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TRENDS IN THE DEVELOPMENT OF INNOVATIVE PROCESSES IN THE INDUSTRY OF THE AGRO-FOOD COMPLEX OF RUSSIA

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Abstract

Sustainable development of the production potential of the agro-food complex is inextricably linked with the introduction of innovative methods and approaches to production. The purpose of the article is to develop theoretical and methodological approaches to the study of sectoral features of the innovative development of production potential. The analysis carried out revealed significant differences in the level of innovative development of agricultural sectors. The study applied the method of normalizing resource intensity indicators in relation to threshold values, which made it possible to determine the degree of innovativeness of the components of the resource potential. The efficiency of costs for innovation activity is calculated, it is revealed that the lowest cost efficiency is typical for dairy cattle breeding and grain production. To identify trends in intersectoral innovative development, the article uses SWOT analysis tools. A matrix of innovative development of Russian regions has been developed on the example of the dairy cattle breeding industry, which reflects the degree of contribution of resources to the dynamics of the production of innovative products. This approach is aimed at determining the optimal values of resources to achieve sustainable innovative development of the sectors of the agro-food complex.

Key words**:** *trends, sustainability, innovations, agro-food complex, industry development, rationing method, SWOT analysis, efficiency*

INTRODUCTION

In modern conditions of functioning, the sustainable development of the agro-food complex on an innovative basis is a vector for ensuring the food independence of countries. One of the conditions for achieving sustainable socio-economic growth is the intensive introduction of advanced scientific achievements both at the regional and sectoral levels. However, the process of transferring innovations at different levels of management has its own specifics and justifies the need to develop differentiated approaches to management.

Works devoted to the study of sustainable growth of agriculture in various countries [2, 10, 23]. issues of ensuring food security and food independence are analyzed in the works [6, 11, 15]. Description of approaches to state support for agriculture are analyzed in various research papers [27]. Reiff [21]conducted an analysis of differentiated differences in agricultural production on the example of the European Union based on data from the World Bank. Using the Ward's method, countries were classified into six different groups and marked differences in agricultural productivity were shown. The research[9]is devoted to the analysis of differences in production resources - labor, land, capital for agricultural sectors in the European Union. In addition to the Ward method, this work used the DEA method and ANOVA analysis to assess the significance ofdifferentiated differences in the economic and technological efficiency of large agricultural enterprises in the EU countries.Trends in sustainable development of both agriculture in general and production factors are studied in the work of Magrini [4, 13] using Eurostat statistics for the period since 2006.

This study revealed the relationship between subsidies and production growth in specific

agricultural sectors. Studies on the problems of increasing competitiveness, profitability and economic growth based on the improvement of subsidiary support are presented in the works [1, 14].

In the agro-food complex, innovative processes have their own characteristic features associated with the specifics of agricultural production. The most striking features include geographic, natural and climatic factors, seasonality of production, mixing of technological processes with natural ones, a low degree of integration of scientific achievements into the production sector, a lack of competencies demanded by the digital economy, low demand for innovations and high technology products, imperfection mechanism for the introduction and transfer of innovative technologies and advanced scientific achievements to agricultural producers [3, 16].

First of all, attention is drawn to the continued diversity of agriculture, which is especially noticeable in the low-concentration production of potatoes and vegetables. On the contrary, in grain production and pig breeding, the dominance of agricultural organizations predetermines a rather high level of production concentration [8].

The share of the ten largest companies in the total volume of industrial pork production in the Russian Federation amounted to about 60% in 2021 [20].

The purpose of this work is to assess the industry-specific features of the process of introducing innovations, to substantiate differentiated approaches to managing innovation activities at the industry level using the example of dairy cattle breeding using SWOT analysis tools.

MATERIALS AND METHODS

The methodological basis of the study was state legislative acts, government decrees and decisions, scientific works of domestic and foreign scientists - economists and agricultural specialists on the problem under study.

In the course of the study, monographic, abstract-logical, analytical, economic-statistical, expert research methods were used. Legal and regulatory acts, information from Rosstat, National Research University 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 were used as the information base for the study.

RESULTS AND DISCUSSIONS

A study of innovation and research activities at the intersectoral level was carried out. Agriculture lags far behind the average level in the economy in terms of innovation activity (Figs. 1 and 2).

The cumulative level of innovative activity as of 2019 was at the level of 4.8% in crop production and 4.0% in animal husbandry. The innovative activity of organizations in industrial production was more than 3 times higher and amounted to 15.1%.

In the structure of costs for technological innovations, more than half falls on the purchase of machinery and equipment. Also, a significant share falls on engineering, and the indicator in agriculture is 2.7% higher than in industrial production.

One of the main factors in the growth of innovative activity belongs to research activities (Fig. 3).

Research and development at the end of 2019 amounted to 24.6% of the total cost of technological innovation. This indicator shows a low level of susceptibility of agricultural producers to the implementation of the results of research activities in agricultural production.

The imperfection of the mechanism of interaction between the participants in the innovation process hinders the implementation of the results of scientific and innovative activities in agricultural production. Technological exchange processes, due to the low level of innovative activity of enterprises, do not play a priority role in increasing the volume of agricultural production. The involvement of organizations in innovation processes is characterized by low congruence, which is confirmed by the

indicators of the readiness rating of Russian regions for the introduction of digital technologies in agriculture. The group of regions with a high degree of readiness includes subjects of the Russian Federation with a good technological base, an appropriate level of training of specialists in agriculture (Krasnodar Territory, Novosibirsk Region, Republic of Bashkortostan, as well as Belgorod, Voronezh, Nizhny Novgorod, Novosibirsk, Tambov, ChelyabinskRegions. In the regions This group has developed and operates programs to support the introduction of new technologies in agriculture, digital technologies are widely used.However, in the vast majority of Russian regions, the necessary conditions for the introduction of digital agriculture technologies have not yet been created [24].

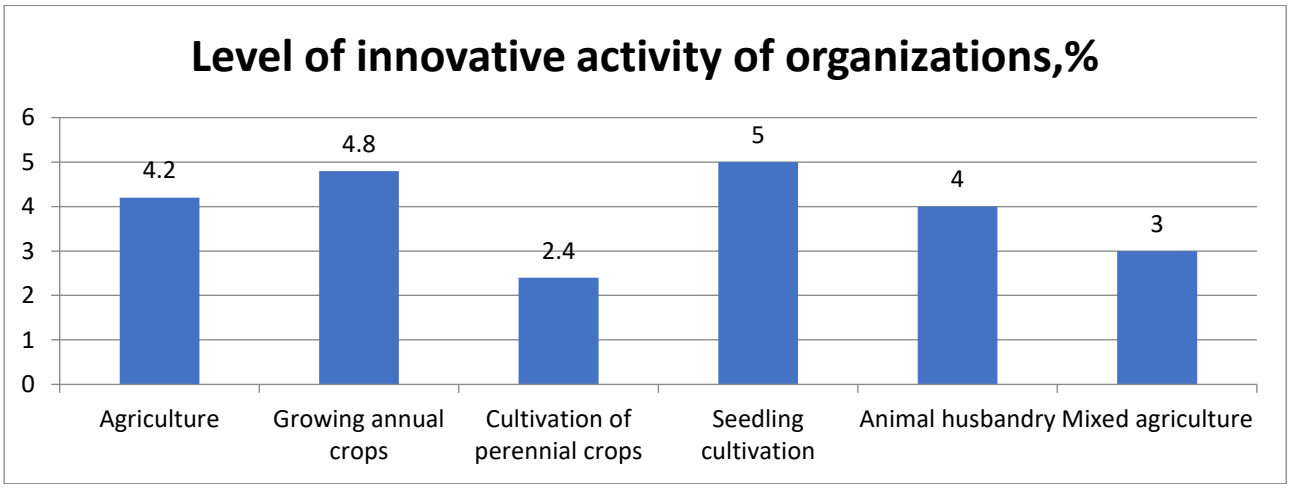

Fig. 1. Intersectoral differentiation of innovative activity of agricultural organizations in Russia in 2019 Source: Own calculations based on data [7].

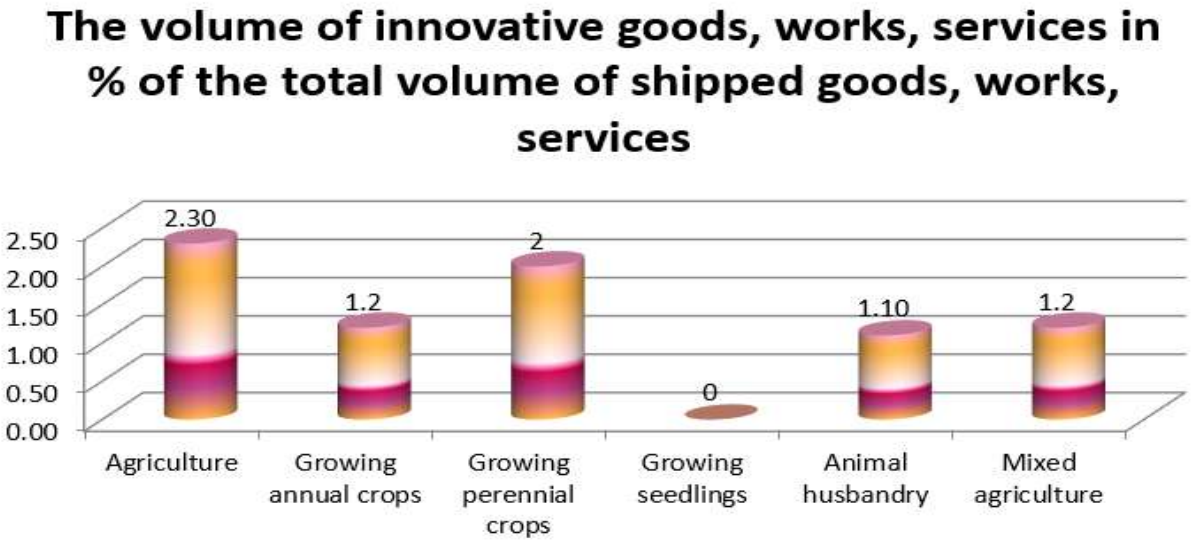

Fig. 2. Intersectoral differentiation in the production of innovative products in 2019
Source: Own calculations based on data [7].

The innovative activity of the organizations of the agro-food complex is not high enough, and the efficiency of organizations' costs for innovative activities (calculated as the ratio of the cost of shipped innovative goods of their own production, works and services performed to the costs of organizations for innovative activities) has significant industry differences (Fig. 4).

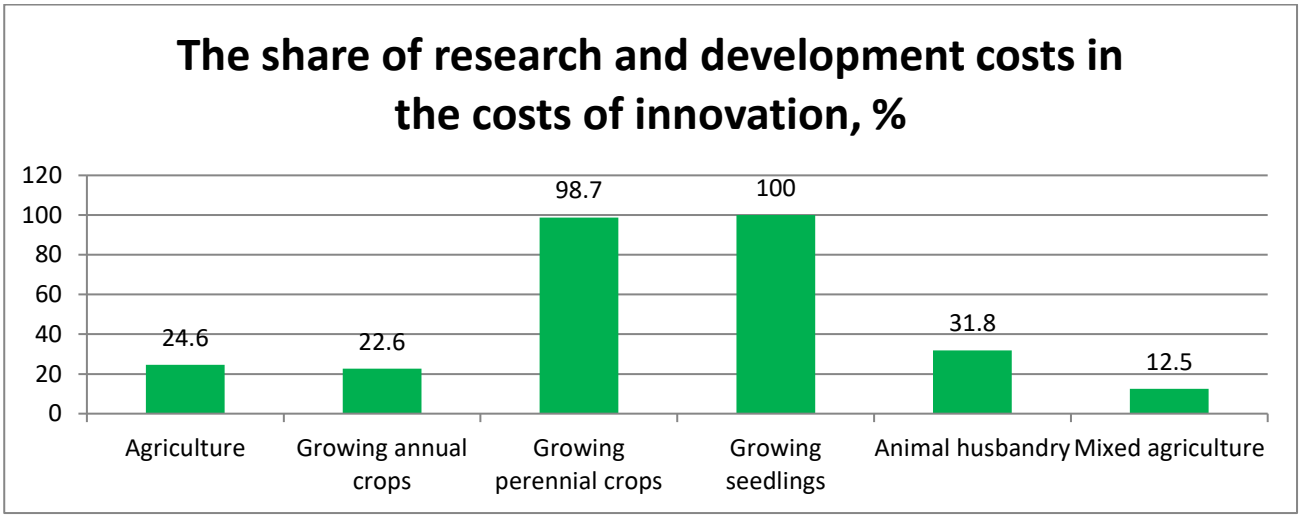

Fig. 3. Intersectoral differentiation of research activities in agriculture 2019
Source: Own calculations based on data [7].

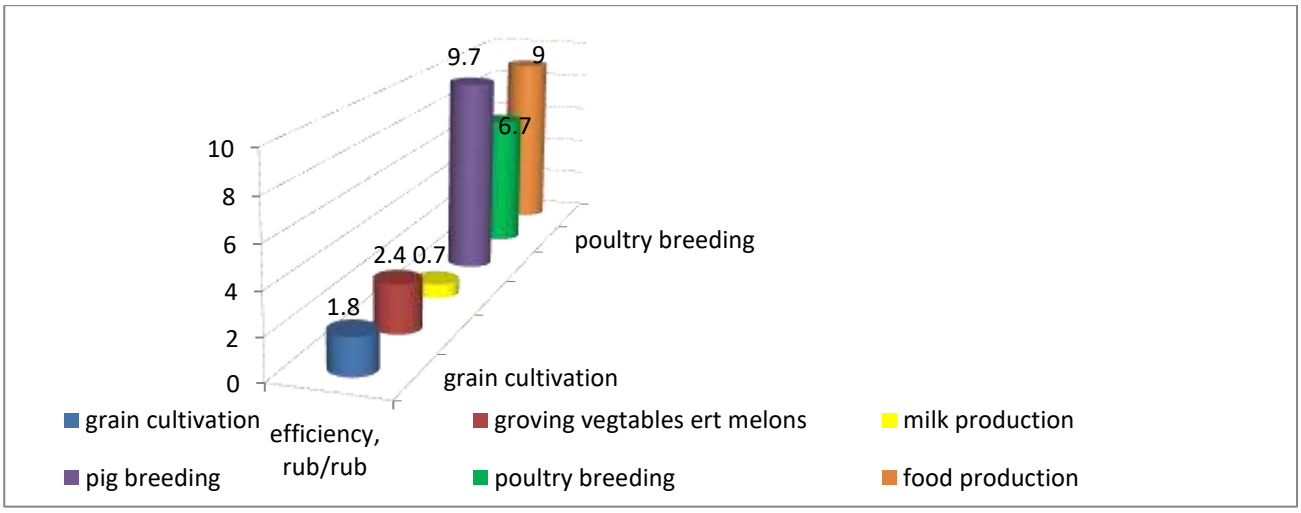

Fig. 4. Cost effectiveness of organizations for innovative activities, rub/rub. 2021
Source: Own calculations based on data [7].

The lowest cost efficiency for innovation activities is typical for dairy cattle breeding (0.7 rubles) and grain production (1.8 rubles). In animal husbandry, the highest cost-effectiveness for innovative activities was achieved in pig breeding (9.7 rubles), slightly exceeding the same indicator for the type of activity "Production of food products" (9.0 rubles).

Identification of the priority factors of innovation activity will significantly improve the efficiency of managing innovation processes in the agro-food complex. In this study, SWOT analysis tools were used to identify trends in intersectoral innovative development

The results of the analysis using the SWOT-analysis tools made it possible to identify the factors of innovative development in various types of agricultural production. The main advantage of cultivating grain crops and vegetables is the availability of both necessary and sufficient land resources. In grain production, industrial biotechnologies are widely used, deep processing of grain is carried out. The development of deep processing as one of the most important areas of innovation predetermines the innovative diversification of grain exports. [22].

At the same time, the low cost effectiveness of innovation activities and the low share of costs for technological innovation in the total volume of shipped goods are significant limiting factors for the innovative development of grain and vegetable production. The lack of a full-fledged base of

developments in the field of breeding and seed production, including those for specific crops, also hinders innovative processes. A large role in strengthening the innovative dominant of crop production is given to expanding the network of innovation and technology centers, business incubators and techno-policiesin order to develop fundamentally new technologies and varieties of grain, vegetable and melon crops with high yields and resistance to adverse factors. One of the promising forms of organizing greenhouse vegetable growing is the creation of completely closed facilities with continuous production, which is especially important for regions with unfavorable natural and climatic conditions.

The most important direction in the innovative development of animal husbandry is the formation of a competitive domestic breeding base, associated with the use of technologies for genomic selection and genomic evaluation of animals.

In animal husbandry, there are significant intersectoral differences in innovation activity. For example, in dairy cattle breeding, due to the heterogeneous institutional environment, regional and intra-industry differentiation of technological modernization can be traced: about 60% of milk is produced according to modern technological standards, while in poultry farming this figure is 65-70%; in industrial pig breeding - 85-90%. In large pig breeding companies, the costs of feed, labor, and electricity correspond to world standards [12].

It should be noted that due to the increase in the payback period of projects, the costs of innovation activities have a multidirectional effect on achieving compliance with modern technological parameters.

According to a sample survey of the results of innovation activities conducted by Rosstat in 2021, the most noticeable impact of innovations on modernization processes was observed in 38% of poultry enterprises and 20% of dairy cattle breeding enterprises. The lack of influence of innovations on the development of modernization and technological re-equipment was noted by representatives 41% grain farms, 21% pig farms and 25% vegetable farms.

The point effect of scale generates the level of costs and product quality in large enterprises with higher innovative activity, and therefore the introduction of digital technologies is especially important for small enterprises. A steady trend of low innovative development in the small-scale commodity economy is also characteristic of individual Eastern European countries [19].

The current institutional structure of dairy cattle breeding predetermines a lower level of use of innovative potential compared to other industries. Previous studies have proposed methodological approaches to assessing the innovativeness of individual resource components, according to which the level of innovativeness of feed costs in dairy cattle breeding is 70%, and fuel costs - 35%; in pig breeding - respectively 92% and 77%. In poultry farming, the innovativeness of feed reaches 90%, and the cost of electricity - 78% [26].

A promising direction of innovative development is the precision animal husbandry system based on the use of sensor technology, robotics and artificial intelligence. According to experts of the Russian dairy market, automated systems for organizing the production process provide an increase in milk yield by 30–40% [5], and the costs of individual production resources will decrease by 2.5–4 times [17].

Thus, in the medium term, digital technologies will actively influence the processes of innovative transformation of agricultural production. In the future, new digital ecosystems will be used to calculate the economic efficiency of implemented solutions and optimize the implementation process itself, as well as increase the efficiency of interaction between the stakeholders of the innovation process [18]. The paper proposes recommendations for improving the efficiency of state regulation based on the diversification of production in grain production and vegetable growing.

In the short term, in order to increase the share of high value-added products, it is planned to invest in the construction of facilities for the

storage and processing of agricultural raw materials; as well as modern wholesale distribution centers.

The formation of the innovative potential of vegetable growing, including the production of their specific types, is largely determined by the mechanisms for stimulating the innovative susceptibility of organizations to introduce innovations at all stages of the innovation process [25].

Subsidizing the reimbursement of part of the costs for the creation and modernization of facilities remains a necessary instrument of state regulation, which is especially important for the greenhouse industry.

The prospects for increasing the gross value added in agriculture are associated with technical and technological modernization, changes in the field of breeding and seed production. The creation of a domestic cross-country of meat chickens will reduce the dependence on imports of poultry genetic resources by 25-30%.

On the example of dairy cattle breeding, methodological approaches have beendeveloped to assess the impact of innovative support on the innovative potential of milk production and processing in the regional context (Table 1).

Table 1. Matrix of regional innovative potential of milk production and processing and innovative support (2020)

The level of the innovative potential of milk production and processing	Level of provision with resources for innovation support		
	High	Middle	Low
High	Regions-leaders of the dairy market with a high return on innovative subsidies. Typicalregion: Belgorodregion.	Regions of sustainable growth - with a fairly high return on innovative subsidies. Typicalregion: Kurskregion	Regions with low innovation subsidies and high innovation potential of milk through the introduction of digital platforms. . Typical region: Novosibirsk region.
Middle	Regions of potential growth in milk production due to the introduction of innovative technologies by large agricultural enterprises. Typicalregion: Vladimir region.	Regions that actively use innovative technologies that have the opportunity to increase the production potential of milk. Typicalregion: Kalugaregion	Regions with low innovation subsidies and limited opportunities to increase innovative production potential due to unfavorable natural and climatic conditions. Typicalregion: Amur, region.
Low	Regions with a low return on innovative subsidies and a weak position in the dairy market. Typicalregion: Pskovregion	Regions with a low return on innovative subsidies due to the predominance of small-scale milk production. Typicalregion: Volgogradregion	Regions with weak positions in the milk market with low innovative production potential and underfunding of innovations. Typicalregion: Astrakhanregion.

Source: Own calculations.

The processing depth indicator was calculated as the share of cheeses, butter and milk powder in the volume of manufactured products. Innovative support resources are proposed to be calculated as the sum of the ranged values of subsidies for reimbursement of costs for the modernization and support of breeding stock. In the development of these provisions, an innovation matrix was developed, built according to the principles of ranking groups of regions according to innovative support resources and the

innovative potential of milk production and processing.

Such a methodological approach makes it possible to identify the degree of sufficiency of innovative support resources to improve the efficiency of using the production potential of milk production and processing, as well as to justify the necessary measures to stimulate the introduction and use of innovations.

CONCLUSIONS

Thus, the article highlights the priority areas of innovative development aimed at increasing the added value. In order to improve approaches to management and in-depth study of industry differences, a SWOT analysis toolkit was proposed and the cost efficiency of organizations for innovative activities was calculated.

The matrix of innovativeness has been developed, which makes it possible to identify groups of regions according to the ratio of the contribution of resources to the growth of the value added of innovative production. The results of this study will allow more targeted and accurate development of the directions of state support for the development of innovation and increase the efficiency of production potential on the example of the dairy cattle breeding industry.

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