Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 25, Issue 1, 2025
PRINT ISSN 2284-7995, E-ISSN 2285-3952

FORMATION OF AN INSTITUTE OF INDUSTRY INNOVATION SYSTEMS BASED ON THE SYMBIOSIS OF SCIENCE, STATE AND AGRIBUSINESS

Ivan SANDU, Vasily NECHAEV

Federal State Budgetary Scientific Institution «Federal Research Center of Agrarian Economy and Social Development of Rural Areas - All-Russian Research Institute of Agricultural Economics», 35, kor.2 sh. Khoroshevskoe, Moscow, 123007, Phone: +7499195-60-16, Mobile: +79032382618, +7(925)3514444; E-mails: i.s.sandu@vniiesh.ru, v.i.nechaev@vniiesh.ru

Corresponding author: i.s.sandu@vniiesh.ru

Abstract

Increasing agricultural production volumes to ensure food security of the country is inextricably linked with increasing the efficiency of integration between the state, science and agribusiness. The aim of the work is to improve the theoretical provisions for the formation of the Institute of Industry Innovation Systems and the tools for assessing the effectiveness of the Federal Scientific and Technical Program for the Development of Agriculture for 2017-2030. Methodological aspects of building the Institute of Industry Innovation Systems based on the transfer of positive foreign experience have been developed. Directions for adapting the AIS, ACIS, NARS systems to regional and industry conditions of the agricultural sector of the Russian economy have been proposed. The dynamics of production indicators for individual types of agricultural activity within the framework of the state program has been studied. Based on the results of the analysis and assessment of the effectiveness of the implementation of the FSTP subprograms, areas for growth in the production of sugar beets, potatoes, beef cattle and forage production have been identified.In order to maintain positive trends and increase agricultural production volumes, a systemic and functional approach is proposed to improve the efficiency of interaction between the state, science, and agribusiness based on the harmonization of their functions and interests. The practical significance of new models and mechanisms for the formation of the Institute of Industry Innovation Systems consists in increasing the growth of agricultural production through a balanced interaction between science, the state, and agribusiness for the neo-industrial development of the agricultural sector of the Russian economy.

Key words*: science, government, agribusiness, Institute of Innovation Systems, efficiency, industry specifics*

INTRODUCTION

Positive trends in the growth of agricultural production are based on effectively functioning state support programs in the agricultural sector of the economy. Such programs include the Federal Scientific and Technical Program for the Development of Agriculture (FSTP) and the national project "Science and Universities". Strengthening the integration of the state, science and business in the process of mastering advanced achievements and technologies in agricultural production is associated with the creation of organizational and regulatory conditions for the formation of the Institute of Innovation Systems both at the regional and industry levels. By 2030, the level of technological independence of Russia in the agri-food sector should be 66.7%, which is almost 21 percentage points higher than the level of 2023.

FSTP subprograms for individual types of activities are fully integrated into the innovation cycle, including the use of advanced solutions and technologies in agricultural production. Research support and financial support of FSTP are associated with the national project “Technological Support for Food Security” and the national project “Science and Universities” [21].

The following are recognized as the most important areas of research in agricultural production: agricultural machinery and equipment, selection and genetics, biotechnology, as well as the production of veterinary drugs and vaccines. The funding volume for these purposes is 260 billion rubles [25].

The main priorities of "Science and Universities" include the creation of an innovative environment, the development of a system for training and educating personnel for the agricultural economy. As part of the implementation of the national project, youth laboratories and student campuses have been created, and the material and technical base of the country's leading universities is being intensively updated. One of the tasks is the development and subsequent implementation of programs for the interaction of science, education and business [5]. The experience of leading regional agricultural enterprises is widely used in the scientific and educational environment [16]. Generalization of theoretical and methodological aspects of the growth of agricultural production is expressed in the development and adaptation of the triple helix theory, the quadruple helix theory of innovation, systems theory, and the theory of open innovation [6].

The issues of functioning of agro-innovation systems have been widely reflected in the research topics of foreign and Russian scientists. Of undoubted interest are studies of the institutional structure of agro-eco-innovation systems, identifying effective relationships between its participants. In agriculture of the EU countries, social partnerships that unite numerous participants play a significant role in the innovation process [18, 19]. Thus, Leeuwis, C. Represents an innovation system as «a network of organizations, enterprises and individuals that produces new products; develops and implements new processes and new forms of organization in the economy». The AIS agricultural innovation system is aimed at creating competitive agriculture and maintaining the achieved positions in a changing economic and social environment. The main feature of AIS compared to AKIS, which unites classical knowledge and innovation systems (universities and research institutes), is a wider range of participants, including both state and private organizations [15].

In addition to AKIS and AIS, there is the National Agricultural Research System (NARS), the main objective of which is the creation and transfer of innovative developments and technologies to agricultural production. According to the World Bank, this system includes institutions for organizing, coordinating and conducting research on the introduction of advanced achievements into agricultural production [30].

The AKIS (Agricultural Knowledge and Innovation System) model has become widely used; it is designed to generate information flows and improve the process of knowledge transfer while developing the relevant competencies of farmers [1].

The AKIS concept is widely used in the activities of the European Innovation Partnership on Agricultural Productivity and Sustainability (EIP-AGRI). Its practical application allows to successfully solve the issues of acceleration of innovation processes and development of rural regions. Fieldsend, A.F. focuses on the synergistic effect between various state programs both at the national and supranational levels [7].

In his opinion, EIP-AGRI coordinates cooperation between participants of social partnership, implementing an effective innovative model.

In the process of developing and implementing advanced achievements, interaction occurs between farmers, intermediaries and scientific researchers [10]. According to Ingram, J., in the process of interaction between science, government and agribusiness, it is necessary to create innovative networks [12].

In developing this theme, it is worth noting the work of Guerrero-Ocampo. The concept of agro-innovation systems defines the network as an innovative space in which subjects of innovative activity are in close interaction [24]. Research institutes as innovators and universities as knowledge generators [8]. Social networks play a significant role in the promotion of knowledge, expanding opportunities for participation in the innovation process.

The authors concluded that financial institutions are the main link in the successful implementation of innovative projects in rural areas, generating an appropriate level of state

support. EU countries, which are most provided with financial resources, have the ability to implement rural development priorities, both at the national and supranational levels [9].

Amerani, E., Michailidis, A, investigated the features of the AKIS system functioning in Greek agriculture based on the SWOT analysis of the environment using an expert survey. According to the survey results, the majority of respondents from various fields noted the development of new knowledge as the advantages of the system, as well as the organization of the training process for farmers to form relevant competencies, access to communication information technologies. As constraints, 65% of respondents identified low incomes and insufficient knowledge among elderly farmers. The transition to organic and precision farming has great potential for the successful operation of AKIS. At the same time, over 80% of survey participants emphasized the imperfection of the use of the regulatory framework [2].

Kassem, H. S., Ismail, H., Ghoneim, Y. investigated the institutional linkages and communication between agricultural knowledge and information systems (AKIS) in selected agricultural regions of Egypt to assess the process of knowledge dissemination, implementation of agro-innovations, and availability of financial resources. Respondents identified higher education and research as the most important sources of knowledge dissemination in agricultural cooperatives. In turn, agricultural cooperatives also play an important role in knowledge transfer by providing information to other AKIS participants [13].

The questionnaire survey revealed low levels of interaction between NARS participants, a shortage of technology parks and a lack of technology transfer infrastructure. The need to use best practices and develop effective strategies in these areas was noted. It is recommended to strengthen the research potential in the field of agricultural sciences, increase publication activity, improvement of educational and retraining programs, training programs and projects (including virtual ones). This will improve the process of interaction between participants in the innovative agricultural system. It is recommended to create new institutions of intermediary organizations and a center for agricultural innovation to improve the functioning of the system [4, 14].

The formation of the Institute of Industry Innovation Systems in Russia is associated with increasing the efficiency of interaction between the state, science, and agribusiness. The aim of the work is to develop theoretical and methodological provisions, assessment tools, and mechanisms for the formation of the Institute of Industry Innovation Systems. The study pays much attention to the works of Russian and foreign scientists dealing with the problems of innovative agricultural systems.

MATERIALS AND METHODS

The research is based on the use of various sources of information, statistical information, regulatory documents, and expert assessments.

New data on actual and projected indicators of individual subprograms of the Federal Scientific and Technical Progress and agriculture in general, and indicators of technological development were used.

An analysis of scientific developments in the field of selection and seed production was conducted, the dynamics of production indicators were studied, and directions for increasing the efficiency of interaction between the state, science and agribusiness in the process of forming the Institute of Innovative Industry Systems were proposed.

The study also used generally accepted methods used by scientists and experts dealing with innovative problems. In methodological terms, such methods as monographic analysis, synthesis, critical assessment, and compilation of scientific approaches by other authors, logical construction of ideas and results, comparison, analogy, and visualization of statistical data were used. It is proposed to use the experience of EU countries in promoting agricultural knowledge using the example of the AIS, ACIS, NARS systems and adapt them to the agricultural sector of the Russian economy.

RESULTS AND DISCUSSIONS

Analysis and assessment of the interim results of the implementation of the Federal Scientific and Technical Program emphasizes the positive trends in the growth of agricultural production. For example, seed imports in 2024 decreased by 3 times compared to last year, of which potato seeds by 93%, barley and corn - by 80%, oilseeds - by more than 60 percent. Import substitution for sugar beet increased in 2024 to 8% compared to 3% in 2023 [11, 26]. Particular successes are characteristic of the production of domestic veterinary drugs, the production of which increased 8 times over the year, amounting to 70% of the domestic market [20].

The implementation of the results of breeding developments is characterized by significant territorial differences. In 2024, the highest rates of use of domestic seeds were observed in the Novosibirsk (68%) and Omsk (89%) regions. In the Krasnodar Territory, 70% of domestic soybean seeds were used, and in the Novosibirsk Region - 95% [17].

The results of the implementation of the national project "Science and Universities" have shown significant success in agro-economic research and development based on universities. During the period under review, 15 world-class scientific and educational centers and over 150 laboratories that meet international standards were created. 10 scientific centers were engaged in research on technological development priorities, 3 centers - in genomic research.

The West Siberian scientific and educational center of world class has created an agrobiotechnical complex, including research, educational, technical and production modules. Biological protection of plants is carried out based on the use of modern hydroponics technologies and artificial intelligence. In order to preserve the gene pool of certain species of rare wild berries, genetic and selection work is carried out for such berry plants as blueberries and cloudberries.

A new generation of mineral fertilizers with biologically active additives have been developed, the use of which increases the yield of wheat and corn by 15%. A new method for protecting oil flax crops from weeds has been developed. A promising area is the production of environmentally friendly biofertilizers [23].

Table 1. Forecast values of the FSTP indicators for individual types of agricultural products

Indicators	2025	2030	2030 to 2025 %
Domestic selection in plant growing			
Use of sunflower seeds for sowing, thousand tons	15.3	123	803.9
Use of sugar beet seeds for sowing, thousand tons	0.1	1.1	1,100
Domestic selection in animal husbandry			
Number of day-old chickens of meat crosses of chickens million heads	29.5	308.6	1,050
Number of breeding calves of dairy cattle, thousand heads	94	99	105.3
Veterinaryservices			
Number of domestic veterinary drugs, thousand packages	200.2	234.3	117.0
Number of domestic vaccines, billion dollars	19.0	21.0	110.5
Foragebase			
Volume of production capacity for the production of enzymes and feed additives, thousand tons	148	363	245.3

Source: Own calculations based on data [25].

Currently, 13 subprograms are being implemented within the framework of the Federal Scientific and Technical Program. In 2024, 17 regions implemented the subprogram on potatoes, 4 on sugar beets, 4 on oilseeds, 3 on poultry farming.

The table presents indicators of technological leadership for individual types of agricultural products obtained.

The given indicators reflect the planned formation of breeding resources of dairy cattle breeding and meat poultry farming; active use of selection achievements in the process of cultivation of sugar beet and sunflower; improvement of veterinary services and strengthening of the forage base. In 2025-2030, the volumes of sowing of domestic sunflower and sugar beet seeds should increase, respectively, by 8 and 11 times.

The synergistic effect from the introduction of innovative scientific developments in production is confirmed by the use of new agricultural technologies in accordance with the needs of agricultural producers. The number of such technologies should be 25 units in 2030, i.e. will increase 4 times compared to 2025.

A significant increase in efficiency in agriculture is expected: labor productivity will increase in 2030 by almost 16%, and investments in fixed assets - by 20% [25].

The positive results of the FSTP in 2020-2023 can be confirmed by the growth rates of production and yield of individual types of products.

The highest results were obtained during the implementation of the FSTP subprogram on potatoes. In 2023, the gross potato harvest in farms of all categories increased in Russia as a whole compared to 2022 by 6.6%, and the yield - by 10 percent. In the regions where the FSTP subprogram is in effect, these indicators were significantly higher (Fig. 1).

Fig. 2 shows the growth rates of oilseed crop yields in the leading Russian regions.

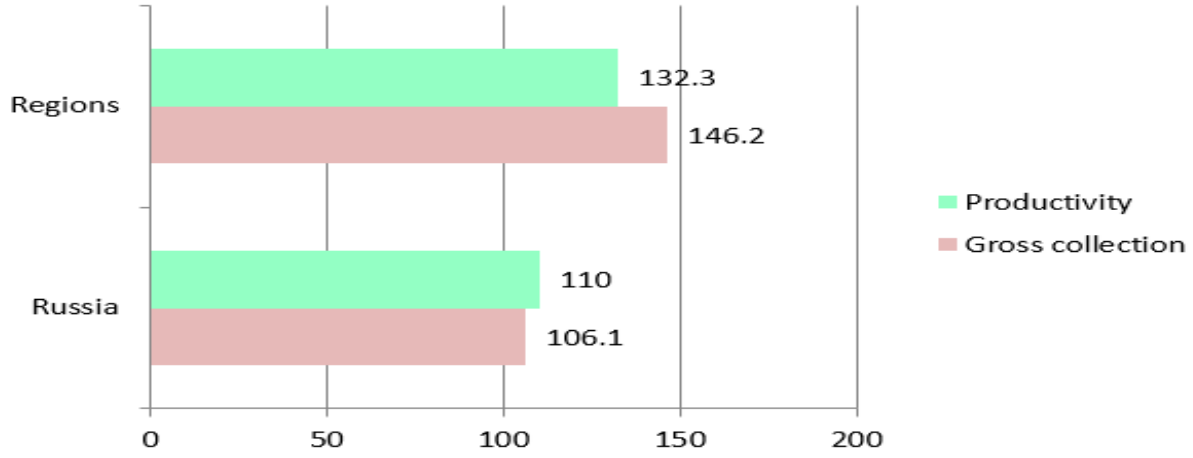

Fig.1. Growth rates of potato production and yield in 2023 compared to 2022, %
Source: Own calculations based on data [3].

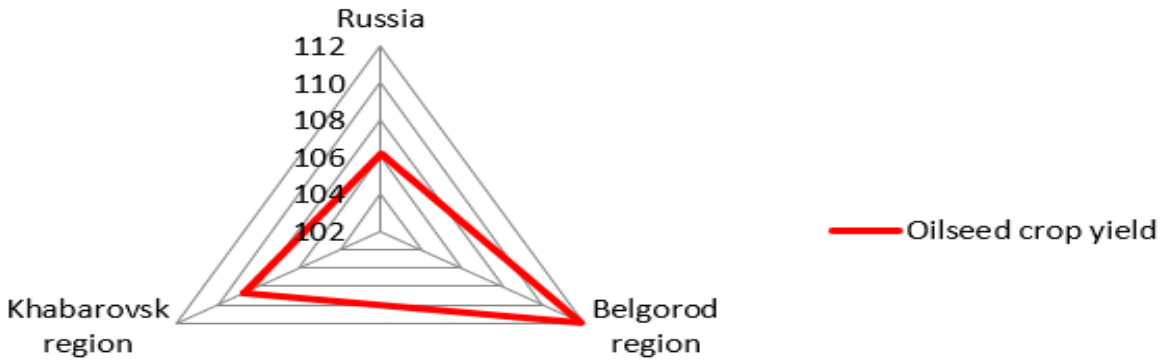

Fig. 2. Growth rates of oilseed crop yields in 2023 in Russia and its leading regions,%
Source: Own calculations based on data [3].

Preliminary results of the implementation of the FSTP subprograms demonstrate the need to strengthen state support, which is confirmed by studies by Russian scientists. The production of various types of products is associated with different adaptation to changing economic and financial conditions. For example, high adaptation is characterized by such types of activity as in crop production - growing sugar beets, growing grain and leguminous crops, oilseeds, growing vegetables, melons; in animal husbandry - pig breeding, poultry farming, breeding dairy and beef cattle. The group with average adaptation includes growing shrubs and nuts, growing grapes, breeding sheep and goats, cultivating potatoes. Types of activity with weak adaptation - breeding pedigree beef cattle. Currently, two more FSTP subprograms are being developed, covering agricultural machinery and the production of drugs.

It is planned to organize serial production of a fundamentally new generation of agricultural machinery and equipment with the attraction of additional investments in the amount of more than 6 billion rubles from the budget. Investments in the amount of more than 13 billion rubles are planned for the implementation of the subprogram for the development of immunobiological technologies and the production of veterinary drugs [29].

The implementation of both subprograms will be carried out on the principles of selecting comprehensive scientific and technical projects.

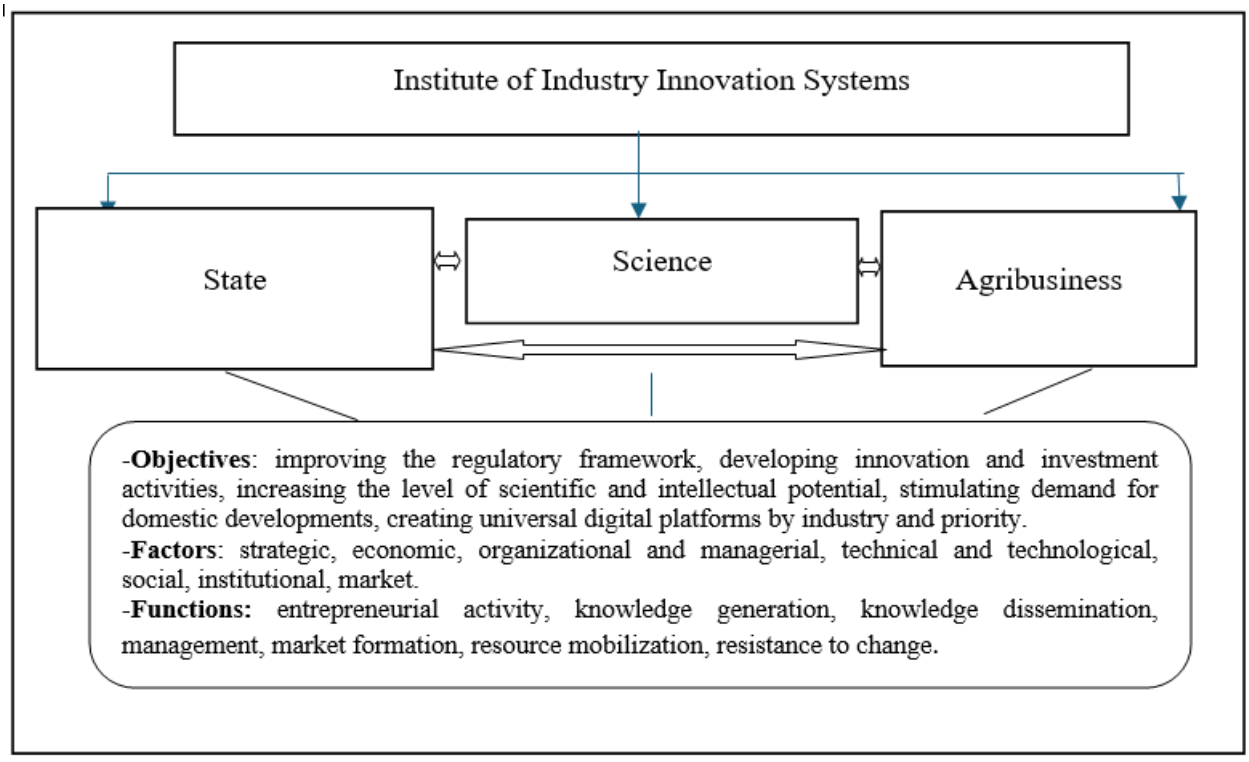

Fig.3. Scheme of formation of the Institute of industrial innovation systems
Source: Own design.

In order to maintain positive trends and increase the volume of agricultural production, a systemic and functional approach is proposed to improve the efficiency of interaction between the state, science, and agribusiness based on the harmonization of their functions and interests (Fig. 3). The paper proposes a systemic-functional approach to the construction of the Institute of Industry Innovation Systems [27].The article highlights seven functions of the proposed structural unit: entrepreneurial activity, knowledge generation, knowledge dissemination, management, market formation, resource mobilization and resistance to change for the neo-industrialization of the agricultural sector of the Russian economy [22, 28].

CONCLUSIONS

The article develops methodological aspects of building the Institute of Industry Innovation Systems based on the transfer of positive foreign experience. The directions of adaptation of the AIS, ACIS, NARS systems to regional and industry conditions of the agricultural sector of the Russian economy are proposed. The dynamics of production indicators for individual types of agricultural activity within the framework of the state program is studied.

Based on the results of the analysis and assessment of the effectiveness of the FSTP subprograms, areas of growth in the production of sugar beets, potatoes, beef cattle and forage production are identified. In order to maintain positive trends and increase the volume of agricultural production, a systemic and functional approach is proposed to improve the efficiency of interaction between the state, science and agribusiness based on the harmonization of their functions and interests.

The practical significance of new models and mechanisms for the formation of the Institute of Industry Innovation Systems lies in increasing the growth rate of agricultural production through a balanced interaction between science, the state and agribusiness for the neo-industrial development of the agricultural sector of the Russian economy.

ACKNOWLEDGEMENTS

The reported study was funded by the Russian Science Foundation, project №23-18-00236 «Structural transformation of accumulation and consumption in order to neo-industrialize the agricultural sector of the Russian economy in modern geopolitical conditions».

REFERENCES

[1]Agricultural Knowledge and Innovation Systems in Transition – a reflection paper EU SCAR. Agricultural Knowledge and Innovation Systems in Transition—A Reflection Paper; European Commission: Luxembourg, 2012: 23–46.https://ec.europa.eu/eip/agriculture/en/publications/agricultural-knowledge-and-innovation-systems.html, Accessed on February 3, 2025.

[2]Amerani, E., Michailidis, A, 2024, The Agricultural Knowledge and Innovation System (AKIS) in a Changing Environment in Greece, Proceedings, 94 (1): 29.

[3]Bulletin “Gross harvests and crop yields in the Russian Federation in 2023" (part 2). https://rosstat.gov.ru/compendium/document/13277, Accessed on February 3, 2025.

[4]Cano, L. F. G., Sossa, J.V.Z., Sarta, J.F.M., Lopera, J.C.O., Saavedra, J.I.Q., Guzman, L.M.S., Tapasco, D.A.A.,2024, National Agricultural Innovation System (NAIS): Diagnosis, Gaps and Mapping of Actors, Sustainability, 16 (8): 3294.

[5]Derunova, E., Vasilchenko, M., Shabanov, V., Derunov, V., 2021, Mechanisms to stimulate the acceleration of innovative development in the agroindustrial complex, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development. Vol. 21(2):209–222.

[6]Derunova, E.A, Vasilchenko, M.Y., Shabanov, V.L. 2021, Assessing the Impact of Innovation and Investment Activity on the Formation of an Export-Oriented Agricultural Economy. Economic and social changes-facts trends forecast, 14 (5), 100-115.

[7]Fieldsend, A.F.,Cronin, E., Varga, E., Biró, S.,Rogge, E., 2021, Sharing the Space’ in the Agricultural Knowledge and Innovation System: multi-actor innovation partnerships with farmers and foresters in Europehttps://www.researchgate.net/publication/348588715_'Sharing_the_space'_in_the_agricultural_knowledge_and_innovation_system_multi-actor_innovation_partnerships_with_farmers_and_foresters_in_Europe, Accessed on February 1, 2025.

[8]Gava, O., Favilli, E., Bartolini, F., Brunori, G.,2017, Knowledge networks and their role in shaping the relations within the Agricultural Knowledge and Innovation System in the agroenergy sector. The case of biogas in Tuscany (Italy), Journal of Rural Studies, 56: 100-113.

[9]Guerrero-Ocampo, S. B., Díaz-Puente, J. M., Nuñez Espinoza, J. F.,2022, Multi-actor partnerships for agricultural interactive innovation: Findings from 17 case Studies in Europe,. Land, 11(10):1847.

[10]Horizon 2020 Multi-Actor Projects, Bruss. EIP-AGRI Serv. Point 2017, , https://ec.europa.eu/eip/agriculture/sites/default/files/eip-agri_brochure_multi actor_projects_2017_en_web.pdf, Accessed on February 3, 2025.

[11]In Russia, imports of oilseeds decreased by 64% in 2024, https://фнтп.рф/news/202412/v-rossiya-snizilsya-import-semyan-maslichnykh-na-64-v-2024-godu, Accessed on January 22, 2025.

[12]Ingram, J., Maye, D., Kirwan, J., Curry, N., Kubinakova, K.,2015, Interactions between niche and regime: an analysis of learning and innovation networks for sustainable agriculture across Europe, The Journal of Agricultural Education and Extension, 21(1): 55-71.

[13]Kassem, H. S., Ismail, H., Ghoneim, Y. A., 2022, Assessment of Institutional Linkages and Information Flow within the Agricultural Knowledge and Innovation: Case of Dakahlia Governorate, Egypt, Sustainability, 14(11): 6415.
[14]Kountios, G., Chatzis, I., Papadavid, G.,2024, Agricultural Knowledge and Innovation Systems and Sustainable Management of Natural Resources, Proceedings,. 94(1):10.
[15]Leeuwis, C.,2012, Development and Support Role of Extension Services for Sustainable Intensification in Agriculture: Moving from Extension to Innovation Intermediation, Teagasc Best Practice in Extension Services 'Supporting Farmer Innovation, Dublin, Ireland, 1 November. multi-actor innovation Partnerships with Farmers and Foresters in Europe, The Journal of Agricultural Education and Extension, 27(4): 423–442.
[16]National project "Science and Universities": results and challenges of 2024, https://ноп.рф/natsproekt-nauka-i-universitety-rezultaty-i-vyzovy-2024-goda/, Accessed on January 12, 2025.
[17]Oilseed digest: the share of sunflower seeds and soybeans of domestic breeding has increased in Russia, https://specagro.ru/analytics/202412/daydzhest-maslichnye-v-rossii-uvelichilas-dolya-semyan-podsolnechnika-i-soi, Accessed on January 12, 2025.
[18]Popescu, A., 2006, Research concerning the economic impact of investments in dairy farms of various size, International Symposium "Prospects of Agriculture in the 3rd Millennium", UASVM ClujNapoca, 5-6.
[19]Popescu, A., Dinu, T., Stoian., E., 2019, Efficiency of the agricultural land use in the European Union, Scientific Papers Series "Management, Economic Engineering in Agriculture and Rural Development", Vol. 19(3): 475-486.
[20]Russian veterinary medicines occupy 70% of the domestic market — Rosselkhoznadzor, https://specagro.ru/news/202412/rossiyskie-vetpreparaty-zanimayut-70-vnutrennego-rynka-rosselkhoznadzor, Accessed on January 20, 2025.
[21]Sandu I., Nechaev V.I., 2024, Implementation of subprograms of the federal scientific and technical program for the development of agricultural economy in Russia in modern geopolitical conditions and their influence on the development of agricultural economy in Russia, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.24(1), 775-784
[22]Sandu, I.S., Nechaev V.I.,2023, Neoindustrialization of the agricultural sector of the economy as a necessary condition for innovative transformation of productive forces and achieving technological sovereignty. Scientific Papers Series «Management, Economic Engineering in Agriculture and Rural Development», Vol.23(3), 802-810.
[23]Science.rf: "Science and Universities": Main Achievements of 2022 https://english.spbu.ru/news-events/university-media/science-and-universities-main-achievements-2022, Accessed on January 18, 2025.
[24]Spielman, D. J., Davis, K., Negash, M., Ayele, G.,2011, Rural innovation systems and networks: findings from a study of Ethiopian smallholders, Agriculture and Human Values, 28: 195-212.
[25]The Russian Government has approved a plan to achieve national development goals. https://specagro.ru/news/202501/pravitelstvo-rf-utverdilo-plan-dostizheniya-nacionalnykh-celey-razvitiya, Accessed on January 13, 2025.
[26]The share of sunflower seeds of domestic breeding increased to 43% in 2024, https://фнтп.рф/news/202412/dolya-semyan-podsolnechnika-otechestvennoy-selekcii-vyrosla-do-43-v-2024-godu, Accessed on January 10, 2025.
[27]Turner J.A., Rijswijk K., T. Williams, T. Barnard, L. Klerkx, 2014, Challenges to effective interaction in the New Zealand agricultural research and extension system: an innovation systems analysis, Extension Farming Systems Journal 9.(2014): 89–98.
[28]Vasilchenko, M., Sandu, I., 2020, Innovative investment development of agriculture in the conditions of formation of the export-oriented economic sector: system approach, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol 20(1), 599–612.
[29]VNIIZH increased the production of vaccines for animals three times, https://specagro.ru/news/202501/vniizzh-uvelichil-proizvodstvo-vakcin-dlya-zhivotnykh-v-tri-raza Accessed: 14.01.2025
[30]World Bank,2012, Agricultural Innovation Systems: An Investment Sourcebook; Agricultural and Rural Development, World Bank Publications: Washington, DC, USA, 680 p.