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DIGITAL TRANSFORMATION OF AGRICULTURAL INDUSTRIAL COMPLEX IN THE IMPLEMENTATION OF ITS DEVELOPMENT STRATEGY

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Abstract

In modern conditions, the innovative development of agriculture has reached a high level and ensures a steady growth in agricultural production. In this regard, the identification of new reserves for the growth of agro-industrial production will give a new impetus to the development strategy of the agro-industrial complex, one of which is the digitalization of agriculture as the basis for the stable functioning and growth of its efficiency. The work of the agricultural sector directly affects the employment, quality and standard of living of millions of Russians, as well as the food and national security of the country. One of the goals of the implementation of the agro-industrial complex development strategy is its digital transformation, which correlates with the national policy to accelerate the introduction of digital technologies in the economy and social sphere. Digital technologies will significantly change the quality of technological process control and decision-making at all levels. The real prospects of the domestic agricultural sector in the direction of digital transformation include the transition to a qualitatively new level of use of agro-industrial technologies - "smart agriculture", including precision farming, smart farms and others using elements of artificial intelligence. The purpose of the publication is to define the concept of "Digital transformation of the agro-industrial complex", analyze the indicators and indicators of the program of digitalization in agriculture and determine the possibilities of using information and digital technologies in agriculture. The work used general and special research methods, including analysis and synthesis, generalization of scientific information, logical method and systematization. The result of the work is an analysis of the current state of agricultural development and systematization of indicators of the digitalization program for agriculture and determination of parameters for the use of digital technologies in crop and livestock production. The use of digital technologies in the agro-industrial complex would increase not only the volumes of production and exports, but also the competitiveness of Russian products. Reasonable use of information technologies could almost double the efficiency of the Russian agro-industrial complex.

Key words**:** *digital transformation, strategy, agro-industrial complex, agriculture, development*

INTRODUCTION

Information technologies implies digitalization of the agricultural companies in order to enable them to develop their business and economic efficiency [3, 5].

Digital transformation of the agro-industrial complex - the transformation of economic activity through the introduction of digital tools - technologies and platform solutions designed for the generation, processing, in-depth analysis and translation of its results in the form of numerical information about objects and subjects of the economy for subsequent adoption of informed management decisions and ensuring a technological breakthrough in the agro-industrial complex.

The main task of the digital transformation of the agro-industrial complex is the integration of objective data streams of commodity producers and government data into the digital production platform to ensure global planning and provide accurate recommendations to market participants, including using artificial intelligence; activation of innovative processes based on the modern apparatus of innovative management [14].

Digitalization has become a strategic vector for the development of the Russian agro-industrial complex. This was preceded by the following events:

- in the Federal Assembly (December 1, 2016) it was proposed to launch a large-scale

systemic program for the development of the economy;
- adoption of the program "Digital Economy" of the Russian Federation (2017). The Ministry of Telecom and Mass Communications was renamed into the Ministry of Digital Development, Communications and Mass Media of the Russian Federation;
- publication of the strategy for sustainable development of rural areas of the Russian Federation for the period up to 2030;
- Decree of the Government of the Russian Federation "On approval of the Federal Scientific and Technical Program for the Development of Agriculture for 2017 - 2025".
In the Federal Assembly (March 1, 2018) it it was told about the super-efficient use of the enormous technological potential accumulated in the world, which would make it possible to make a technological breakthrough and bring the economy to a new level.
In this context, the purpose of the publication is to define the concept of "Digital transformation of the agro-industrial complex", analyze the indicators and indicators of the program of digitalization in agriculture and determine the possibilities of using information and digital technologies in agriculture. The work used general and special research methods, including analysis and synthesis, generalization of scientific information, logical method and systematization. The result of the work is an analysis of the current state of agricultural development and systematization of indicators of the digitalization program for agriculture and determination of parameters for the use of digital technologies in crop and livestock production. The use of digital technologies in the agro-industrial complex would increase not only the volumes of production and exports, but also the competitiveness of Russian products.

MATERIALS AND METHODS

The authors used general and special research methods, including analysis and synthesis, generalization of scientific information, logical method and systematization. The materials were normative acts, the works of domestic scientists, statistical collections.

RESULTS AND DISCUSSIONS

Legal framework

By order of the Government of the Russian Federation of July 28, 2017 No. 1632-r, the State Program "Digital Economy of the Russian Federation" was approved, which states that digital data is a key factor in the production of all spheres of socio-economic activity, which makes it possible to increase the country's competitiveness and the quality of life of citizens, ensure economic growth and national sovereignty [2].

Digital panorama in the future

In turn, the number of strategic documents has increased, where such terms as “numbers” and agriculture are mentioned [4]. By all accounts, the digital panorama of tomorrow's agriculture has already taken shape. The development of a departmental project was also completed by the Ministry of Agriculture of the Russian Federation, the implementation period of which is 2019 - 2024 [6].
The goal of the project is the digital transformation of agriculture through the introduction of digital technologies and platform solutions.
Currently, the use of information technology in the agro-industrial complex is not only the use of computers [7]. Digital technologies allow you to control the full cycle of production - "smart" devices measure and transmit the parameters of soil, plants, microclimate and more. All this data from sensors, drones and other equipment is analyzed by special programs. Mobile or online applications come to the aid of business entities in the agro-industrial complex - to determine the favorable time for planting or harvesting, to draw up a fertilizer introduction scheme, to predict the harvest, and much more.
Roughly 70.0% of farms in the US, Canada and Europe are already using smart technologies for agriculture. Also, among domestic farmers, the demand for digital is growing. Digitalization will help the Russian

agro-industrial complex make a powerful leap forward.

Russian agriculture performance

In the past 12 years, there has been a significant breakthrough associated with the construction of new agricultural enterprises with the introduction of modern technology and equipment.

The Russian Federation ranks 5th in the world in terms of value added in agriculture, and 7th in terms of foreign direct investment in agriculture.

At the same time, thanks to the state policy for the development of agriculture, the Russian Federation is currently the world's largest producer of barley, ranks second in the production of sunflower seeds, third in the production of potatoes and milk, and fourth in the world - in the production of wheat, having become in recent years the largest exporter of this crop, and 5th in the production of eggs and chicken meat.

Despite unfavorable weather conditions, in 2019 the gross grain harvest in net weight amounted to 121.2 million tons, which is 7.0% higher than the level of 2018 (113.3 million tons), the gross harvest of soybeans was a record 4.4 million tons, which is 8.3% more than its production in 2018 (4 million tons). The gross harvest of rapeseed in 2019 amounted to 2.1 million tons in net weight, which is 3.6% more than in 2018 (2 million tons). The average yield of rapeseed was 14.5 c per hectare (in 2018 - 13.3 c per hectare). The gross harvest of sunflower amounted to 15.4 million tons of oilseeds in weight after processing (in 2018 - 12.8 million tons) with a yield of 18.3 c per hectare (in 2018 - 16 c per hectare).

The gross harvest of potatoes in all categories of farms in 2019 amounted to 22.1 million tons (in 2018 - 22.4 million tons), vegetables - 14.1 million tons, which is higher than the level of 2018 winter greenhouses in agricultural organizations and peasant (farm) farms, including individual entrepreneurs, exceeded 1.15 million tons (in 2018 - about 1 million tons), which is a record figure [9].

The gross harvest of fruits and berries amounted to 3.46 million tons. A record 18.1 thousand hectares of new orchards and new vineyards were laid on an area of 6.94 thousand hectares. In 2019, the production of livestock and poultry for slaughter in live weight in farms of all categories amounted to 15.2 million tons, which is 1.9% more than in 2018. Increase in the production of raw milk (the growth rate was 104.6%) affects the volumes of dairy products production. Milk production in farms of all categories in 2019 amounted to 31.3 million tons (102.4% of the level of 2018). Milk yield per cow in agricultural enterprises (excluding micro-enterprises) increased by 401 kg compared to 2018 and amounted to 6,492 kg. The production of eggs in farms of all categories in 2019 amounted to 44.9 billion pieces, or 99.9% of the level of 2018. The average egg production of 1 laying hen in agricultural organizations in comparison with 2018 was 312 pieces. The food production index in 2019 remained at the level of 2018 and amounted to 104.9%. The beverage production index was 103.1% (102.6% in 2018). The production of eggs in farms of all categories in 2019 amounted to 44.9 billion pieces, or 99.9% of the level of 2018. The average egg production of 1 laying hen in agricultural organizations compared to 2018 was 312 pieces. The food production index in 2019 remained at the level of 2018 and amounted to 104.9%. The beverage production index was 103.1% (102.6% in 2018). The production of eggs in farms of all categories in 2019 amounted to 44.9 billion pieces, or 99.9% of the level of 2018. The average egg production of 1 laying hen in agricultural organizations in comparison with 2018 was 312 pieces. The food production index in 2019 remained at the level of 2018 and amounted to 104.9%. The beverage production index was 103.1% (102.6% in 2018).

In January-December 2019, compared to the corresponding period of 2018, food and processing industry enterprises shipped: food products (work performed, services) in the amount of 6,061.2 billion RUB, or 7.4% more than in the corresponding period of 2018; drinks worth 869.6 billion rubles, or

13.5% more than in the corresponding period of 2018.

In the structure of retail trade turnover, the share of food products, including drinks and tobacco products, amounted to 47.9% of the total volume, or 16,062.3 billion rubles.

In 2019, the production of livestock and poultry for slaughter increased (the growth rate was 103.0% compared to the level of 2018), which favorably affects the work of processing enterprises and contributes to an increase in the output of meat products. The growth rate of production volumes in 2019 was: canned meat (meat-containing), including canned food for baby food, - 112.2% (676.5 thousand tones); semi-finished meat products - 108.7% (3,559.9 thousand tons). The production of milk and dry cream, freeze-dried, increased up to 112.4% (149.9 thousand tons), cheese - up to 112.2% (523.9 thousand tons).

High rates of production of frozen fruits and vegetables also remained - 131.8% (95.4 thousand tons), processed and canned potatoes - 121.7% (298.2 thousand tons), sugar - 116.5% (7,309.7 thousand tons), vegetable oils and their unrefined fractions (including corn) - 112.6% (6,697.8 thousand tons), mineral water - 104.3% (14,866.4 million half liters), pasta and similar flour products products - 101.6% (1,437.2 thousand tons), cereals - 101.3% (1,540.2 thousand tons). The production of flour from cereals, vegetables and other plant crops remained at the level of 2018, mixtures from them at the level of 99.0% (9,511.5 thousand tons), sausages - 99.7% (2,275 thousand tons), bread and bakery products - 99.1% (6,306 thousand tons), confectionery - 100.4% (3,931.2 thousand tons).

Digital transformation of the agro-industrial complex

An important goal of the strategy for the development of the agro-industrial complex is the digital transformation of agriculture with an increase in the number of digital agricultural enterprises and a 2-fold increase in labor productivity by 2021 [8].

Table 1. Indicators and indicators of the program of digitalization of agriculture

Indicator	Base value	2020	2021
In the field of implementation of the national intellectual system of state support measures and private agricultural services			
The share of data on objects of agricultural resources (land, livestock, agricultural machinery) included in the Digital Agriculture Center:			
- agricultural land,% of the total area of agricultural land	75.0	100	100
- farm animals,% of the total livestock	1.0	50	100
- agricultural machinery,% of the total number of units	50.0	100	100
Share of “smart” contracts concluded with recipients of subsidies,% of the total number of subsidies	0	50	100
Number of Russian regions that have implemented digital sectoral planning of agricultural production based on the digital platform "Digital Agriculture", units	0	25	85 (100% regions)
In the field of achieving economic effect by agricultural producers			
Cost reduction factor for agricultural production,%	0	15	20
The share of material costs in the cost of a unit of agricultural products (FCM, fertilizers, electricity, planting material, feed, etc.),% of the cost	65	55	50
Labor productivity growth rate at agricultural enterprises,%	0	125	150
Share of investments for the purchase and implementation of digital technologies and digital products,% of the total investment of agricultural enterprises	0.5 (0.1)	3 (1.5)	7 (5)
The share of agricultural raw materials and finished products tracked and shipped for export by the intelligent system "Agroexport",% of the total export of agricultural products	0	15	50
In the field of training industry specialists with the competencies of the digital economy			
The share of specialists of agricultural enterprises who have undergone retraining in working with digital technologies,% of the total number of specialists employed in agricultural enterprises	five	20	35

Source: Platform "digital agriculture", https://www.mcxac.ru/upload/medialibrary/0f3/0f3e94a2348bb7122977c138e069ece1.pdf, [11].

Modern information and digital technologies allow real-time monitoring of production processes in agriculture, which makes it possible to adapt these technologies to the needs of modern agriculture based on the construction and development of an electronic agriculture system in the agricultural sector of the Russian economy. The main indicators of digitalization of agriculture are presented in Table 1 (Platform "digital agriculture") [11].
The introduction of modern land use systems and information agricultural technologies requires the development and development of innovative digital technologies. Such systems include GLONASS, Rapid Eye satellites, CORINE Land Cover. For example, to ensure a successful harvest, farmers must be able to create ideal conditions for crop health and identify any potential pest or disease threat before they spread. Digital technologies allow accelerating soil testing before planting, as well as monitoring plant nutritional status and recognizing plant diseases after growing. Autonomous vehicles and drones can be equipped with cameras and sensors to collect data, which are then loaded into software. This allows you to quickly present information about the crop to the user or farmer to see and quickly identify potential problems [12].
The introduction of GIS technologies, precision farming allows to reduce the costs of farmers and increase the efficiency of resource use. One of the most promising areas is the use of GIS technologies for monitoring agricultural land [13].
Robots and autonomous vehicles can reduce labor costs while increasing production efficiency. GPS and drone contour mapping quickly provide farmers with detailed information on water levels and soil fertility - and the data can even be transferred via the cloud.
The use of the achievements of the space industry is one of the main requirements of the modern functioning and development of agricultural production, since the presence of significant territories of the agricultural sector of the Russian Federation predetermines the need for obtaining information on the state of resources and forecasting yields. Satellite navigation systems allow monitoring the vast territory of Russia, preventing or minimizing losses from the onset of adverse weather events. Note that the scope of application of global navigation satellite and geographic information systems, as well as methods of remote sensing of the Earth is constantly expanding.
GLONASS technologies in the agro-industrial complex can be used in three cases:
- guidance systems;
–Systems for data analysis;
- variable rate systems.
The main function of satellite navigation systems in agriculture is contact mapping of fields by soil fertility (humus content). Another area of application of GPS technology is precision irrigation (irrigation) systems for linear irrigation equipment. This system improves the accuracy and quality of irrigation equipment and the irrigation process.
In the agro-industrial complex, in order to make timely and informed decisions, information about the current state of crops is needed, for the collection of which it is possible to use data from RapidEye satellites, which allow collecting data for monitoring and analyzing the state of the vegetation cover (assessment of the content of chlorophyll, protein and nitrogen) [1].
The introduction of modern technologies in animal husbandry is characterized by the renewal of the technological base of farms with the latest equipment for keeping animals. Thus, China, as part of the modernization of agriculture, is switching to innovative technologies in the management of pig breeding complexes. A multifunctional artificial intelligence system allows you to effectively manage large farms. With the help of infrared sensors, it is possible to keep track of the number of pigs, as well as track the movement and health of animals. Thanks to artificial intelligence, it has become possible to abandon expensive and ineffective RFID tags. This technology allows you to read data from tattoos applied to pigs. Artificial intelligence technologies can be useful in shaping the diet of animals. On modern farms, pigs are kept in relatively small groups, in

which the most similar animals are selected. Obtaining information on the progress of feeding individual individuals allows you to create individual pig feeding programs and the selection of an individual composition of food additives, which, in turn, significantly increases the yield. For example, in the UK, they launched a project to use artificial intelligence to identify diseases in calves. The project aims to develop a robust approach for early detection of respiratory disease in cattle using infrared thermography coupled with artificial intelligence. Obtaining information on the progress of feeding individual individuals allows you to create individual programs for feeding pigs and the selection of an individual composition of food additives, which, in turn, significantly increases the yield. For example, in the UK, they launched a project to use artificial intelligence to identify diseases in calves. The project aims to develop a robust approach for early detection of respiratory disease in cattle using infrared thermography coupled with artificial intelligence. Obtaining information on the progress of feeding individual individuals allows you to create individual pig feeding programs and the selection of an individual composition of food additives, which, in turn, significantly increases the yield. For example, in the UK, they launched a project to use artificial intelligence to identify diseases in calves. The project aims to develop a robust approach for early detection of respiratory disease in cattle using infrared thermography coupled with artificial intelligence.

The main advantage of using neural networks for decision-making in agriculture is the ability to reduce the risks associated with a shortage of qualified personnel, to provide a high level of management of the usual economic activities of an agricultural enterprise.

For the effective use of neural networks in the Russian agro-industrial complex, it is necessary to form a national publicly accessible neural network, focused, among other things, on solving problems related to veterinary medicine. This will make it possible to make a qualitative leap in the development of animal husbandry, as well as significantly reduce the costs of farms for veterinary services [10].

The effect of the introduction of such systems will be especially noticeable in small farms, which normally cannot afford a full-time veterinarian.

Thus, Table 2 presents the possibilities of using information and digital technologies in agriculture.

Table 2. Possibilities of using digital technologies and neural networks in crop and livestock production

Parameter	Plant growing	Livestock
Possibilities of use	- precision farming systems - GLONASS; - satellite technologies; - maps of the landscape cover; - determination of the actual cultivated areas; - forecasting the productivity of harvesting and crop losses; - computer vision for planting analysis; - monitoring of crop health; - automatic irrigation systems	- machine vision for counting livestock; - face recognition systems for livestock; - the formation of the diet of animals; - veterinary service; -optimization of the agricultural machinery fleet
Application problems	-significant need for financial investments; - requires a large amount of research and development; - the need for highly qualified personnel, scientists; - closeness of informational data of aerial photography	- high cost of equipment renewal and modernization; - the need to import modern technological means of keeping, feeding and caring for animals; - a high level of physical wear and tear of domestic equipment.

Source: Altukhov, A.I., 2019, Global digitalization as an organizational and economic basis for the innovative development of the agro-industrial complex of the Russian Federation./A.I. Altukhov, M.N. Dudin, A.N. Anischenko. 2019, Problems of market economy. No. 2, pp.17-27 [1].

CONCLUSIONS

The agro-industrial complex plays an important role in the development of the Russian economy, therefore one of the important tasks of the state is to ensure its effective functioning. The digital transformation of the agro-industrial complex contributes to ensuring food security, reducing the cost of agricultural production, as well as increasing the country's competitiveness in the global food market.

The greatest potential in agriculture will be possessed by technologies for monitoring and controlling machinery and technologies for precision farming. Popularization of scientific ideas about the advantages of the latest achievements of science and technology among the population, training of specialists - IT agronomists and IT zootechnicians - will also contribute to the activation of the processes of introducing digital technologies into production processes in the field of agriculture.

Carrying out an end-to-end digital transformation of all processes in the agro-industrial complex will allow to overcome existing barriers to the introduction of information tools in the agricultural sector of the Russian economy.

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