

## MECHANISMS TO STIMULATE THE ACCELERATION OF INNOVATIVE DEVELOPMENT IN THE AGROINDUSTRIAL COMPLEX

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### Abstract

*Innovative development in the agricultural sector of the economy is a driver for increasing the efficiency of agricultural production. The purpose of the article is to develop mechanisms to stimulate the acceleration of innovative projects in the agro-industrial complex. The study clarified the theoretical and methodological aspects of the process of accelerating technological development. The restraining and accelerating factors of innovation processes in the agro-industrial complex are systematized. The analysis revealed disparities in the efficiency of investments in the agro-industrial complex and their contribution to the main macroeconomic indicators and export orientation. Mechanisms for stimulating technological acceleration have been developed: the introduction of an innovative lift for startups, the creation of technology platforms, and the improvement of regulatory and financial support. The practical significance of the presented mechanisms will stimulate the acceleration of innovative projects and increase the economic, social, technological and budgetary efficiency of agro-industrial complex management in industries and regions.*

**Key words:** technological acceleration, innovative projects, agro-industrial complex, efficiency, incentive mechanisms, forecasting

### INTRODUCTION

Increasing the competitiveness of the agro-industrial complex in the context of the transition to an export-oriented agrarian economy can be achieved through the development of an innovative agrosystem that provides the processes of generation, diffusion and acceleration of innovations and science-intensive products into production processes. The formation of balanced innovation and investment agricultural systems is a driver of sustainable socio-economic growth of the national economy. The problems of insufficient coordination of research institutes with sectors of the economy hinder the scientific and technological development of Russia [14,42,46]. The insufficient degree of congruence of interests of the stakeholders of the innovation process of science, the state, agribusiness, and society, the imbalance in the distribution of resources, knowledge,

information, competencies, and technologies at all stages of the innovation process hinders the formation of balanced innovative agricultural systems.

The intensity and quality of congruence of stakeholders in innovation processes between large and medium-sized companies, small firms, research and educational centers, information and consulting services, universities, government bodies, non-profit structures is becoming increasingly important in the design of innovative agroecosystems. The evolution of national innovation systems NIS contributes to the increase of the main macroeconomic indicators of the development of society [13]. The efficiency of innovation processes is associated with both the circulation of intellectual capital in the production process and the quality of coordination between stakeholders in the process of emerging new ideas, generating and disseminating knowledge, and

implementing scientific and technological opportunities [3, 4, 10, 52].

In recent years, in foreign economic thought, one of the popular concepts that integrate science, education, and innovation into a single whole to develop and substantiate national innovation policy is the "knowledge triangle", which, by the way, is also reflected in the documents of the Bologna Process, the mechanism of functioning of which is shown in the works, for example, by M. Unger and V. Polt [48]. The authors demonstrated that the "knowledge triangle" unites other concepts that partially complement each other, such as the "third mission", where the need to modernize higher education as an initial element of human capital reproduction comes to the fore, "triple helix" (triple helix), where institutions such as the University, Business, Power strive for cooperation and, if necessary, partially take over each other's functions, which ultimately forms an innovative component of their interaction, an "entrepreneurial" university, which presupposes the entrepreneurial behavior of a higher educational institution, which in symbiosis with business should lead to the economic development of the region, as well as the "smart specialization" of the regions, developed by the expert group "Knowledge for Growth" of the Directorate for Technology and Innovation of the European Commission, interactions taking into account the existing unique competencies of each region within the framework of a single innovation cluster.

The model of "open innovation" is also aimed at developing cooperative ties between enterprises, universities, and state scientific organizations, which involves the search for the latest approaches to managing the transfer of knowledge and technology from universities and state scientific organizations to industry, where an important role is played by the commercialization of scientific research. M. Cervantes and D. Meissner [6] note the special value of the unique structure of innovation systems in the process of creating and commercializing new products, services and technological processes. Basically, we are talking about optimizing the structure and activities of technology transfer

centers, including the formation of appropriate alliances.

Due to the openness of modern economic systems, the model of knowledge flow in clusters is gaining popularity recently, where knowledge becomes the main component of the production process and the main factor of competitive advantage, a feature of which is its resistance to copying and the possibility of self-generation [22].

The formation of new knowledge and its free flow within the cluster is one of the fundamental factors that are necessary for the transition of a cluster to an innovative development model. For the effective organization of innovation management in agriculture, it is important to develop directions for its balanced development, taking into account strategic approaches at the federal and regional levels [40, 50]. This can be achieved using the concept of national and regional agro-innovation systems (AIS). From a scientific point of view, the AIS concept is in a state of renewal and development, in the literature, there are discrepancies in the interpretation of the term, approaches to the analysis of the phenomenon [18, 27, 41, 35]. Relations between AIS subjects undergo a process of reorganization in the process of its formation, reaching a certain necessary balance (Leeuwis C., 2004), (Röling N., 2009), (Klerkx, L. et al, 2010) [23, 24, 37]. As a result of this process, several actors can be squeezed out of the system of emerging relations [5, 47, 49]. The principles of analysis and action of AIS integrate more traditional activities (support for research, dissemination, and education, creating links between research, extension services, and farmers) with other complementary activities that include the provision of skills, incentives, and resources for developing partnerships and business. , improving knowledge flows; creating conditions that allow actors to innovate.

According to Chris Steyaert, different startup models need to be considered to form effective relationships between company participants [43]. The experience of developing knowledge-intensive startups in Ankara (Turkey) has shown that stakeholder

relations begin to take shape already in the process of creating a company. The development of mutually beneficial relationships between the stakeholders of the startup helps to successfully achieve the company's development goals [21, 39].

A low degree of integration interaction hinders the effective functioning of innovative agricultural systems and predetermines the need to justify special support measures within the framework of the state's innovation policy.

In modern conditions, such a form of the business institute as science-based startups has developed, the creation of which makes special requirements for the organization of the innovation process, based on a combination of research, engineering, and business skills [7]. Along with the development of a new product, an entrepreneur must create a sustainable enterprise and promote its transformation into a major technological accelerator.

The study aims to develop the fundamental foundations, methodology, and assessment and forecasting tools for the formation of innovative and investment agricultural systems and mechanisms to stimulate the acceleration of innovative development of the agro-industrial complex.

## MATERIALS AND METHODS

The methodological basis of the study was the state legislative acts, decrees and decisions of the government, scientific works of domestic and foreign scientists - economists and agricultural specialists on the problem under study. In the course of the research, monographic, abstract-logical, analytical, economic-statistical, expert research methods were used. As an information base for the study, we used regulatory and legislative acts, information from Rosstat, the Higher School of Economics, the Ministry of Agriculture of the Russian Federation, the Deloitte Research Center, as well as regulatory documents and materials from scientific literature and periodicals.

The methodology for the formation of balanced innovative agroecosystems is based

on the synthesis of theories that determine the content, essence, specifics of the interaction of structural elements, and the dynamics of the development of ongoing processes. The theories that determine the content and essence of creating sustainable agrosystems include the theory of institutional development, the theory of NIS, and the concept of open innovation. The structure and structure, the specificity of the interaction of the elements of the innovative agrosystem is determined based on the theory of the triple helix and the actor-network theory. The study of the dynamics of the development of the course of innovation processes is determined by the specifics of the absorption capacity of knowledge absorption, marketing mechanisms to stimulate the demand for innovation, the functional characteristics of the actors of the innovation process - institutions of science, the state, agribusiness, taking into account the needs of society in the context of digital transformation [12]. The paper substantiates the synergy of interaction between the state, universities, academic institutions, agribusiness, taking into account the needs for innovation in the context of industries and regions.

The methodology for the formation of innovative agrosystems takes into account the transformation of the value-functional structure of the stakeholders of the innovation process into balanced innovative agrosystems and the presentation of the innovative agrosystem as a new stage in the evolutionary transformation of the agro-industrial complex, the application of the NIS theory and consideration of the author's innovative agrosystem as part of the NIS, taking into account the specifics of institutional interaction, according to North's theory, as a set of principles, norms, and rules for a balanced interaction of knowledge, information, competencies, technologies to form sustainable innovative agricultural systems [9, 11, 51]. The author's innovative agroecosystem in the context of the dynamics of the development of the processes taking place in it is presented as a flexible, open, multifunctional dynamic network structure of a full cycle, aimed at researching the need,

creating, introducing, distributing, commercializing and applying various types of innovations by the socio-economic needs of industries and regions.

There are different approaches and methods for assessing the level of innovative activity that are used abroad. There are several methods among them: European Innovation Scoreboard, Technology Achievement Index, Innovation Capacity Index, World Innovation Index Boston Consulting Group (GII BCG), World Innovative Index INSEAD (GII INSEAD), Global Innovation Factor Global Innovation Quotient). The works of various foreign and domestic researchers are devoted to the development of methodological approaches to assessing the level of innovative development and the effectiveness of innovation and investment agricultural systems both in the economy as a whole and in agriculture [30-34]. Studied the issues of analyzing and diagnosing the effectiveness of the course of innovative development processes, taking into account the synergistic interaction of the stakeholders of this process

- the state, science, agribusiness, society, and implementation formations on an information basis.

## RESULTS AND DISCUSSIONS

The paper analyzes and evaluates innovation processes in the agro-industrial complex of Russia in the context of the main stakeholders of the innovative agricultural system, studies the dynamics of innovation and investment activity, export potential.

In the ranking of countries by the level of innovative development. The Russian Federation occupies 47th place [16, 2], and the leading positions belong to Switzerland, Sweden, the USA, Denmark, Germany, the Netherlands, China, etc. In Fig.1. the level of government spending on research and development is presented, in% of GDP in 2017. Leading values for this indicator are also typical for Denmark, Portugal, and Germany, which justifies the high level of their innovative activity [17].

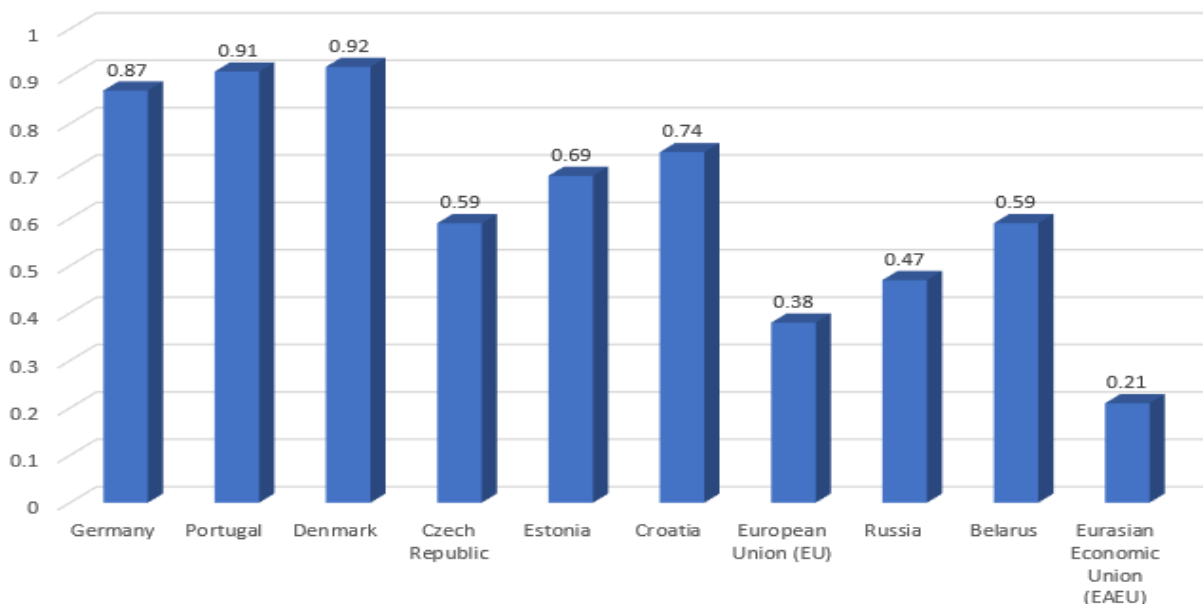


Fig. 1. Government spending on research and development, % of GDP in 2017  
 Source: Own calculations based on the Global Innovation Index [16].

Russia, undoubtedly, has a high agricultural potential, but it is still realizing it with an insufficient degree of efficiency, which fluctuates at the level of 15-17%. In foreign countries, this indicator is at the level of 55-

60%. The share of agriculture in Russia's GDP is extremely low, which indicates an insufficiently effective use of the existing potential, despite the presence of significant climatic, scientific and intellectual resources.

Table 1 shows the indicators of the goals of the fundamental instrument of state support «State Program for the Development of Agriculture for 2013-2020».

Table 1. Indicators of the goals of the State Program for the Development of Agriculture and Regulation of Agricultural Products Markets in Russia in 2013-2018

Indicator	Year					
	2013	2014	2015	2016	2017	2018
Share of agriculture in GDP,%	3.5	3.8	4.2	4.4	4.2	3.5
Index of agricultural production in farms of all categories (in comparable prices) by 2015	-	-	100	104.8	107.8	107.2
Crop production index in farms of all categories (in comparable prices) by 2015, %	-	-	100	107.8	111.42	108.72
Livestock production index in farms of all categories (in comparable prices) by 2015, %	-	-	100	101.6	104.2	105.6
Physical volume index investment in main agricultural capital by 2015,%	-	-	100	112.2	116.5	121.5
Performance Index labor to the previous year, %	106.2	103.3	104.29	102.69	105.3	101
Produced gross value added created in agriculture, billion rubles	2,193.4	2,656.3	3,214.8	3,312.2	3,270.3	3,268.8
Number of high-performance jobs, thousand jobs	298.4	325.2	284.6	305	365.8	314.6

Source: Data National report [25].

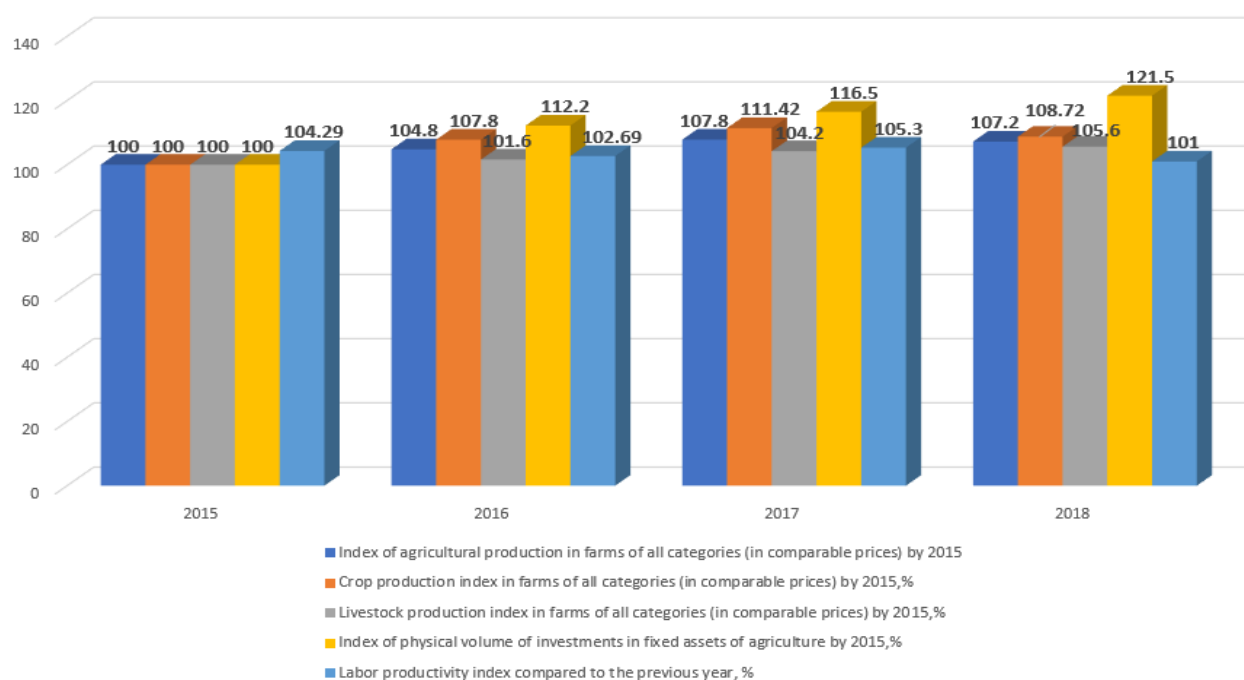


Fig. 2. Dynamics of achievement of indicators of the goals of the State program for the development of agriculture and regulation of agricultural markets in Russia in 2013-2018

Source: Own calculations based on the data National report [25].

The agricultural production index in 2018 amounted to 107.2% compared to 2015, which exceeds the target of the State Program by 0.5 percentage points. The index of production of livestock products in 2018 compared to 2015 increased by 0.2 percentage points. The opposite picture is observed in the crop production industry, it is characterized

by a decrease in this indicator by 2 percentage points about 2015, associated with record volumes of crop production in 2017. The labor productivity index decreased by 3% in 2017, which is associated with fluctuations in the macroeconomic situation and difficult natural and climatic conditions on the territory of Russia (Fig. 2).

Table 2. Indicators characterizing innovation, investment, export activity and the process of modernization and rationalization by type of activity: agriculture, hunting and the provision of related services in these areas in Russia in 2012-2018

<b>Indicator</b>	2012	2013	2014	2015	2016	2017	2018
The amount of state support funds within the framework of the State Program for the Development of Agriculture and Regulation of the Markets of Agricultural Products, Raw Materials and Food, RUB million	-	260,960	262,122	254,982	295,928	257,529	254,141
Investments in fixed assets aimed at the development of agriculture, RUB billion	-	516	510	505	511	434	-
Fixed capital investments aimed at environmental protection and rational use of natural resources - land, RUB billion	19.7	13.8	14.5	15.7	12.2	10.2	10,0
The share of investments aimed at reconstruction and modernization in the total volume of investments in fixed assets (agriculture, hunting and the provision of related services in these areas),%	11.9	8.7	8.4	8.6	8.9	10.3	9.2
Share of investments in machinery, equipment, vehicles in the total volume of investments in fixed assets aimed at reconstruction and modernization, %	25.0	15.9	13.5	13.6	15.7	12.9	20.3
The share of exports of innovative goods, works, services in the total sales of goods, works, service	2.6	2.9	2.6	2.1	1.9	1.7	1.6
The share of innovative goods, works, services in the total volume of sales, goods, works, services in the domestic market	6.7	7.7	7.3	7.7	8.4	6.6	5.8
The share of innovative goods, works, services in the total volume of exports of goods, works, services	12.1	13.7	11.5	8.9	8.4	7.1	6.6

Source: Rosstat data and National report [15, 25].

Figure 3 shows the growth of investments in machinery and equipment, vehicles in 2018 compared to 2017, however, there is a decrease in this indicator compared to 2012. The level of investments in reconstruction and modernization is also characterized by a downward trend, which significantly affects the rate of increase in innovative activity.

Despite the increase in the share of innovative goods in the total volume of shipped products in agriculture, it remains at a low level, in crop production, 4.2% of organizations are innovatively active, in animal husbandry - 3.9% compared to 2 times exceeding the average values in the economy.

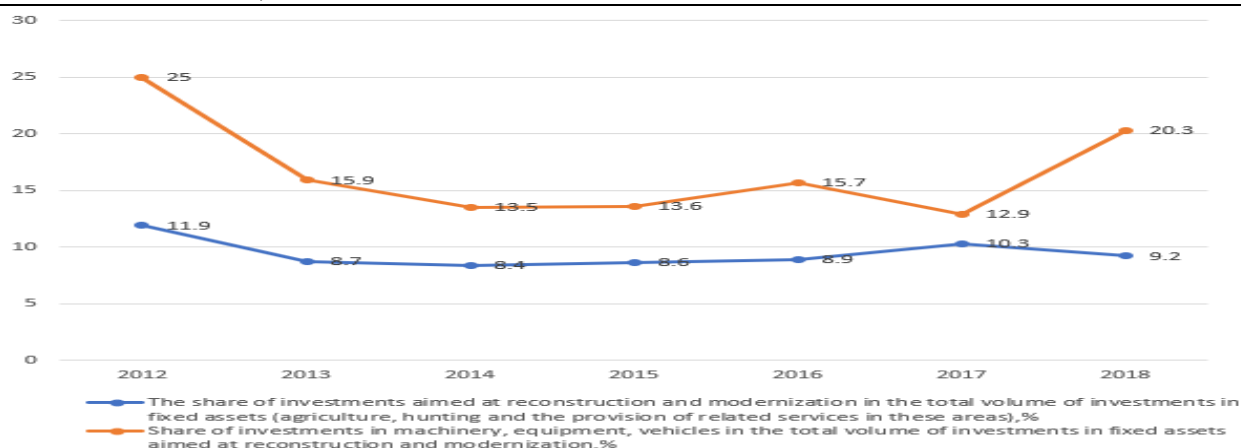


Fig. 3 Dynamics of indicators of innovation and investment activity of the agro-industrial complex, %  
 Source: Own calculations based on the data National report [25].

According to the Deloitte Research Center, the value of the weighted rating of the diffusion of innovations and science-intensive products in the agro-industrial complex at the end of 2018 is only 0.13 [1]. A higher degree of influence of the results of innovations on ensuring compliance with modern technical regulations, rules, and standards in 2019 was traced by the types of activities: "Growing of annual crops" (10) and "Breeding of poultry" (9); in agriculture as a whole – 33 [44]. An extremely low level of innovation activity

is characteristic of such priority areas as precision farming technologies, used by about 5-10% of producers. On the other hand, in the EC this value reaches about 80%, in the USA – 60%, IT technologies about 0.05%. According to V.F. Fedorenko, out of the total number of completed, accepted, paid for by the Ministry of Agriculture of Russia and recommended for the introduction of applied innovations and scientific and technical developments, only 2–3% are being introduced [15].

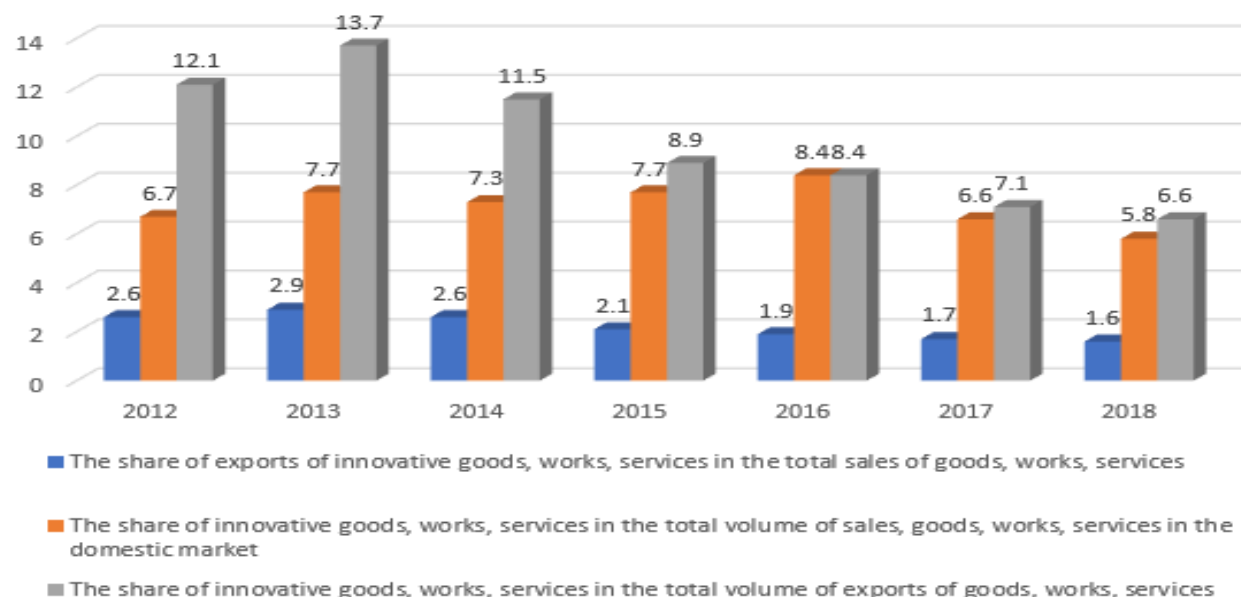


Fig. 4. Indicators of export activity of the agro-industrial complex in 2012-2018  
 Source: Own calculations based on the data [19].

About 40-50% of innovations and advanced scientific and technological achievements and developments remain unclaimed in the industry annually [8]. The current agrarian

policy does not provide for the social development of agriculture and sustainable growth using innovative factors [26].

In modern conditions of the coronavirus pandemic and sanctions policy, it is especially important to increase the export potential and the formation of an export-oriented agricultural economy. The dynamics of export activity indicators are shown in Fig.4.

Figures 5 and 6 shows the indicators of financial support for the implementation of the priority project "Export of agricultural products" within the framework of the State Program for the Development of Agriculture and Regulation of Agricultural Products Markets [19].

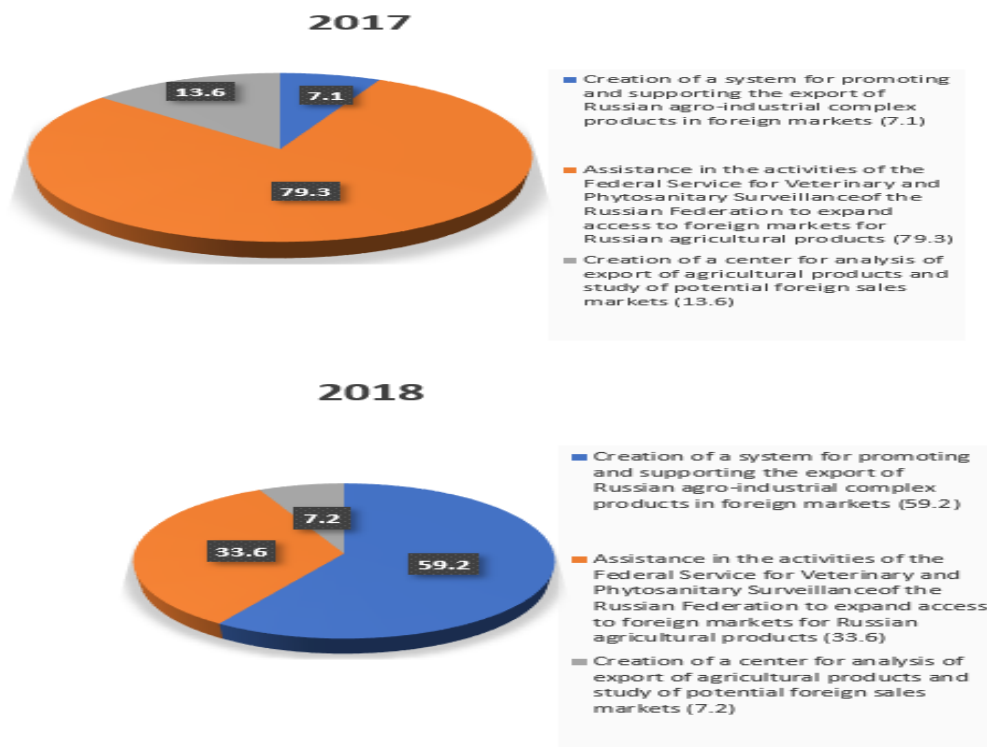


Fig.5. The structure of federal budget expenditures for the implementation of the priority project «Export of agricultural products" in 2017-2018», %

Source: Own calculations based on the data [25].

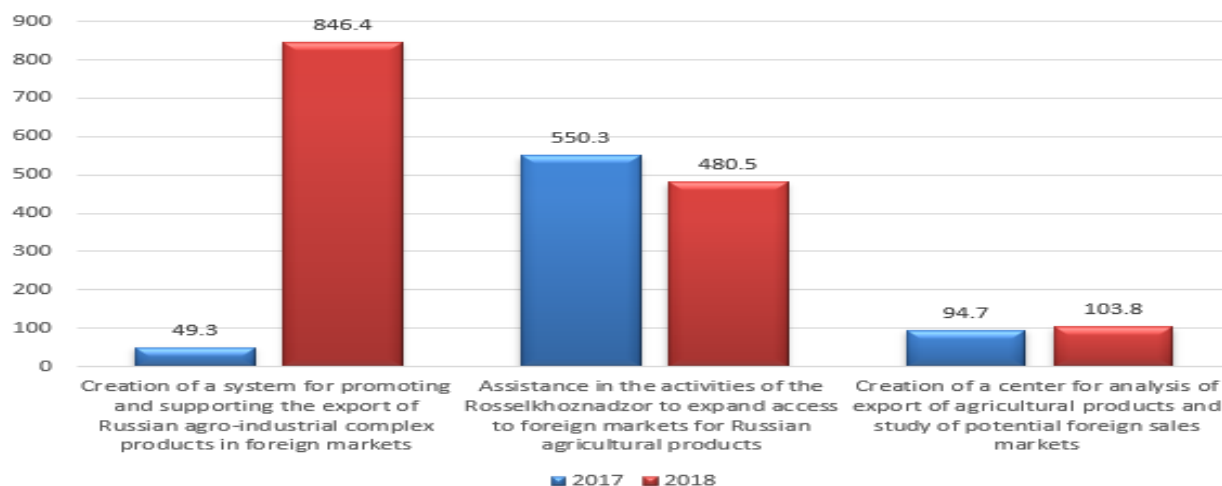


Fig. 6. Structure of federal budget expenditures for the implementation of the priority project "Export of agricultural products" in 2017-2018, million rubles

Source: Own calculations based on the data [25].



The development of an export-oriented agricultural sector of the economy based on the formation of balanced innovative agricultural systems presupposes the coordination of the efforts of stakeholders in the innovative processes of production and consumption of agricultural products; increasing sales markets, improving the quality of manufactured products, and reducing costs, building up the professional

competencies of the main stakeholders, creating the necessary conditions for the self-development of innovative agricultural systems [25]. The study formulates methodological principles for the formation of innovative agricultural systems to develop organizational, economic, and financial mechanisms for the acceleration of innovative development (Fig. 7).

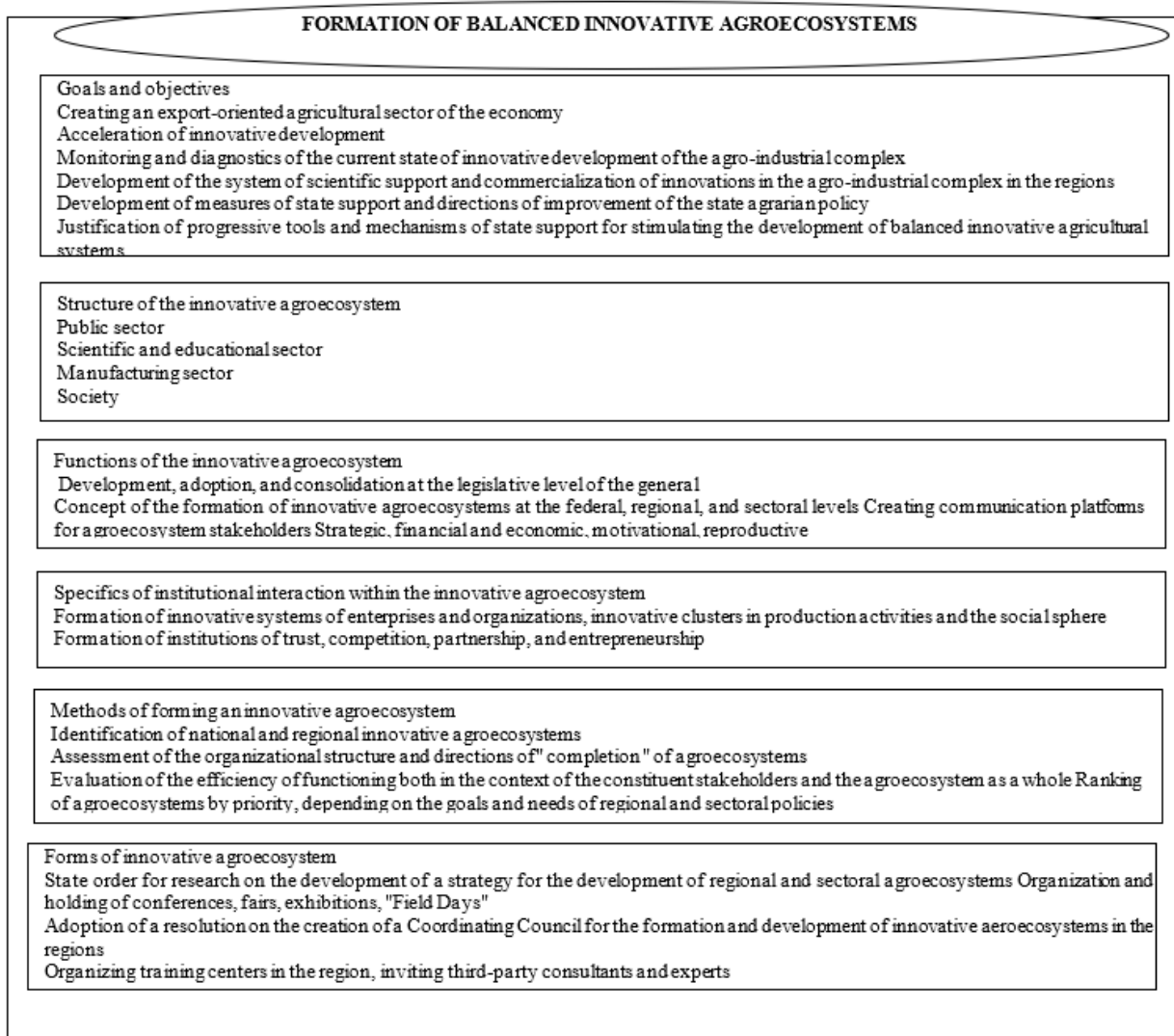


Fig. 7. Methodology for the formation of balanced agroecosystems in order to accelerate innovation and technological development.

Source: Own calculations.

(1) The principle of priority development of the regional infrastructure of the agro-industrial complex indicates the need for priority investment and supply of resources to those sub-sectors and enterprises that form the infrastructure of the agricultural system in the region;

(2) The principle of forming a balanced agricultural policy based on the flow of knowledge, competencies, technologies of the main stakeholders;

(3) The principle of direct and equal partnership within the agrosystem presupposes the creation of conditions for the

implementation of institutional functions, tasks, and mechanisms for accelerating the acceleration of innovative development of the agro-industrial complex.

(4)The principle of export-oriented orientation presupposes a policy aimed at integration into the world market;

(5)The principle of the synthesis of public and private sources of financing and stimulation of the formation of balanced agricultural systems involves the simultaneous use of mechanisms for creating agricultural systems and the formation of state coordinating bodies, making public investments and allocating resources to support and develop agricultural systems.

To develop effective organizational, economic, and financial mechanisms to stimulate the acceleration of innovative and technological development, it is necessary to

study in more detail the essence and specifics of the formation of innovative agroecosystems. The figure 8 shows methodological approaches to the formation of balanced agroecosystems to accelerate innovative and technological development.

State support for the development of the agro-industrial complex in Russia is currently carried out within the framework of five key programs and projects: "The State Program for the Development of Agriculture for 2013-2020." [42]; State program "Comprehensive development of rural areas" [36] "Federal scientific and technical program for the development of agriculture for 2017-2025." [14]; National project (program) "International cooperation and export" [29]; National project "Small and Medium Business and Support for Individual Entrepreneurial Initiatives" [45].

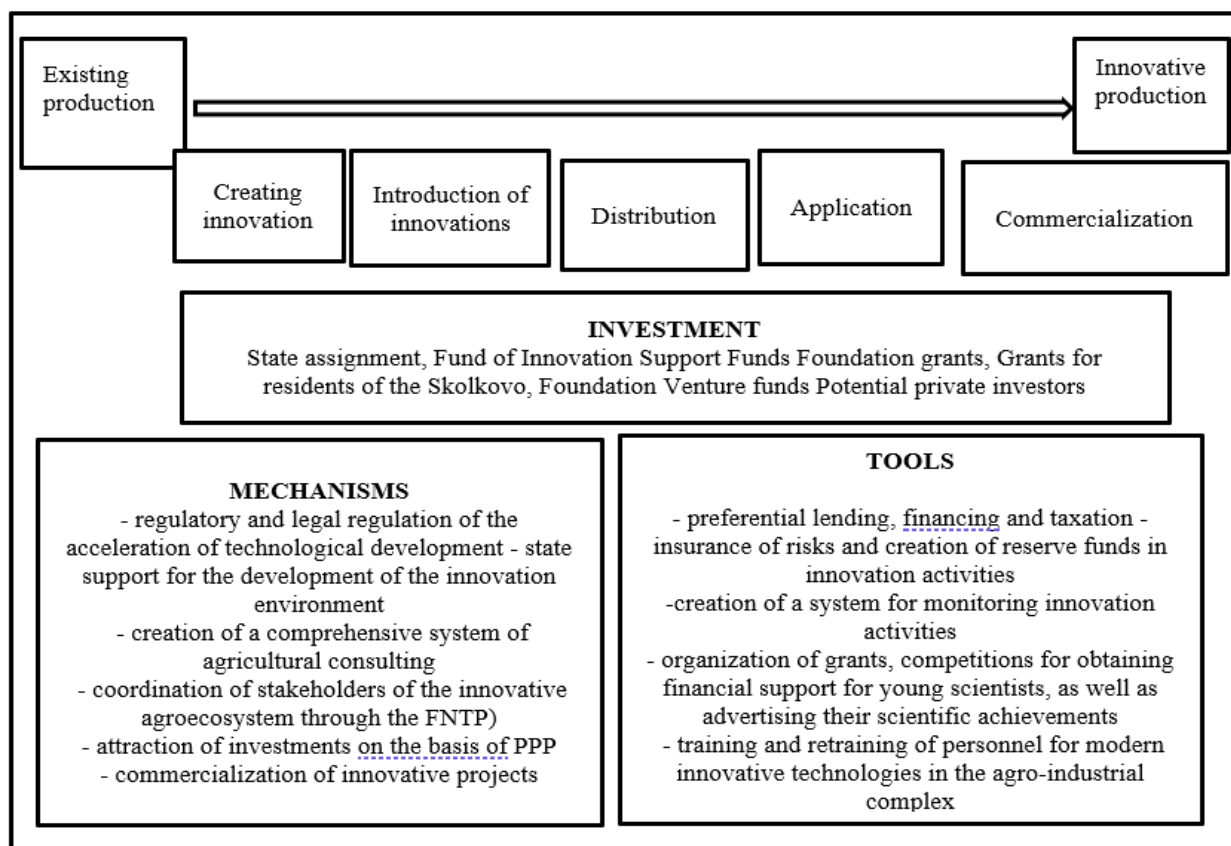


Fig. 8. Mechanisms and tools for stimulating and supporting the acceleration of technological development of the agro-industrial complex

Source: Own calculations.

Each state program and project has corresponding budgetary funding, which may be revised in connection with the COVID-19 pandemic [28, 38]. State support for the acceleration of innovative and technological development is carried out in direct, indirect, and mediated forms. The direct form of support is the "State Program for the Development of Agriculture for 2013-2020", "The Federal Scientific and Technical Program for the Development of Agriculture for 2017-2025. When implementing support in this form, producers, and consumers of scientific products are forced to be guided in their economic activities by the norms and rules established at the legislative level. With indirect support from the state, prerequisites are created for independent decision-making by both manufacturers and consumers of scientific products. An example is the creation of selection and breeding centers within the framework of the national project "Science". An indirect form of support is not directly related to both producers and consumers of scientific products but has an indirect impact on their development. An example is the Integrated Rural Development Program.

Support at the early stages of the innovation process is carried out through general instruments: grants from the RFBR (Russian Foundation for Basic Research) and Russian Science Foundation (Russian Science Foundation), a state assignment of the Russian Academy of Sciences. For developers of innovative solutions (starting from the pilot stage): grants for residents of the Skolkovo Foundation, as well as for venture capital opportunities through the Skolkovo Venture Fund - Agrotechnical I, created in 2018. Investments in start-ups in the agro-industrial complex are also carried out by private venture funds [20]. In this case, the attention of the state should be focused on the formation of a favorable investment climate, modernization of science and agricultural education. Some proposals to improve the efficiency of state support in the scientific and technological sphere of the agricultural sector of the economy. The article proposes the creation of the Fund of Funds for the Support of Agro-Innovation as a key element of the

investment mechanism for financing and distributing funds on the principles of co-financing from the state and large agribusiness. Moreover, co-investors, along with the powers of the Fund, can participate in the investment committee and make the most active decisions.

## CONCLUSIONS

The article develops theoretical and methodological foundations for the formation of balanced innovation and investment agricultural systems and practical mechanisms for accelerating the technological development of the agro-industrial complex. The methodology for the formation of balanced innovative agroecosystems is based on the synthesis of theories that determine the content, essence, specifics of the interaction of structural elements and the dynamics of the development of ongoing processes. The study of the dynamics of the development of the course of innovation processes is determined by the specifics of the absorption capacity of knowledge absorption, marketing mechanisms to stimulate the demand for innovation, the functional characteristics of the actors of the innovation process - institutions of science, the state, agribusiness, taking into account the needs of society in the context of digital transformation. The paper substantiates the synergy of interaction between the state, universities, academic institutions, agribusiness, taking into account the needs for innovation in the context of industries and regions. The author's innovative agroecosystem in the context of the dynamics of the development of the processes taking place in it is presented as a flexible, open, multifunctional dynamic network structure of a full cycle, aimed at researching the need, creating, introducing, distributing, commercializing and applying various types of innovations in accordance with the socio-economic needs of industries and regions. The paper analyzes and evaluates indicators characterizing innovation and investment, export activity and the process of modernization and rationalization in the Russian agro-industrial complex in 2012-

2018, reveals disparities in the level of investment and efficiency of agricultural production. The article develops the principles of the formation of innovative agricultural systems and methodological approaches to their formation and development in order to develop organizational, economic and financial mechanisms for the acceleration of innovative processes. Organizational, economic and financial mechanisms and instruments of state support for the acceleration of innovative and technological development have been developed. For the further development of the agro-industrial complex, it is necessary to form a system of financial institutions for uninterrupted continuous financing of agribusiness at all phases of the innovation cycle. These investment institutions include government assignments, grants from funds, grants for residents of the Skolkovo Foundation, venture funds, funds to support small innovative businesses, public-private partnerships, and impact investment.

Stimulating the acceleration of the technological development of the agro-industrial complex requires the implementation of an active state innovation policy, which should be aimed at creating conditions for the effective development of innovative activities and the further formation of development institutions (technology parks, venture funds, business incubators, etc.), consolidating the Concept at the legislative level. the formation of regional and sectoral innovative agroecosystems in order to increase the export potential of the domestic agro-industrial complex and the formation of a model of an export-oriented agricultural economy.

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