

CONDITIONS FOR THE DEVELOPMENT OF THE INSTITUTIONAL STRUCTURE OF THE SCIENTIFIC AND INTELLECTUAL POTENTIAL OF THE AGRICULTURAL FOOD COMPLEX

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Abstract

The scientific and intellectual potential of the agri-food complex is the most important determinant of the process of innovative development of the agri-food complex of the national economy. The aim of the study is to improve the theoretical and methodological provisions for the formation of the institutional structure of the scientific and intellectual potential of the agri-food complex at the federal and regional levels and practical recommendations for its development based on the development of mechanisms for increasing the effectiveness of interaction of its stakeholders. The author's paradigm for the development of the institutional structure of the scientific and intellectual potential of the agri-food complex is described by the concept of the national innovative agrosystem (NIS), and the interaction between its stakeholders is described by the triple helix model. The theory of the triple helix has been developed by including, along with science, agribusiness and the state, such institutional elements as society and the institution of information support; specific features of the formation of an innovation system in the agricultural sector of the economy have been identified. Based on the results of the analysis, disparities in the structure of scientific and intellectual potential and indicators of the effectiveness of its functioning were revealed. The systemic-functional approach to the development of scientific and intellectual potential by linking the identified systemic problems with specific functions of innovative development, taking into account the characteristics of the agri-food complex, has been substantiated. The practical implementation of the proposed approach consists in the possibility of forming strategies for the innovative development of agriculture at the sectoral and regional levels based on the synergistic effect of the complex interaction of the stakeholders of the innovation process based on improving the organizational, economic and legal conditions.

Key words: *scientific and intellectual potential, agri-food complex, institutional structure, interaction of stakeholders, system-functional approach, strategies for innovative development*

INTRODUCTION

Improving the efficiency of agricultural production, ensuring sustainable balanced development of rural areas in the context of the transition to an export-oriented agrarian economy can be achieved only through the large-scale introduction of innovative technologies and high-tech products into production processes. According to the Strategy of Scientific and Technological Development of the Russian Federation, approved by Decree of the President of the Russian Federation of December 1, 2016 N 642, the problems of insufficient coordination of research institutes with sectors of the economy hinder the scientific and technological development of Russia.

Accelerating the diffusion of agro-innovations into production and increasing the efficiency of innovative processes is inextricably linked with the improvement of the institutional structure of the scientific and intellectual potential of the agri-food complex, aimed at increasing the effectiveness of interaction between science and production.

The theoretical basis of the study is a set of theories describing both the process of formation of the institutional structure of the scientific and intellectual potential of innovative agricultural systems and the process of interaction of their constituent stakeholders. The formation of innovative agricultural systems is described by the NIS concept, as well as by systems theory. The interaction between the stakeholders of the

scientific and intellectual potential of innovative agricultural systems is described from the perspective of the theory of the triple helix and its development. Formation of the institutional structure of innovative agrosystems is based on effective interaction between the stakeholders of agrosystems, which is regulated by institutions like norms and rules, customs, ensuring the innovative receptivity of agribusiness [35].

Let us consider the synthesis of these theories about agriculture to form the author's paradigm for creating the institutional structure of the scientific and intellectual potential of the innovative agrosystem. The modern concept of innovation systems is based on the classic works of economic theory [32].

Currently, there are different points of view on the innovative development of territories: the concept of national innovation systems by K. Freeman, J. Clark and L. Soete [11, 20, 21], mechanism and tools for spatial replication of innovations A. Preda, H. Perloff, B. Berry, J. Friedman, G. Richardson [15, 23, 30]. the "diffusion of innovation" model by T. Hägerstrand [16], the concept of technological orders S. Glazieva, V.E. Dementieva [12, 10].

Russian scientists VV Ivanov made a significant contribution to the development of the concepts of innovation systems at the regional level [18, 13, 8].

The internal mechanism of functioning of innovation systems is based on the Triple Helix model, which is the concept of interaction between government, business, and universities. The model was developed in the mid-1990s. famous scientists G. Itskovits and L. Leidesdorff in the form of integration of institutional ideas of economists, sociologists, and biologists [14, 17].

According to N. Smorodinskaya, the concept of the "triple helix" is based on the evolutionary theory. She describes the transformation and structural shifts of economic systems based on the development of technology. In the process of these transformations, the forms of combining science, business and the state have changed. The independent activity of these agents

(actors) did not give an effective result at the next stage of technology development [3, 33]. The high relevance of the formation of the institutional structure for the socio-economic development of society is studied in the works of D. North, V.M. Polterovich, J. Hodgson, GB Kleiner [19, 24].

Currently, the following interpretation of Douglas North's institutions is most widespread: "Institutions are rules, mechanisms ensuring their implementation, and norms of behavior that structure repetitive interactions between people" [22, 4].

National innovation systems of different countries have their own specific goals and objectives.

One of the main reasons for the emergence of institutional "traps" of food systems and agrosystems with a complex organization is the divergence of interests of the main stakeholders of innovation systems, a combination of different models of their economic behavior based on these interests [7].

MATERIALS AND METHODS

The study aims to improve the theoretical and methodological provisions for the formation of the institutional structure of the scientific and intellectual potential of the agri-food complex at the federal and regional levels and practical recommendations for its development based on the development of mechanisms for increasing the effectiveness of interaction of its stakeholders.

The object of the research is the institutional structure of the scientific and intellectual potential of the agri-food complex, represented by a set of stakeholders - science, agribusiness, state, society, and informatization, the interaction of which is aimed at increasing the efficiency of agricultural production and increasing its innovative activity.

The subject of the research is complex organizational, economic, and managerial relations that ensure an increase in the efficiency of interaction between stakeholders of scientific and intellectual potential in the process of forming its institutional structure.

The main research methods were abstract-logical, graphic, statistical, comparative, and expert methods.

The development of theoretical provisions for the innovative development of the agrarian sector of the economy, models, and approaches to the interaction of stakeholders of innovative systems, made it possible to represent the scientific and intellectual potential of the agri-food complex as a set of institutional elements, such as science, business, government, society, informatization, the effectiveness of interaction of which contributes to the formation of the stakeholder receptivity.

The author's paradigm for creating the institutional structure of the scientific and intellectual potential of the agri-food complex is based on the development and adaptation of the synthesis of theoretical and methodological provisions for the formation of the institutional structure of the innovative agrosystem. Building an institutional structure based on the NIS concept presupposes the formation of new approaches to explaining the processes of the emergence and diffusion of innovations about the agricultural sector of the economy. At the same time, properties and new trends are analyzed, which are reflected in the interaction of stakeholders of the system-state, science, and business.

When forming the institutional structure of the scientific and intellectual potential of the innovative agrosystem, it is necessary to take into account the general formal norms and rules that determine the behavior and interaction of its stakeholders. Its formation is also influenced by informal institutions - beliefs, culture, customs, practices, norms of behavior, and attitudes. Informal institutions are characterized by specific features at the national, regional, and sectoral levels. Innovation-oriented institutions support entrepreneurship, shape the attitude of the stakeholders of the innovative agrosystem to risk, their orientation towards individual or social education, the development of scientific and intellectual potential competencies in the context of the digital transformation of the economy, as well as to threats and shocks of the external environment. The specificity of

building an innovative agricultural system is determined by the characteristics of agriculture, complex climatic and geographical factors, high risks of agricultural production, the uneven spatial distribution of the scientific and innovative potential of agriculture [6].

Successful foreign experience in the study of the most important resources of agricultural systems, such as land, labor, production, technological, informational, are reflected in the works of foreign researchers [25-29].

RESULTS AND DISCUSSIONS

The methodology for the formation of the institutional structure of the scientific and intellectual potential of the agri-food complex is represented by a set of approaches, principles, functions, research methods, as well as its specific features. When forming the institutional structure, systemic, marketing, process, and behavioral were taken into account. institutional, program-targeted approaches. The main research methods are abstract logical, expert, statistical, and methods of economic and mathematical modeling. The study developed the author's principles for the formation of the institutional structure of the scientific and intellectual potential of the agri-food complex, which has the property of innovative susceptibility:

1. interaction of stakeholders (multi-stakeholder partnerships) on the issues of identifying the needs for agro-innovation, the creation, implementation, and dissemination of science-intensive technologies in agricultural production;
2. rational distribution of competencies and resources in the process of functioning of the stakeholders (actors) of the system;
3. the flow and exchange of knowledge, information, innovative ideas both from scientific institutions and government agencies, as well as from the sphere of production, marketing, and consumption;
4. focus on the needs of end-users - enterprises, industries, regions, national priorities;
5. the integrity of the innovation chain from the stage of identifying the needs for targeted

innovation to implementation to the end consumer and distribution;

6. assistance of the state to stimulate the innovative susceptibility of the system through legal, administrative, economic measures; the state is viewed in the innovative agrosystem as a customer of innovations, it stimulates the introduction of innovations through loans, loans, tax incentives, finances most of the fundamental and most important applied research on agriculture;

7. flexibility of interaction and redistribution of resources between the stakeholders (actors) of the system to achieve the planned goals;

8. determination of the main subsystems and elements of the innovative agrosystem and analysis of the forms of knowledge circulation within it. Based on the developed

methodological principles for the formation of innovative agricultural systems, an analysis of the effectiveness of innovative activities in agriculture was carried out, taking into account the contribution of stakeholders included in the innovation system. With its high scientific potential, agriculture is currently showing growth and is the engine of economic growth in the economy as a whole, creating the necessary jobs and gross added value [9]. However, in Russia, there is an insufficiently stable trend of investment inflow into agriculture. Table 1-3, some proposed indicators for assessing the effectiveness of the functioning of the innovative potential of agriculture in dynamics are presented based on existing statistical data.

Table 1. Key indicators of the level of innovative activity in agriculture of the Russian Federation in 2013–2017, %

Indicators	2013	2014	2015	2016	2017
The aggregate level of innovation activity (share of organizations, carrying out technological, marketing, organizational innovations, in the total number of organizations in agriculture)	...	...	...	4.0	3.7
Of them:					
the share of organizations engaged in marketing innovations in the total number of organizations	...	...	...	0.4	0.5
the share of organizations that carried out organizational innovations in the total number of organizations	...	...	...	0.9	0.9
the share of organizations implementing technological innovations in the total number of organizations	...	...	...	3.4	3.1
The share of organizations implementing technological innovations in the total number of organizations in industry	9.7	9.7	9.5	9.2	9.6

Source: Rosstat data [31].

Table 2. Dynamics of indicators of costs for innovative development of agriculture in the Russian Federation, 2013-2017

Indicators	2013	2014	2015	2016	2017
The amount of state support funds under the State Program for the Development of Agriculture and Regulation of the Markets of Agricultural Products, Raw Materials and Food, RUB mln	260,960	262,122	254,982	295,928	257,529
Investments in fixed assets aimed at the development of agriculture, billion rubles	516	510	505	511	434
Expenditures on technological innovations of agricultural enterprises, mln rubles	29,974	25,864	25,023	23,963	23,976
Share of costs for technological innovation in relation to the volume of goods shipped, work performed, services by agricultural enterprises,%	0.57	0.55	0.53	0.54	0.55

Source: Rosstat data [31].

Tables 1 and 2 show that the level of innovative activity in agriculture remains low despite a slight increase in the cost of technological innovation. Agricultural organizations are characterized by a rather low involvement in innovation processes: the development of the latest scientific and technical products was carried out by only

3.1% of organizations. For comparison, Table 1 shows data on industry, where the share of organizations implementing technological innovations is 3 times greater than in agriculture.

Table 3 shows the dynamics of the production of high technology products in the agricultural sector of the economy.

Table 3. Dynamics of production of high-tech products in agriculture, in the Russian Federation, 2013-2018

Indicators	2013	2014	2015	2016	2017	2018
The number of created varieties and hybrids of agricultural crops	298	293	287	266	295	238
The number of breeding forms of animals, birds, fish and insects	4	9	7	4	3	1
Number of new and improved technologies developed	301	295	273	247	224	210
Number of developed vaccines, diagnostics, biological products	59	47	36	36	27	15
Number of new food items developed	364	392	214	192	188	172

Source: Rosstat data [31].

As a result of the analysis, the following trends were revealed: low level of innovative activity in agriculture; low level of demand for domestic developments among agricultural producers of various types, unsatisfactory rates of implementation of modern technologies in small and medium-sized farms; the insufficient level of funding for agricultural science.

The diagnostics of the identified factors and systemic problems based on the results of the analysis made the task of targeted improvement of the institutional structure at the sectoral and regional levels urgent.

The paper proposes a system-functional approach to improving the institutional structure, based on the principles of construction and functions of the scientific and intellectual potential of the agri-food complex. The synergistic effect of the interaction of stakeholders is due to the use of a co-innovative approach in the architecture of the institutional structure of the scientific and

intellectual potential of the agri-food complex [34].

The application of a co-innovation approach at the regional and sectoral levels will make it possible to develop a set of incentive instruments and mechanisms for innovation policy. A wide range of innovation policy instruments exists to strengthen support for innovation processes, such as research funding, patent regulation, and industry standards that stimulate innovation.

Targeted tools for stimulating innovation are aimed at overcoming the shortcomings of innovation susceptibility, coordinating the policy of fundamental and applied research. The development of these tools is aimed at countering specific systemic problems by supporting the performance of the functions of agrosystems, joint forecasting and vision building, balancing supply and demand for various types of innovation support, and creating a space for learning and experimentation of stakeholders [5].

The development of innovative processes based on improving the institutional structure of the scientific and intellectual potential of the agri-food complex is proposed to be carried out by linking the identified systemic tasks with the specific functions of the innovation system. The scientific and intellectual potential of the innovative agrosystem is realized through the following functions: entrepreneurial activity, knowledge generation, knowledge dissemination, management, market formation, resource mobilization, counteraction to change [2].

The function of entrepreneurial activity is aimed at transforming the potential of new knowledge, networks, and markets into real actions for the formation and implementation of consumer value. This function determines the level of progress of the innovative agricultural system, is an indicator of the spread of high technology products. It is a central function linking other functions of the agrosystem and stimulating the creation of knowledge.

The knowledge generation function is of fundamental importance, aimed at finding ideas and developing knowledge with the help of scientific institutions and agribusiness.

The function of spreading or diffusing knowledge across technological platforms and networks is of high importance. It provides policy and market support for innovation, increasing the number of users to further facilitate the co-evolution of social, technological, institutional, and market change. Among the forms of knowledge dissemination, we note seminars, conferences, and scientific and technical speeches.

The function of managing the development of an innovative agricultural system includes planning, organization, motivation, coordination, and control. The form of its implementation is the stimulation of entrepreneurial activity and the transition to a new technological level, the establishment of research priorities, the assessment of the necessary resources to achieve the set goals.

The function of market formation is important and completes the process of interaction between stakeholders. It is proposed to enhance its importance by diagnosing the

needs of agricultural producers in specific innovations and the production of scientific and technological solutions by the needs of agribusiness.

The function of mobilizing resources in an innovation system includes the accumulation and optimization of financial, intellectual, informational, regulatory, and other resources necessary for the development of technologies and the development of innovative market concepts.

The function of counteracting changes and adapting the stakeholders of the innovative agricultural system to the transforming conditions of the external environment, redistributing resources between stakeholders to achieve the priority tasks of scientific and technological development at the federal, regional and sectoral levels is also of high importance [1].

The development of a management mechanism for the institutional structure of the scientific and intellectual potential of an innovative agricultural system is based on the improvement of legal, economic, and organizational conditions (Fig. 1).

The interaction between science and industry is possible through the development of a research program by representatives of the manufacturing sector, joint research programs, and timely funding of research programs. The development of relations between science and the state is proposed based on the introduction of long-term funding programs, the participation of representatives of scientific organizations in government advisory bodies, the implementation of state tasks, as well as the expansion of informal contacts.

Funding is possible through the use of such forms as venture funds, innovation, and implementation firms and centers, technology parks, technology transfer centers, etc.

The unification of stakeholders in an innovative agricultural system is a driver for obtaining new knowledge and translating it into products and technologies. Networks or systems that can effectively disseminate knowledge, technology, and information are acquiring key importance; science is embedded in the system of production and

diffusion of knowledge. In an innovative agricultural system, science fully contributes to the production of knowledge, transforming

it into science-intensive products for agricultural production.

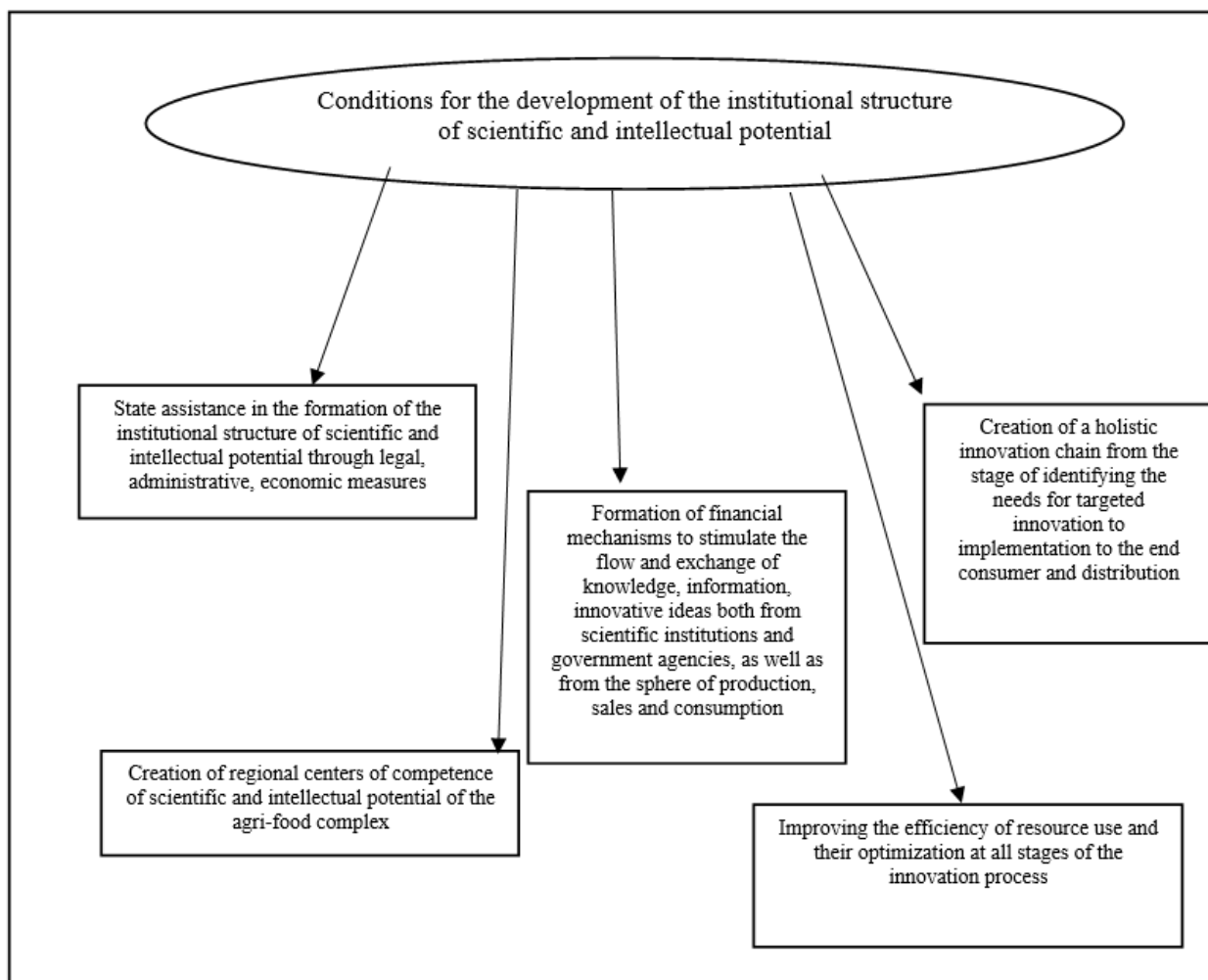


Fig. 1. Organizational and economic conditions for the development of the institutional structure of the scientific and intellectual potential of the agri-food complex

Source: Own calculation.

The dynamic nature of innovative agrosystems manifests itself in the symbiosis of participants in the innovation process in the face of emerging risks and external shocks. This task requires the development of interdisciplinary research, the creation of new technologies based on the partnership between the state and private business, the approval of new rules for international trade, trade, and competition.

CONCLUSIONS

The study developed theoretical and methodological provisions for the formation of the institutional structure of scientific and

intellectual potential at the federal and regional levels and practical recommendations for its development based on the development of mechanisms for increasing the effectiveness of interaction of its stakeholders. The author's paradigm of the innovative agricultural system is described by the NIS concept, and the interaction between its stakeholders corresponds to the triple helix model.

The formation of the institutional structure of innovative agrosystems is based on effective interaction between the stakeholders of agrosystems, which is regulated by institutions like norms and rules, customs that

ensure the innovative susceptibility of agribusiness according to D. North's concept. The methodology for the formation of an innovative agrosystem is represented by a set of approaches, principles, functions, research methods, as well as its specific features. Based on the developed methodological principles for the formation of innovative agricultural systems, the analysis of the effectiveness of innovative activities in agriculture, taking into account the contribution of the stakeholders included in the innovation system, is carried out. As a result of the analysis, the following trends were identified: an insufficient level of efficiency of innovative activities in agriculture, an insufficient level of funding for agricultural science, as well as a weak connection between research topics and the needs of agribusiness.

The paper proposes a system-functional approach to improving the institutional structure, based on the principles of construction and functions of the scientific and intellectual potential of the agrosystem. The synergistic effect of the interaction of stakeholders that are part of the agrosystem is due to the application of the methodological approach of innovations in the architecture of the agrosystem. Taking this approach into account at the regional and sectoral level will make it possible to develop a set of incentive instruments and mechanisms for innovation policy. The development of innovation processes is presented based on improving the institutional structure of the innovation system by linking the identified systemic problems with specific functions of the innovation system.

The features of the implementation of the seven main functions of the scientific and intellectual potential of the innovative agrosystem are highlighted, revealing the nature of the interaction between its stakeholders, the system with the external environment, and between other innovative systems: entrepreneurial activity, knowledge generation, knowledge dissemination, management, market formation, resource mobilization, counteraction to changes ...

A range of innovation policy instruments aimed at eliminating the identified imbalances by supporting the performance of the functions of the agricultural system is proposed.

The paper proposes directions for the development of a mechanism for managing the institutional structure of scientific and intellectual potential, including the improvement of legal, economic, and organizational conditions.

The practical implementation of the proposed approach consists in the possibility of developing strategies for the innovative development of agriculture at the sectoral and regional levels based on the synergistic effect of the complex interaction of the stakeholders of the innovation process. The significance of the research results lies in increasing the efficiency of scientific and intellectual potential based on improving the organizational, economic, and legal conditions for interaction of stakeholders to accelerate the scientific and technological development of the agri-food complex.

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