of the advantages of IT systems and consulting work on their design [16]. However, despite the noted significant role of the state, it is necessary to emphasize the importance of private initiatives, awareness by enterprises of the need to transform the business model in the direction of digitalization, advantages and benefits from the use of IT technologies [5].

Based on these postulates, a step-by-step organizational and economic mechanism of

digitalization of agribusiness in the regions of Russia with functional bifurcation of the tasks being solved at the public and private levels was formed (Figure 1).

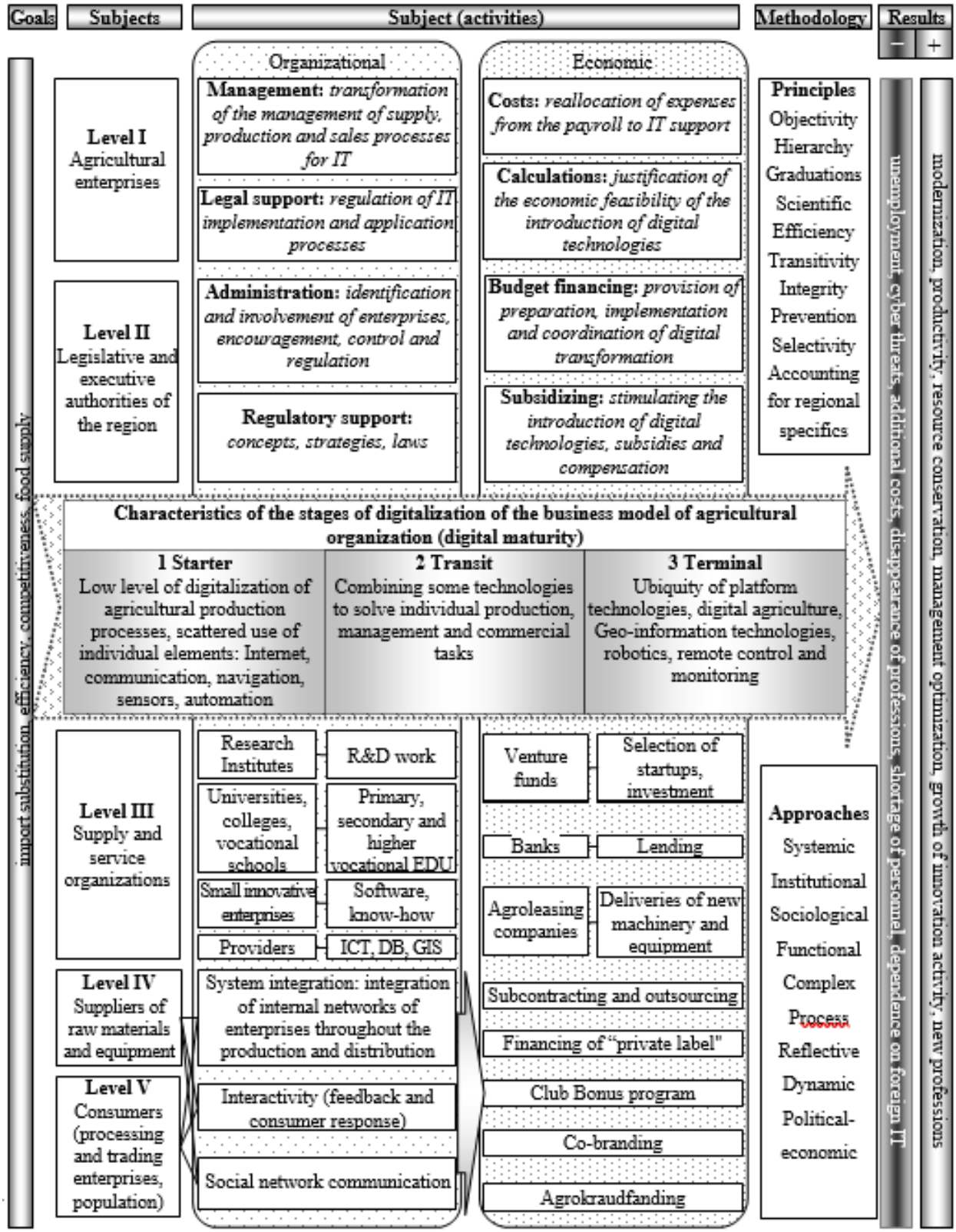

Fig. 1. Organizational-economic mechanism of digitalization of the agroindustrial complex
Source: Compiled by the authors.

At the same time, it is necessary to discretely consider the elements of the mechanism according to economic (monetary) and organizational (management, administration, legal and regulatory support) components, reflecting both the digitalization process and its internal structuring, as well as financial support for achieving targets (indicators or benchmarks). In addition, the mechanism of digital transformation of agribusiness in the region should spectacularly separate the roles of public and private structures in accordance with their powers and functions in the economy. It also determines their place in the structure and the relationship with the objects (processes) of the mechanism.

The main tasks solved by the agribusiness management bodies should be:

- promotion of the benefits of digitalization of agribusiness;
- development of regional concepts and programs for digitalization of the agroindustrial complex;
- formation of a working group on the implementation of the policy in the field of digitalization of agriculture;
- computational design of information systems and economic justification of the feasibility of their implementation;
- administrative and financial support for preparatory and organizational measures in the direction of digitalization;
- subsidizing and subsidizing digital business units.

The mechanism as a three-stage process of intellectualization of agribusiness from the disparate use of individual IT elements through the combination of some technologies to solve individual production, management and commercial tasks to the highest level of digital transformation of the agricultural sector - digital agriculture based on the ubiquity of platform technologies reflects in a temporary context all measures to form a digital business model of an agricultural organization.

The expected results of this process can be both negative and positive. Negative results include:

– the release of labor resources due to digitalization and the risks of increasing unemployment;

– risks of cybersecurity, biological, quarantine, genetic engineering security;

– additional costs for the purchase of hardware and software;

– the disappearance of individual professions;

– a high level of shortage in the industrial labor market of specialists who are able to work effectively with innovative digital technologies;

– increased dependence on foreign technologies.

Positive results will be:

+ technological renewal of agricultural enterprises;

+ increase of labor productivity at agricultural enterprises;

+ development of resource-saving adaptive technologies, reduction of anthropogenic load on the ecosystem;

+ optimization of the management decision-making process through dispatching, aggregation and optimization of data flows;

+ general increase in patent and innovation activity in the AIC;

+ involvement of workers of new professions in agricultural production.

Summing up, it can be noted that the developed unified mechanism of digitalization of the agroindustrial complex of Russia offers an effective and universal solution to the issue of streamlining the process of implementing information technologies at both the public and private levels. The organization of the process of digitalization of agricultural enterprises in the regions on the basis of the presented mechanism will accelerate the introduction of information technologies and bring the agricultural sector in line with the average level of the economy.

CONCLUSIONS

As a result, it can be noted that currently in Russia there are active processes of digitalization of various sectors of the economy. The agroindustrial complex does not lag behind other industries, where projects

for the development of information technology have been developed and implemented in recent years. However, today the level of use of information technologies in agriculture in Russia is very low and is mainly reduced to the use of computers and general-purpose software for accounting and fixing commercial transactions. Some commodity producers use digital technologies, but mainly for monitoring the condition of fields, crops and animals. With the help of special software, some links of the agricultural process are monitored.

The long production cycle, exposure to natural risks, seasonality of work, crop losses during harvesting and storage have largely predetermined the restrained, but much-needed progress in labor productivity growth and innovation. There is an urgent need for digitalization of all spheres of activity of agricultural enterprises, which is due not only to the need to improve the quality and efficiency of production management, but also to increase investment attractiveness. At the same time, one of the obstacles to the widespread spread of IT in agriculture is the low interest of technology companies in working in rural areas, the main reason for which is the territorial dispersion of enterprises and the corresponding high level of costs for creating IT infrastructure.

There is an urgent need to digitalize all aspects of enterprises' activities and attract IT specialists to the agricultural sector, which is due to the need to increase the investment attractiveness of agriculture, organization and management of the Russian agroindustrial complex. It is necessary to solve the tasks set at the public and private levels in accordance with a clear and consistent organizational and economic mechanism of digitalization. The prospective development of the AIC on the basis of the proposed mechanism will contribute to improving the efficiency and competitiveness of agricultural producers and their products. The additional effect of introducing new technologies, creating jobs and increasing tax revenues from IT enterprises makes it obvious that digitalization of the agroindustrial complex of Russia is an effective means of strengthening innovation orientation and stimulating regional development.

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