Digital aspects of management of the agro-industrial complex of Russia

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Abstract. The article is devoted to the study of digital and innovative management mechanisms of the agro-industrial complex of Russia. These mechanisms can act as a significant stimulus for the development of the industry, allowing to take into account the achievements and modern trends in technology and science, which is especially important in the context of the digitalization of the economy. The use of digital technologies and innovations in the agro-industrial complex of Russia are a competitive advantage both in the development of the production process of an agricultural enterprise and in improving the management efficiency of the agro-industrial complex. At the same time, with the help of the digital transformation of agriculture in Russia, the industry is being modified into a high-tech and competitive one not only at the national level, but also in the international capital markets. The digital transformation of the agro-industrial complex of the Russian Federation must be viewed from the position of state regulation since the digitalization of the industry also requires improving the mechanisms of state support for the introduction of digital technologies into the industry. The study of the digital aspects of agro-industrial complex management allows us to generalize the existing developments and build a mechanism for the digital transformation of agriculture. It is the use of digital and innovative mechanisms in the agro-industrial complex that makes it possible to manage the processes of the influence of climatic, natural, and other factors on agriculture. The seasonality of agricultural production is an inhibiting factor in the development of the industry. In addition, the digitalization of the agro-industrial complex makes it possible not only to increase the efficiency of management and production processes but also to create conditions for the functioning of new economic models using modern technologies.

1 Introduction

The agro-industrial complex of the Russian Federation is one of the priority sectors of the national economy, which allows ensuring food security of the population, which is "the basis for the economic and scientific and technological development of the country, region, and also determines the welfare and health of the population" [1]. At the same time, it is obvious that achieving an optimal level of food security in the country is possible by enhancing the

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development of the country's agro-industrial sector through "digital transformation", the use of digital technologies, and innovation to improve the efficiency of the agricultural management system. As I. A. Ganieva pointed "digital transformation of agriculture is the transformation of economic activity in the industry through the introduction of digital tools - technologies and platform solutions designed to generate, process, in-depth analysis and broadcast analysis results in the form of numerical information about objects and subjects of the agricultural economy for the subsequent adoption of sound management solutions that provide a technological breakthrough in the agro-industrial complex "[2, p.5].

Agricultural products are characterized by low shelf life, seasonality of production, and other industry-specific characteristics that cause risks and problems during production, transportation, storage, and processing. The agro-industrial complex of the country is able to provide the population of Russia with the necessary amount of food, therefore its development is included in the priority national projects of both individual regions and the country as a whole. The use of digital technologies and innovations in the agro-industrial complex of Russia is conditioned, on the one hand, by the activation of the general strategy of digitalization of the economy, as well as the need to introduce scientific achievements and technological progress into the management system of the agro-industrial complex of Russia, in order to increase its efficiency and competitiveness of the industry.

A low degree of understanding of the need for a consistent transition to the digitalization of the country's agro-industrial complex determines the slowdown and inconsistency of the industry management system both at the level of its individual participants and at the state level. The lack of interconnection between the decisions at the regional and federal levels of state power, state programs in the field of agricultural development, the fragmentation of methodological and informational support, non-systematic management in the agro-industrial complex, necessitates the study of digital aspects of this process. In these conditions, a systematic analysis of the state and assessment of the prospects for the use of digital and innovative mechanisms in the management system of the agro-industrial complex of Russia within the framework of the world economy will allow identifying the main directions of the "digital transformation" of Russian agriculture, as well as the national economy as a whole.

2 Materials and Methods

The agro-industrial complex of Russia, as one of the most significant national and priority areas of the country's socio-economic development, is an important object for the application of digital and innovative technologies in the management system. For the Russian Federation, which has vast territories and complex agricultural industries, and schemes for building management systems, it is especially important to activate the process of introducing digital technologies. Also, "the historically low efficiency of land use and, in general, the mass of unresolved issues in agriculture create the preconditions for its digitalization" [3, p.48]. In the context of digitalization and increased application of innovations, taking this factor into account in the agro-industrial complex is a necessity, not a factor of choice.

The methodological basis of the study is a set of scientific approaches that reveal the conceptual foundations of the agro-industrial complex management system, which are interdisciplinary and multi-level. In the course of the formation of conclusions, a systematic approach is used, including general scientific and special methods: subject-object, logical, comparative, spatial, and statistical analysis, used in various combinations at different stages of the study, depending on the goals and tasks to be solved, which contributed to ensuring the reliability of economic analysis and the validity of the findings.

One of the effective management systems in the modern economy is clustering and building a network system of interaction between the major participants in the production

sphere and the management system, which is also relevant for agriculture (including the agro-industrial complex) in Russia. Clustering in the agro-industrial complex of Russia is a self-developing and backbone management system that creates conditions and requires the use of digital and innovative mechanisms. The study of various aspects of digitalization of the agro-industrial complex, allows you to develop a toolkit for applying the achievements of science and technology in the management and production of agricultural products.

The fragmentation of the activities of the main participants in the Russian agro-industrial complex is one of the main factors hindering the development of the industry. An attempt to combine into a single management and production system based on the use of a "single digital platform" will significantly increase the efficiency of agriculture in the country. The development of the agro-industrial complex management system and the degree of implementation of digital technologies, in our opinion, are carried out in parallel. From the point of the general economy, the following general economic management systems have developed historically: hierarchical (centralized); market (more flexible, but chaotic), and integrated network. These control systems have found their application in the agro-industrial complex of Russia. Taking into account the factor of using digital technologies, the following control systems can be distinguished:

1.The traditional management system, characterized mainly by the use of labor resources, the process of building agriculture under the significant influence of the human factor. With this management system, the use of digital and innovative mechanisms is minimal or completely absent, moreover, it is characterized by a relatively low yield, high costs that form the cost of products (works, services). Under the traditional management system, predominantly "rural entrepreneurs rely on their resources and capabilities also in relations with state authorities and local self-government" [4, p.305]. Besides, the main participants in agricultural production are rather skeptical, since individual enterprises do not have sufficient resources for the development of innovative activities and cannot act as a "growth point". It becomes necessary to intensify the introduction of innovations and digital technologies into the management system to increase its efficiency and expand the capabilities of the main participants in this industry.The innovative activity of agro-industrial complex enterprises is influenced not only by objective, internal and external factors concerning the enterprise, but also by subjective factors, determined by the behavior of decision-makers (DM) in the implementation of innovations at the enterprise level [5, p. 883].

2. Digital transformation of agriculture or "partial" digitalization of the management and production system - involving the automation of production process control, active implementation and use of digital and innovative mechanisms in production activities, (for example, digitalized agricultural machinery, sensors and unmanned aerial vehicles, as well as others digital-elements), which will increase productivity indicators and reduce the volume of costs that form the cost of agricultural products, works and services. As M.S. Oborin notes [6, p. 224], "in the transition to smart agriculture, a person will play a secondary role in tracking the current state of the natural environment. This function will be taken over by various sensors that will analyze the state of the components of the natural environment (air, soil, water), as well as automatically control lighting, watering, and fertilization. " Digital transformation of the Russian agro-industrial complex will allow automating management and production processes, which can reduce the impact of production seasonality and other industry characteristics.

3. Digital ecosystem of agricultural management - digitalization not of individual elements of the agro-industrial complex or partial use of digital and innovative mechanisms in the management and production system, but cooperation in the digital space of most of the participants and the digitalization of management systems and production process in agriculture.

The use of digital technologies and innovations in the agro-industrial complex of the Russian Federation is a competitive advantage in market conditions for individual participants in this industry. At the same time, the issue of the digital transformation of agriculture is a geopolitical and important factor in the development and management of the agro-industrial complex, a strategic component. The digital transformation of agriculture or the use of digital and innovative mechanisms in the management and production system presupposes the need to create a single basic model of digitalization or a single digital space. To create a basic model of the digital transformation of the agro-industrial complex in Russia, it is necessary to have universal systems for managing the production process in agricultural enterprises that can cover a wide range of input parameters, their accumulation, and analysis of big data.At the same time, control systems in the context of digitalization should provide the possibility of modifying various options and vectors for the formation of control algorithms for various conditions, which is especially important for agriculture. Multivariance implies mobility and the ability of the management system to adapt to different conditions for the functioning of agricultural enterprises. In addition, the algorithm of the digital control system in the agro-industrial complex can cover all stages of management and production: preparatory, production, and sales, as well as management tools (devices, equipment, processes, etc.). The mechanism of the digital transformation of agriculture can be as follows (see Fig. 1):
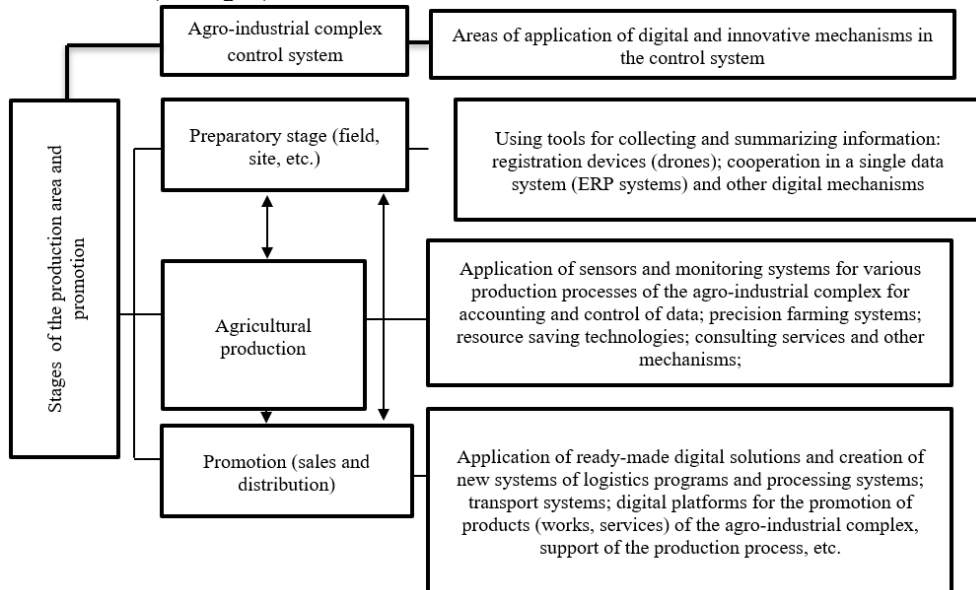
Fig. 1. Mechanism of digital transformation of agriculture

Shown in Fig. 1 mechanism for the digital transformation of the agro-industrial complex in Russia is already being implemented, but it allows solving only a part of the complex problems of the country's agriculture. The management system in these conditions can solve the pinpoint problems of the agro-industrial complex using digital and innovative mechanisms, but to cover large areas for digitalization in agriculture, it is necessary to create conditions for the functioning of the agro-industrial complex management ecosystem. One of the difficulties in a single cycle of production and sale of agricultural products is the presence of feedback between producers and consumers, as well as taking into account consumer preferences. Taking this factor into account is necessary to increase the efficiency of promoting agricultural products and accompanying the production process.

The solution to this and other similar difficulties is to consider the agro-industrial complex of Russia as an ecosystem, and to intensify the introduction of digital and innovative mechanisms into the management system to increase its efficiency and overall competitiveness of the industry. The ecosystem approach to the agro-industrial complex, as well as the creation and use of clusters as an element of the agricultural management ecosystem, serves as a conceptual basis for development in modern conditions. The agro-industrial complex should be considered as an ecosystem, which is a universal and local complex that unites not only agricultural enterprises that produce and process agricultural products, but also other structures: representatives of science, the business community, government authorities, as well as service organizations that complement activities in the field of agriculture ... As G.B. Kleiner, "the inclusion of ecosystems in the line of the main objects of study in the economy (along with enterprises, holdings, sectors, regions, and markets) corresponds to the general development of economic theory" [7, p. 40]. Moreover, the agro-industrial complex ecosystem is a self-developing system of functioning of various participants in a single environment. The ecosystem approach is especially important for the Russian economy, which is not characterized by a systemic nature, which "manifests itself in territorial, subject and social fragmentation, the inconsistency of decisions made at almost all levels and the absence of a generally recognized operational strategy at almost all levels of management" [7, p.41]. In practice, the universal parts of the ecosystem can be such components as cluster system (organizational or structural); a specific platform as an ecosystem infrastructure; network as a business process element; business incubators as innovations. The use of the cluster system in the agro-industrial complex is an important element of the ecosystem, which makes it possible to significantly increase the efficiency of industry management. But the effectiveness of any ecosystem can be achieved by combining all its parts into a single environment, a space within which they can function efficiently, smoothly and connected, sharing the results of their activities. In general, "the development of a theory of ecosystem management, based on principles similar to the principles of management of self-regulatory organizations on the one hand, and collective (self-governing) enterprises on the other" [7], allow within the framework of the agro-industrial complex to increase the efficiency and competitiveness of the management system, as well as to activate the degree of implementation digital and innovative technologies.

3 Results and discussion

Consideration of the agro-industrial complex of the Russian Federation as a kind of ecosystem will allow solving the problems and difficulties of preventing global challenges in the field of food and biological security not only for a single country but also for humanity as a whole. The digitalization of the agro-industrial complex requires the creation of a new type of agriculture, which is based on the principles of waste-free production and sustainable development, while the management system must be "intellectual". As rightly noted by a group of scientists (Voronin B.A., Mitin A.N., Chupina I.P., Voronina Y.V.), "intelligent agriculture is based on the use of automated decision-making systems, integrated automation and robotization of production, and also technologies for designing and modeling ecosystems" [3].

Implementation of the concept of a digital ecosystem of agro-industrial complex management will allow to reduce the influence of external factors and switch attention to internal factors of production, their development under the influence of the achievements of technology and science. The digital ecosystem of agricultural management involves the creation of a unified platform of digital and innovative solutions that allow not only control and accounting, but also to plan and forecast supply and demand in agriculture through digitalization, the use of various categories of information (satellite, climate, customs, tax,

accounting, financial, statistical and other) generated and received from various sources both in the established format and online. The effectiveness of the management ecosystem of the agro-industrial complex in Russia can be achieved by applying the cluster approach for the development of agriculture in Russia.

The use of clusters as backbone systems in the agro-industrial complex of Russia increases the efficiency of the industry on the one hand, and also allows to generalize and build management mechanisms within a single space. It becomes possible not only to generalize efforts (resources, technologies, research results, etc.) of individual participants in the agricultural management and production process but also to develop mechanisms for the management system, planning and forecasting various risks. From the standpoint of the digital transformation of agriculture, this is possible to implement as part of the creation of a digital ecosystem for agricultural management. The digital ecosystem is a community that emerges from a combination of the daily use of the platform and its applications by customers, developers, suppliers of goods and services, and agents, with skills and competencies acquired through this use [8, p. 17].

The mechanism for applying digital technologies in the control system is the use of the information system "digital cluster" - a backbone element of the control system. This system assumes creating conditions for the formation and communication to all participants of cluster formations "control action that minimizes the deviation of the overall process from a given target state, corresponding to the satisfaction of customer needs." Within the framework of the "digital cluster" application, it is possible to fulfill orders from participants in agro-industrial clusters for the purchase of machinery and equipment, for service maintenance, for the purchase of raw materials and materials from suppliers for the implementation of the main activities. At the same time, the "Digital Cluster" technology does not include "unnecessary intermediaries" in the value-added chain and provides trading platforms with products, taking into account all redistributions:
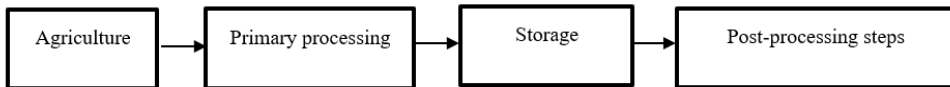
Fig. 2. Redistribution of value added in the agro-industrial complex [9, p. 187]

As shown in fig. 2 redistributions of added value in agriculture form a self-organizing system. The use of the digital cluster technology in the agro-industrial complex necessitates changes and additions to the regulatory system with the inclusion of the mechanisms of the "digital economy" and the creation of conditions and the functioning of a high-tech environment for various categories of economic entities in the agro-industrial complex. As part of these transformations in the implementation of cluster policy, it is necessary to take into account such sections as human capital and efficiency and its use; conducting a competent policy for the development of various cluster structures. To use digital technologies and participate in cluster structures, it requires readiness for modernization and mobility for transformations at enterprises operating in the agro-industrial complex of Russia.

Areas of application of digital technologies in agriculture are creation and operation of a "smart greenhouse"; creation and operation of a "digital farm"; precision farming; raw material management using temperature storage and other digital technologies; transport management through the use of digital technologies to control the location and promotion of transport, and others. The implementation in practice of the considered areas of application of digital and innovative technologies in the agro-industrial complex can contribute to a significant increase in both the profitability of production activities of agricultural enterprises and the management system. The process of introducing any "digital solution" or innovation in the agro-industrial complex requires an integrated approach, which in turn allows

monitoring the integrity of the integration of the technology being introduced and the consequences of this process on the production activities of agricultural enterprises. For example, for the creation and functioning of a "digital farm", it is necessary to implement such components as the choice of software for monitoring, using special sensors; evaluating the effectiveness of this project using business cases or other financial instruments; collection and generalization of data using mechanisms for analytical data analysis; selection of the necessary technologies and processes that are necessary for the implementation of this project, providing for the necessary changes in the structure of production and management of an agricultural enterprise in which an innovative approach is introduced.

Possible consequences and effects of the use of digital technologies in the agro-industrial complex can be:

- building a control system for the level of humidity, temperature conditions, the optimal time for collecting and storing agricultural products;
- monitoring of the mechanisms of optimal watering and fertilization of the soil, health, and movement of animals;
- control of fuel consumption, staff time, light and wind level, moisture level and soil mineralization, etc.

The introduction of digital and innovative mechanisms in the management system of the agro-industrial complex of Russia is accompanied by the transformation of the industry, taking into account the high-tech mechanisms of both the production of agricultural products (works, services), and in the management system within the framework of the creation of agricultural clusters. All this contributes not only to ensuring the food security of the population in the country, the development of export potential, but also to an increase in the efficiency and competitiveness of the industry at the international level. It is necessary to create opportunities for the implementation of innovative developments, to stimulate the adoption of advanced management decisions that can provide the population of Russia with high-quality and safe products [9]. To implement measures for the digitalization of agriculture, the Ministry of Agriculture of Russia is developing a draft Concept for Digital Agriculture.

Through the use of digital technologies in agriculture in Russia, it makes it possible to reduce costs, with the help of online services, information is summarized from the functioning infrastructure for data analysis and making various categories of decisions. In addition, digital technologies in the agro-industrial complex can be used to automate certain agricultural production procedures, for example, in the field of energy conservation. For farms with an extensive fleet of agricultural equipment, solutions are used on a specialized platform that allows for the prompt collection and processing of information, for example, the Internet of Things (IoT) technology.

Analysis of the world experience in the application of this innovative technology in the agro-industrial complex, in particular in animal husbandry and agriculture, indicates a significant effect: cost reduction - average cost savings by 5-10% due to irrigation management and mechanization of the production process, protection from diseases by 5-10%; increasing yields by 10% due to the efficiency of fertilizer use (about 8-11%), sowing accuracy by 6-14%, etc.

As practice shows, one of the important problems hindering the process of digital transformation of the agro-industrial complex of Russia is "insufficient staffing indicators for the implementation of modern digital technologies in the agro-industrial complex of both the country and in certain regions, etc. [10, p. 353]. Besides, I point on several scientists (A.A. Anfinogentova, M.N. Dudin, N.V. Lyasnikov and O.D. Protsenko) "it is necessary to modernize the existing approaches to training and retraining specialists for the agro-industrial sector, taking into account the concept of a green economy , to restore a multi-level education system based on the integration of efforts of agricultural universities, institutions of

secondary vocational education, science and the state "[11, p.647] Staffing of any process, including in the field of agro-industrial complex, is the fundamental basis of the management system. The transformation of the general strategy of agriculture requires transformations in the field of staffing, since human capital and the intensification of the use of knowledge as one of the elements of the implementation of innovative approaches, for example, when applying the concept of the "triple helix", acts as a competitive advantage for the main participants in the agro-industrial complex.

To increase the efficiency of staffing and the attractiveness of labor in the agro-industrial complex, as rightly noted by some scientists (E.A. Skvortsov, E.G. Skvortsova, I.S. Sandu, G.A. Iovlev) "the use of labor saving technologies, including one can distinguish digital, intelligent and robotic technologies, basically these technologies are represented by robotics, one of the most important functions of which is intelligent" [12, pp. 1014-1015]. This function involves the process of obtaining, collecting data on ongoing production processes in agricultural enterprises, and used to make various categories of management decisions in the field of agro-industrial complex. The gradual introduction of digital, innovative and intelligent technologies, including robotics, will make it possible to build a control and monitoring system for the consumption of resources in the course of agricultural production, track the levels of environmental impact on the environment, optimize staffing factors for the agro-industrial complex, systematize the data obtained, etc.

The digital transformation of agriculture in Russia is associated with certain risks. Influenced by the peculiarities of the agro-industrial complex, the Analytical Center of the Ministry of Agriculture of Russia developed the following main directions and measures for managing the risks of digital transformation of agriculture [9] (Fig. 3):
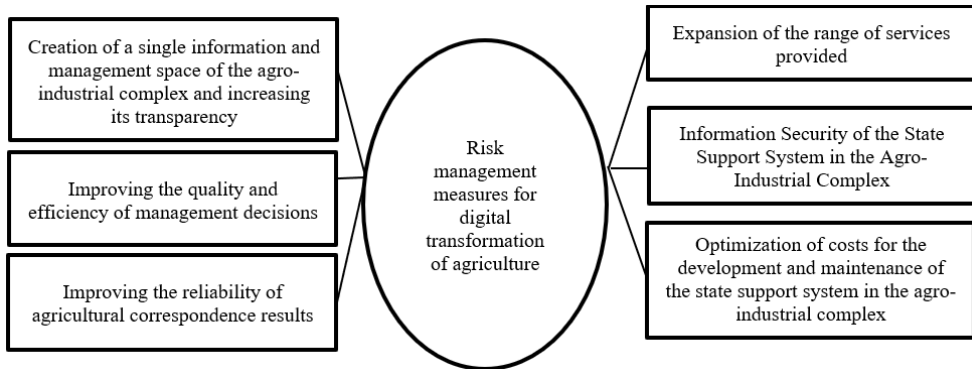
Fig. 3. The main directions of risk management of digital transformation of agriculture [9, p. 188]

Risk management of digital transformation of agriculture contributes to the accumulation of approaches to generalization, systematization, and regulation of data to improve the quality and efficiency of decision-making, the reliability of the results of agricultural correspondence, the efficiency of information security, etc. All these activities can be provided within the framework of the creation of an agro-industrial cluster and the use of digital technologies in the registration, storage, and processing of data. The use of digital and innovative mechanisms in the management system of the agro-industrial complex is most effective in the collective form of doing business in the agro-industrial complex, i.e. creation of tandems within the framework of agricultural production cooperatives, artels, or other forms of association. The creation of such forms of association within the framework of the agro-industrial complex allows you to increase the profitability of a business, to combine the efforts of several individuals or legal entities, which greatly facilitates the achievement of various goals within the framework of entrepreneurship. Moreover, such an association

format makes it possible to successfully scale-up activities and reach new levels of productivity.

4 Conclusions

Thus, in our opinion, as a result of a systematic analysis of the theoretical foundations of digitalization of agro-industrial complex management, it can be argued that the digital transformation of the agro-industrial complex in Russia is a necessity for solving a wide range of problems, but this process should not be selective, but complex. The implementation of the digital transformation of agriculture in Russia must be carried out within the ecosystem, which will allow systematizing the data process and expanding the scope and implementation of digital and innovative mechanisms. The introduction of digital and innovative mechanisms to improve the efficiency of the management system for the agro-industrial complexes of Russia contributes to a significant change not only in the general strategy for the development of agriculture but also to increase the efficiency of the production process of agricultural enterprises, to intensify the process of applying the results of scientific and technological progress, achievements of science and technology. To improve the efficiency of the management system and enhance the use of digital and innovative technologies in the agro-industrial complex of Russia, taking into account the influence of industry-specific features, it is necessary to implement the following measures:

- − to intensify the level of interaction and communication between research centers and structures implementing the results of scientific research in order to increase the efficiency of the implementation of agricultural projects;
- − to increase the amount of funding for scientific potential and support for the implementation of innovations in Russian agriculture;
- − systematize the sequence of the process of introducing modern technologies and innovations in the agro-industrial complex in order to reduce possible losses and damage;
- − to increase the share of domestic developments (technologies, software, etc.), their implementation in the production activities of agricultural enterprises in Russia;
- − to intensify state support for innovative projects in the agro-industrial sector of Russia, for example, through the institution of lending, the allocation of grants, etc.

Acknowledgements

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