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An innovative system of the agro-industrial complex: sectoral and territorial aspects

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Abstract. The relevance of the research topic is connected with the need to modernize and innovate the development of the agricultural sector in the context of the ongoing globalization of the world economy and the tasks of import substitution in Russia. Digital technologies have not yet reached all rural areas, which is a problem for the development of the digital economy in our country. There is a lag in the implementation of innovative products and agricultural projects from the industrial complex. This is primarily due to the lack of state financing and strict regulations of the relations existing in the agro-industrial complex. The formation of innovative systems at the level of territories (regions) cannot but include the agro-industrial complex in the system of management of innovations and investments of the region. The sectoral aspect of the innovative development of the agro-industrial complex is associated with the State Program for the Development of Agriculture and Regulation of agricultural products, raw materials and food markets for 2013-2020. The aim of the study is to substantiate the need for the growth of intensive introduction of innovative products in the agro-industrial sector based on the interrelationships of territorial and sectoral forms of managing innovative development of the agro-industrial complex, since the agro-industrial sector is vital for the population and ensuring food and economic security. The authors demonstrate the problems of innovative development of the agro-industrial complex, present their own vision on the concept of the innovation system, including innovative products, innovative projects, innovative activities, and the innovative system of the agro-industrial complex. The sectoral and territorial (regional) aspects of innovation activities in the framework of the agro-industrial complex of the Voronezh region are considered. Certain features of the management of innovative development in these areas are analyzed. Conditions stimulating the formation of an innovation system of the agro-industrial complex are given, and a number of reasons explaining the lag in the innovative filling of the agricultural sector are also addressed in the paper.

1. Introduction

The relevance of this study lies in the fact that innovation in the agro-industrial sector is a necessary condition not only for improving the agro-industrial production, but also for the development of agricultural territories. The AIC remains a traditional sector of the market economy associated with



the country's economic security. Innovations contribute to the growing competitiveness of the Russian agro-industrial complex and the modernization of rural settlements.

Innovation activity of any sphere is associated with the development of innovation infrastructure, investment attractiveness of the industry, and government regulation and support for this area. Both in Russia and abroad, the share of the agro-industrial complex in GDP is declining. However, the need for food production and industrial processing of agricultural products contributes to the development and introduction of new production technologies, organization, logistics, marketing, information in the agricultural sector. In Russia, due to the vastness of the territory and the difference in natural climatic conditions, certain regions differ in the level of innovative activity.

There is a point of view that the limits of return from innovative and investment resources have been reached in agriculture. Therefore, the direction of additional investments in the AIC will not be able to significantly increase its share in GDP. Investment in high value added manufacturing is needed. Along with this opinion, there are points of view on the growth of private investment in the production and industrial processing of agricultural products, since approximately 90% of the production is created in private enterprises.

Innovation activity is managed both at the level of territories (regions) and at the level of industries. Territorial priorities are associated with innovation clusters, the presence of university-industrial relations. Sectoral priorities reflect the objectives of the industry, as being set in state programs.

The relationship between the territorial and sectoral management of innovative activity of the agro-industrial complex contributes to the identification of problem areas and the definition of modernization tools for enterprises in the agro-industrial sector.

The themes of the development of innovation activity and the formation of innovative systems are disclosed in the works of L. M. Gokhberg, O. G. Golichenko, G. B. Kleiner, V. L. Makarov, A. M. Bukreev, E. Yu. Okolelova, A. V. Shulgin. The strategic aspects of the modernization and innovative development of the agro-industrial complex are reflected in the works of V. G. Zakshevsky, O. G. Charykova, A. I. Altukhov, V. I. Nechaev, I. F. Khitskov, and other authors.

The theoretical basis for increasing the efficiency of interaction between the state and business is revealed in the works of L. Abalkin, D. Lvov, V. Yakimts, and V. I. Tambovtsev, etc.

However, there are still problems associated with the presence of innovation clusters in the region and their interaction with industry innovation management.

The purpose of this study is to substantiate the need for the interaction of territorial and sectoral forms of management of innovative activity in the sectors of the agro-industrial complex to identify institutional gaps in this area and identify points of regulation of innovation activity in the agro-industrial complex by the state. The object of this study is the agro-industrial complex of the Voronezh region. In the course of the study, an analysis was made of the state of the territorial management of innovation activity in the agro-industrial complex of the Voronezh region.

2. Methods

In the course of the study, the authors applied universal scientific methods – dialectical and metaphysical. From the general scientific methods, they used the method of scientific abstraction, analysis and synthesis, historical and logical, as well as the system method. The statistical method was used from private science methods, which allowed the authors to come to certain conclusions regarding the state and possibilities of the development of the innovation system of the agro-industrial complex based on the relationship of the territorial and sectoral management of innovation activity.

3. Results

The research resulted in conclusions regarding the reasons for the lag in the development of the innovation system of the agro-industrial complex from the innovation systems of other industries. The authors also propose definitions of innovation activity. For the very first time, a model of the agro-

industrial complex innovative system is presented. Moreover, tools for the innovative development of the agro-industrial sector are presented. Conclusions are drawn regarding the reasons for the innovation lag of agricultural enterprises from industrial enterprises.

3.1. Problems of innovative development of the agro-industrial complex

The agro-industrial complex of Russia is an important sector of the economy due to the fact that territorially agricultural territories occupy 386.1 million hectares, which is more than 22.5% of the entire territory of the country [14]. About 90% of all agricultural products and products of industrial processing of agricultural raw materials accounted for private business.

Researchers point out that Russia's agribusiness is experiencing problems as a sector of the economy with the contribution to GDP of less than 5%. These problems in Russia are: insufficient state support and financing (the share is 44%), a lack of qualified personnel (36%), the imperfection of state regulation (30%), high costs of energy resources (22%), insufficient solvency of the population (20%), inflexibility of taxation as applied to the agro-industrial complex (18%), geopolitical risks (9%), insufficient penetration of high technologies (9%), risks of changes in sectoral prices (9%), lack of capacity and production and technical potential (7%), unattractiveness of the agro-industrial complex for investors (7%), currency risks (6%), corruption (5%), and imperfect logistics (4%) [13].

The share of agriculture in Russia's GDP is 4.7% [13]. However, the share of agriculture in the regional gross product of certain areas differs from this indicator. Thus, in the Voronezh region in recent years, the share of the agro-industrial complex in the RWP increased from 7.5% in 2010 to 18% in 2016 [16]. This indicates that the agro-industrial sector in the Voronezh region remains a priority for the strategic development of the Voronezh region. However, the need to improve the competitiveness of the agro-industrial complex of the Voronezh region compared to other areas dictates the need for advanced innovative activity.

Table 1. Dynamics of innovation activity indicators in the regions of the Central Black Earth Region [5, 17,18].

1.1. Share of enterprises participating in innovation activity, %												
Region	2000	2001	2002	2004	2005	2006	2007	2008	2009	2010	2015	2016
Belgorod region	7,9	11,4	10,1	8,2	8,7	12,0	16,0	10,8	11,1	10,9	12,7	14,1
Voronezh region	20,1	14,5	12,0	13,6	12,2	14,2	11,8	11,6	8,6	8,6	11	11,6
Lipetsk region	9,3	8,5	8,9	9,1	11,6	10,2	10,3	10,8	9,9	8,9	20	19,2

1.2 Number of advanced production technologies created by regions of the Russian Federation												
Region	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2015	2016
Belgorod region	10	6	15	26	19	16	22	14	12	10	33	51
Voronezh region	21	19	20	18	17	11	9	17	19	10	25	26
Lipetsk region	-	-	-	-	-	-	-	-	-	-	1	1

In terms of import substitution, the regions competing with the Voronezh region are those which territory is located in the climatic zone corresponding for the production and industrial processing of agricultural raw materials. Thus, the agro-industrial complex of the Kursk, Belgorod, Lipetsk, Oryol, and Tambov regions compete in the Central Black Earth Region. It should be borne in mind that the

innovation infrastructure of the regions is not the same. We compared the levels of development of innovation infrastructure in three areas of the Central Black Earth Region (Table 1).

From table 1, it follows that the three competing areas have a different regional innovation system; however, the Lipetsk region, although not sufficiently involved in the creation of advanced technologies, more actively introduces these technologies in itself, including in the agro-industrial sector.

Innovative activity of enterprises and organizations of the AIC of Russia is not the same and depends on the branch of the AIC. For example, the level of innovation activity of organizations in the Russian agriculture is low compared to, for example, the food industry – 4% and 12.1%, respectively. And, of course, it lags behind the level of innovation activity of enterprises in leading industries (Table 2). From table 2 it follows that the innovative activity of organizations in the field of agriculture is not at a high level.

The first reason for this lag is the lack of adaptation of agricultural sectors to innovative products and projects. It is explained by the long (seasonal) stage of implementation and obtaining a result from innovation in crop production, cattle breeding or fishing. At the same time, the peculiarities of farming or animal husbandry will lead to a result (positive or negative) only one year after the implementation of projects.

Table 2. Comparison of innovative activity of organizations in different sectors economy in dynamics [11].

Economic sector	Dynamics of the indicator by year in%		
	2016	2015	Deviations
Metallurgy	19,7	22,9	- 3,2
Production of chark and petroleum products	22,2	21,6	+ 0,6
Engineering	14,3	13,9	+ 0,4
Construction	1,5	2,0	- 0,5
AIC, including:			
Agriculture	4,0	no data	-
Food industry	12,1	11,9	+0,2

The second reason is the lower organic composition of capital in agriculture as compared with industry. The traditional use of a large number of workers with low wages and low mechanization of agricultural work, as noted in the “Capital” of K. Marx, leads to the use of traditional technologies and equipment for a long time. Based on our calculations (according to the State Statistics Committee of Russia), the difference in the organic composition of capital in agriculture and industry is more than 2.5 times.

The third reason for the innovation lag of agriculture from industry is the production of agricultural products, raw materials for industrial processing with low added value. Production of products for high value end added users is highly important.

3.2. Innovative system of the agro-industrial complex

It is necessary to dwell on the definitions of innovation activity and the construction of the innovation system of the agro-industrial complex at the regional level.

By innovation activity in the agro-industrial complex we understand the work on the creation, commercialization or implementation of innovative products and innovative projects in the areas of agricultural production and industrial processing. Accordingly, under the innovative product in the field of AIC is understood implemented new or improved:

- A material object, product;

- Agricultural or agro-industrial resource, process, information, organizational and managerial technology;
- Structural and managerial systems and relations in the field of agriculture;
- Organizational and corporate systems and relations used in the practice or economic turnover of the agro-industrial complex [3, 7, 9];
- Marketing innovations.

In statistics, innovation surveys are conducted in such areas as technological, organizational, marketing innovations, which corresponds to our more detailed classification.

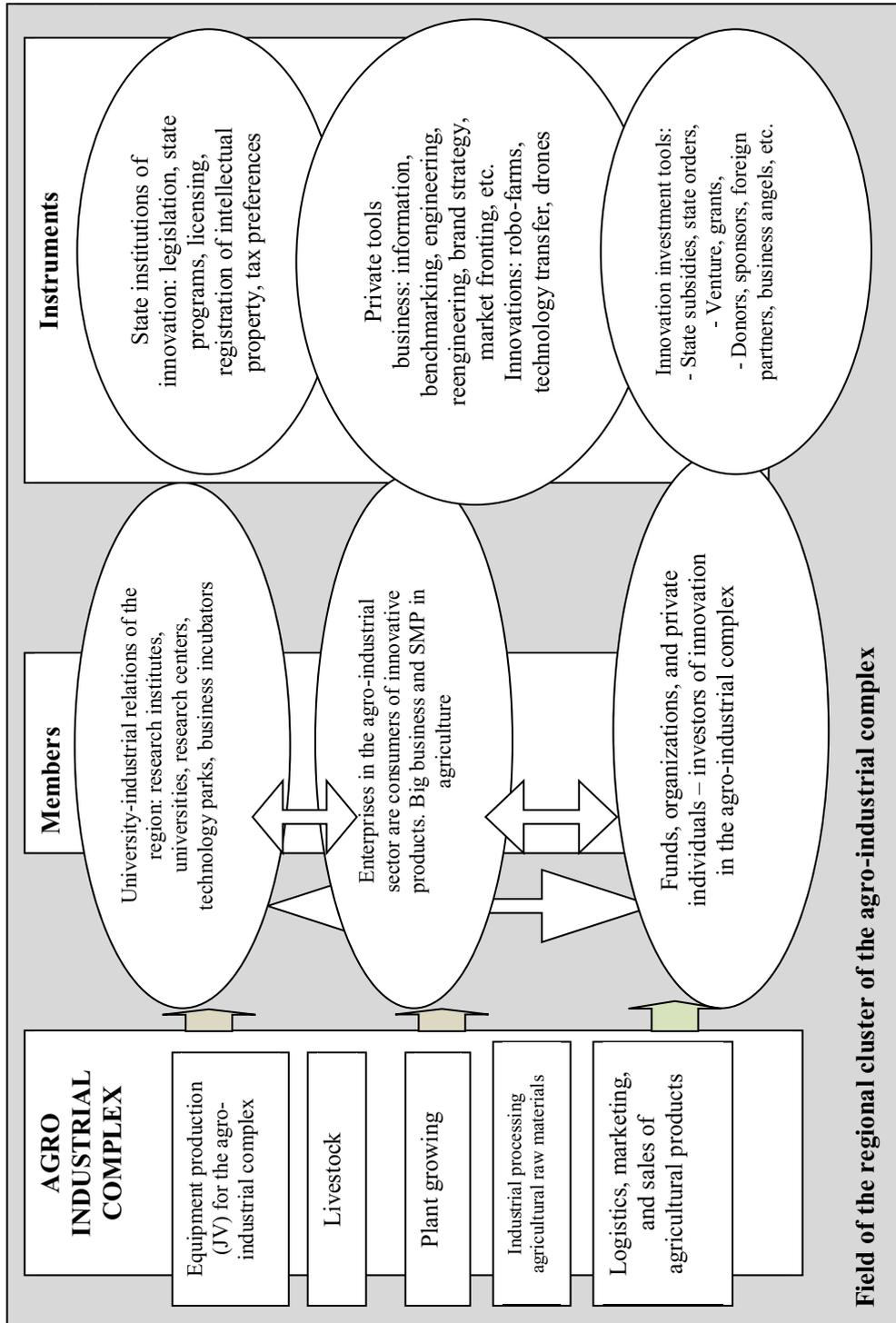
An innovative project in the field of the AIC is understood as a set of measures to create and launch an innovative product, that is, economic, scientific, technical, legal, organizational technologies that justify the need for an innovative product or innovation activity that governs its creation and are formulated in a complex of documents. Thus, the essence and economic content of an innovation project consists in integrating the idea of an innovative product, the procedure for its implementation and documenting its management in the field of agro-industrial systems [1, 9].

Based on the above definitions, we understand the innovative system of the agro-industrial complex as a set of industry elements and components which properties are integrity, hierarchy, and emergence, while it (the set) is designed to solve the problems of development, implementation, and activity of innovative products, technologies, techniques in segments agro-industrial complex, taking into account the risks and environmental factors.

We present an approximate model of the innovation system of the agro-industrial complex in Figure 1 This is the sphere of formation of an innovative product, the sphere of transfer of innovations to the market, the sphere of realization of an innovative product.

In Figure 1 we demonstrate the elements and components of the innovation system of the regional AIC (RIS AIC). Territorial management of the innovation system involves horizontal relationships in the region. Innovative products and projects are actively used in the field of agriculture. The risks of this system are associated with legal institutions, government policies, taxation, lack of resources, human factors.

A certain group of risks is associated with the prioritization of investment in innovation projects and with the contradictions between the created large enterprises-innovators in agricultural production and the existing small and medium-sized enterprises in this area. The contradiction lies in the fact that the introduction of innovations reduces production costs, hence the desire of large private companies to monopolize not only production, but also the corresponding market segment is understandable. We see the resolution of this contradiction in the development of state and regional institutions for segmentation of the food market with respect to each category of business. That is, at the regional level, it is necessary to leave a certain share of the production and sale of agricultural products, as well as food and light industry for small and medium-sized enterprises, while the regional and public control over the quality of products of all producers should remain.



Field of the regional cluster of the agro-industrial complex

Figure 1. Innovative AIC system (regional cluster approach).

The territorial features of the innovation system of the agro-industrial complex are connected with the horizontal management of this area. The Voronezh region ranks 15th out of 85, according to the value of the Russian regional innovation index (RRII is 0.4127 for 2015) [12].

Such a relatively high figure is due to the fact that university-industrial relations are actively developing in the region, which provide innovative activities of various clusters from furniture to dairy cluster and beef cattle cluster of the Voronezh region.

During the last decade, the Voronezh region sought to increase its investment attractiveness and enterprises of the dairy cluster appeared on its territory (Molvest JSC, EkoNivaAgro LLC, UK Don-Agro LLC, MAYAK Collective Farm, Buturlinovsky Agrocomplex LLC, NPU and K Concern “Detskoselsky”), and enterprises of the meat cluster (EcoProduct LLC, Chesmensky Horse Farm LLC, and Zarechnoye LLC). On the territory of the Voronezh region, there are also enterprises that make up logistic chains for grain producers: Verkhnekhavsky Elevator OJSC, Kalacheevsky Bread Factory, Borisoglebsky Elevator LLC, Zerno OJSC (Davydovskiy elevator), and others.

Clusters are characterized by the presence of research organizations and universities that develop scientific support for the activities of the agro-industrial sector. The universities and research institutes of the Voronezh region train qualified personnel in the field of agriculture.

In accordance with the regional agro-industrial policy, the application of innovative developments in the production and industrial processing of agricultural products may have a small time lag.

The sectoral and territorial principles of economic management, both in the region and in the national economy, have long roots. The synergistic effect of the effective relationship of sectoral and regional (territorial) management contributes to the economic growth of the national economy [3].

The sectoral aspect of the innovation activity of agricultural enterprises is associated with the vertical management of this process. It is based on the State Program for the Development of Agriculture and Regulation of Agricultural Products, Raw Materials and Food Markets for 2013-2020 [10]. During the implementation of this program, measures are being taken for the modernization and innovative development of the agro-industrial complex. Thus, the Government Decree No. 122-p of January 28, 2017 distributed subsidies in the amount of 10,654.7 million rubles to the budgets of 38 subjects of the Federation for co-financing expenditure commitments related to reimbursement of part of the direct costs incurred for the creation and modernization of the agro-industrial facilities, as well as the purchase of machinery and equipment.

In 2017, Resolution No. 996 of August 25, 2017 was also adopted. The purpose of the Program is to ensure a steady growth in the production of agricultural products obtained through the use of seeds of new domestic varieties and breeding products, technologies for the production of high-quality feed, feed additives for animals and medicines for veterinary use, pesticides and agrochemicals of biological origin, the processing and storage of agricultural products, raw materials and food, modern diagnostic tools, methods quality control of agricultural products, raw materials and food and the examination of genetic material [19].

That is, the sectoral aspect of managing the innovation system of the agro-industrial complex involves the use of methods of state regulation and state financing of agricultural modernization (Figure 2).

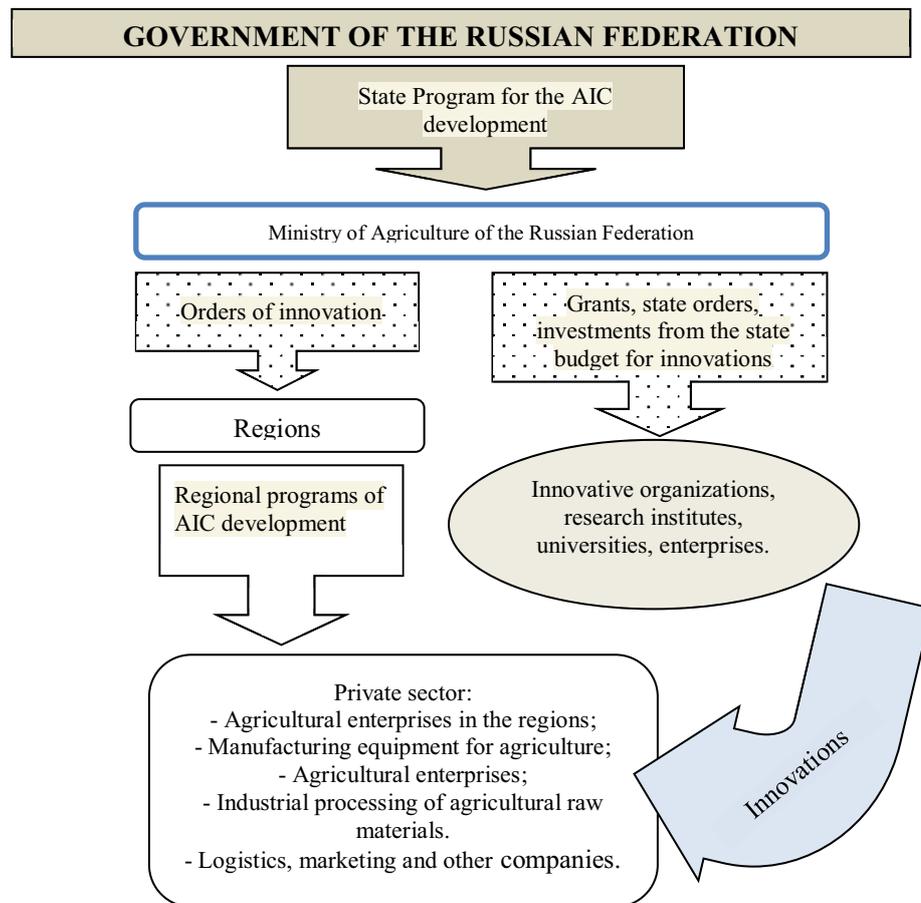


Figure 2. The model of sectoral innovation management in agriculture.

Figure 2 presents a diagram of sectoral innovation management in the agro-industrial complex. In this model, the management of innovative development of the agro-industrial complex goes not only through regional departments, but also uses a wide range of solutions to the problems of modernizing the agro-industrial complex with the provision of all types of financing and investment in this activity.

At the same time, coordination in the management of an innovative system of horizontal (cluster) and vertical interconnections eliminates errors that can occur when “manually” managing each system [20, 21].

4. Conclusions

As a result of the study, we applied investment activity categories to agricultural enterprises, proposed a model of a regional innovation system (RIS) based on university-industrial relations, and also presented the author’s vision of the industry innovation management model in Russia. When analyzing the state of innovation activity of agricultural enterprises, we identified the reasons for the innovation lag of agricultural enterprises from industrial enterprises. Based on the analysis of the development of innovation infrastructure in the regions of the Black Soil Region, it was concluded that the use of innovative products and projects does not always depend on the region’s participation in the production of innovations. Based on all of the above, we have substantiated the need to develop not only innovative cluster forms of the agro-industrial complex, but also the need to coordinate RIS and industry-specific forms of management of innovative agro-industrial complex.

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