

# Features of intensive production in the development of agriculture: the innovative aspect

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**Abstract.** In the article, the authors reveal the organizational and economic mechanism of innovation-intensive development of agricultural enterprises, which is based on a comprehensive system of scientific, technical, economic, technological research and development and depends on organizational, legal, economic, legal and technical levers to increase the efficiency of activities. The component of scientific support for innovation-intensive development, methods and directions of its implementation in agricultural production are identified and justified. It is proved that the determining role in modern conditions for the formation of an innovation-intensive type of development is played by a set of factors that are conditionally divided into external and internal, organizational and managerial, scientific and technical, technological, informational, etc. According to the results of the research, the spheres of application of scientific developments are proposed and the directions of their implementation on the way to the transition to an innovation-intensive type of production in agriculture are highlighted.

## 1 Introduction

In the agricultural sector of Russia, the last decade was marked by an innovative breakthrough, when the activation of the development and introduction of advanced technologies helped to bring domestic agriculture to the leaders in the international market, contributed to improving the quality of products, the emergence of new products.

Efficiency in the field of agricultural-type innovations and especially the possibility of entering international markets is achieved in a complex along with regulatory and legal regulation, staffing, favorable credit conditions and state support.

Consequently, the long-term development of agriculture depends on the intensification and implementation of scientific results obtained on the basis of scientific and technological progress in general.

However, despite the positive results, the problem of intensification of representatives of the agricultural sector is still present, since the level of resource provision is decreasing

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and there is a need to reboot and develop measures in the field of formation and effective use of production potential.

Practice shows that innovation activity has a significant impact on improving the efficiency of agricultural production in the agricultural sector, assuming productivity growth based on increasing the level of technical support, widespread use of the latest means of production and attracting qualified personnel.

The issues of intensification and effective development of agricultural production are revealed in the works of domestic scientists A.I. Altukhov, R.G. Akhmetov, N.V. Voitovsky, A.V. Vorontsovsky, N.Ya. Kovalenko, A.V. Kolesnikov, M.V. Melnik, I.G. Ushachev, G.V. Shadrina, etc. Despite the presence of significant attention to the problem of innovative development of agricultural enterprises, research remains open in the field of intensification in the context of innovative changes taking place in the functioning of the agro-industrial complex and the formation of an innovation-intensive type of production on this basis.

In turn, the final results of the intensification of agricultural producers are provided as a result of the consistent integration of improvement processes and the rational use of all its factors.

*The purpose of the article is to expand theoretical and methodological directions, as well as to develop recommendations in the field of substantiating the need for the growth of innovation-intensive activity of agricultural production*

## **2 Materials and methods**

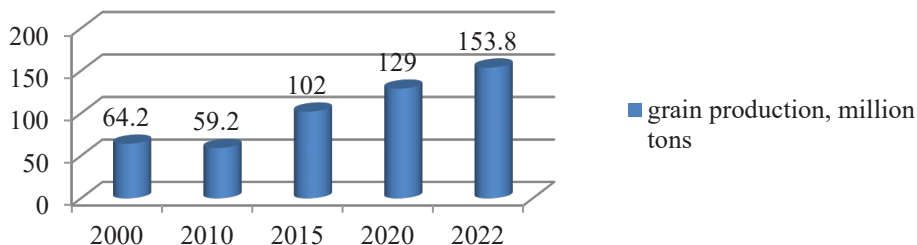
The methodological basis of the study was the generalizing results of domestic and foreign scientists and practitioners, whose fundamental and applied works reveal the issues of innovation-intensive production in agriculture. Also in the article, theoretical and empirical methods were used to reveal the purpose.

## **3 Results**

The implementation of the fullest possible realization of the achievements of scientific and technological progress, the expansion of the scope of work, are associated with the development and introduction into public production of innovations that require objective conditions for the development of socio-economic structures. Therefore, the development of innovative potential is of particular relevance, since only it is able to ensure survival in a competitive state, especially in conditions of future shortage of material, technical, labor and natural resources [1].

At the same time, this process is to a certain extent contradictory, since at the same time, when creating conditions for the qualitative and quantitative growth of the productive forces of society, an increasing volume of them is required for implementation [2].

In the domestic agricultural market, the situation develops in such a way that from year to year Russia achieves high results in a number of areas. For example, record grain harvests (Fig. 1) over the past five years indicate a significant potential for Russia to maintain a leading position in exports (1st place) on the international market. Russia accounts for more than 8% of global wheat production, ranking 3rd after China (17%) and India (12.5%).



**Fig. 1.** Grain production in Russia in farms of all categories (2000-2022) (million tons)  
 Source: compiled by the authors [17]

However, if we consider the average grain yield, this category, despite the annual growth, remains at a very low level (Table.1) compared to the same indicator in other countries, and record harvests can be explained by extensive measures (an increase in the acreage occupied by crops).

**Table 1.** Yield of grain crops in Russia and the countries of the world for (2000-2022), (cwt /ha)

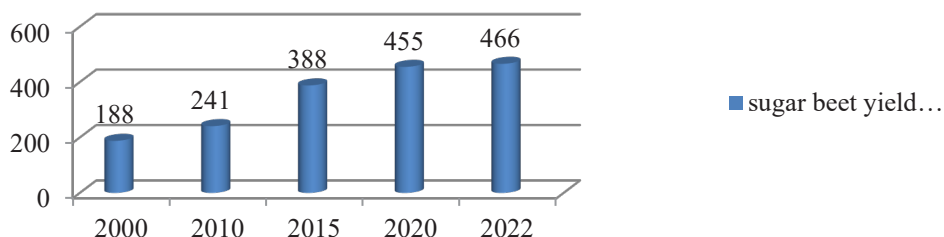
| A country        | years       |             |             |             |             | Deviation 2022-2000 (+;-) |
|------------------|-------------|-------------|-------------|-------------|-------------|---------------------------|
|                  | 2000        | 2010        | 2015        | 2020        | 2022        |                           |
| <i>USA</i>       | 58.4        | 69.7        | 64.3        | 81.4        | 82.7        | 24.3                      |
| <i>Germany</i>   | 64.5        | 66.8        | 74.9        | 71.3        | 69.9        | 5.4                       |
| <i>China</i>     | 47.5        | 55.2        | 60.1        | 63.1        | 63.2        | 15.7                      |
| <i>Argentina</i> | 34.6        | 48.7        | 47.7        | 52.1        | 51.9        | 17.3                      |
| <i>Estonia</i>   | 21.1        | 24.6        | 43.8        | 44.1        | 35.0        | 13.9                      |
| <i>Russia</i>    | <b>15.6</b> | <b>18.4</b> | <b>23.9</b> | <b>27.4</b> | <b>27.6</b> | <b>12.0</b>               |
| <i>Australia</i> | 21.0        | 16.6        | 20.2        | 16.5        | 25.4        | 4.4                       |
| <i>Algeria</i>   | 8.8         | 14.7        | 14.0        | 15.2        | 14.3        | 5.5                       |

Source: compiled by the authors [17]

In particular, experts explain this situation by difficult weather conditions in a number of regions, but no less significant role is played by seed material, most of which is supplied from abroad and undergoes complex testing in climatic conditions in different territories of Russia.

A completely different position in terms of yield among agricultural crops is occupied by sugar beet, where an intensive process is positively influenced from year to year due to the selection achievements of farmers (Fig. 2). There is also an increase not only in yield, but also in sugar yield. For example, if at the beginning of 2000 the yield of sugar (sugar content) of the crop was 10%, then by 2023 this indicator reached almost 16%, which freed Russia from dependence on imports of sugar and raw sugar, and by 2018 Russia had become a net exporter of domestic sugar.

However, despite the fact that Russia exports more than a million tons of sugar annually, even its productivity of 4.6 tons per hectare remains unprofitable for export, since cargo transportation and duties are imposed. According to experts, it is advisable to supply sugar to the world market with a harvest of 8 tons of culture per hectare.



**Fig. 2.** Sugar beet yield for 2000-2022, cwt/ha  
Source: compiled by the authors [18]

Thus, the analysis indicates the need to apply decisive measures aimed at reorienting the domestic agricultural system to modernize the innovation level with further intensification of agricultural business.

## 4 Discussion

The innovation-intensive type of agricultural production, which is a combination of its organizational, economic and technical features, is based on the focus on using the latest scientific achievements to improve or introduce new production technologies in order to reduce the cost of production, improve its quality, and as a result - increase competitiveness, corresponding to the development strategy of domestic agriculture for the period up to 2030.

The objective need for intensification is due to a number of factors, the main among which are:

- the growth of the population's need for food;
- active development of NTP;
- lack of agricultural land areas for the expansion of agricultural production [4].

In this case, the use of advanced technologies together with the tools of scientific and technological progress, as well as organizational and economic support measures, are becoming particularly relevant, aimed at forming both a new and updating the existing technological structure with the use of technical, telecommunications, engineering, biotechnological and other innovative components [7].

Considering the individual elements of the system of forming the innovative potential of agricultural enterprises in order to increase the competitiveness of products on the market and identify the influence of external and internal environmental factors, there is an increasing need to implement a particular type of innovation into business practice, assess its condition and determine the directions of development. This trend suggests that the basis for the formation of innovative potential is the internal reserves for increasing the efficiency of agricultural production on the basis of a material- and resource-saving form of intensification, which involves the use of more efficient labor items and their more rational use, as well as the consumption of less raw materials, electricity and other types of resources [3].

Thus, intensity should be understood as the concentration of the optimal level of advanced capital per 1 hectare of land, which provides a faster increase in production from this area and an increase in the efficiency of the use of invested resources. With the development of scientific and technological progress in agricultural production, the ratio between the costs of materialized and living labor is changing: the share of the first increases, and the second, respectively, decreases.

In addition, an increase in the number of the latest equipment and technologies is not able to provide effective results unless the necessary socio-economic, material and moral incentives are created that activate a person's creative activity and will ensure interest in the results of his work [8].

Taking into account the above, the intensification of production is manifested in the introduction of innovative transformations based on the use of the latest equipment or technologies and the level of professionalism of highly qualified employees [5].

The innovation-intensive type of development is determined by a set of conditions and their impact on ensuring economic growth, which is a consequence of the reproduction of the innovative component of the economic system, and is characterized by an improvement in the process of managing production and marketing of products, more efficient resource consumption and provides for continuous updating of production technologies, products and services.

Innovation-intensive technologies in crop production are based on the management of the process of crop formation, which reduces the gap between potential and real harvest and is based on the support of the innovation implementation process through the introduction of an appropriate system of a set of methods and a set of organizational and economic measures aimed at the rational use of workers' working time, machines and other resources [14].

In the context of the use of traditional production technologies, material and technical resources are created, focusing on the available capabilities of a particular enterprise.

With the use of innovation-intensive technologies, the need for such resources is taken into account in order to achieve the planned results in terms of production volumes, while the amount of costs for achieving them is subject to adjustment, providing:

- "...new crop placement systems with scientifically based crop rotations;
- the use of high-yielding varieties and hybrids of intensive type;
- application of fertilizer norms designed for a programmed harvest and optimization of nutrition during the growing season through a system of fragmented fertilization during periods of their need;
- application of an integrated system of protection against weeds, pests and diseases;
- timely and high-quality execution of all technological operations on the basis of complex mechanization of production and scientific organization of labor;
- ensuring the protection of soils from erosion and loss of fertility and preservation of the environment" [6].

Nevertheless, despite the positive dynamics of the use of innovative technologies that increase productivity and profitability, the consequences of their introduction do not always justify themselves, harming the environment in the form of environmental pollution of territories, the use of fertilizers and chemical protection products. In this context, the introduction of innovations is not only an effective tool for ensuring food security and increasing labor productivity, but also contributes to environmental protection, attracting foreign investment and catalyzes factors to improve the level and quality of life of the population [15].

It is scientifically proved that the determining role in modern conditions for the formation of an innovation-intensive type of development is played by a set of factors that can be conditionally divided into external and internal, organizational and managerial, scientific and technical, technological, informational, etc.

In modern conditions of agro-industrial complex development, there is a close interaction of internal and external factors influencing the formation of an innovation-intensive type of development. In this case, those agrarians who rationally and quickly implement the latest achievements of science and technology can ensure its

implementation, which is the result of changes in the macro-environment and, in particular, in such a link as the scientific and technical environment [16].

In innovation-intensive processes, economic growth is achieved through qualitative improvement of the entire system of productive forces, primarily material and those factors of production aimed at increasing the scale of output.

Thus, it is achieved:

- acceleration of the introduction of scientific and technological progress;
- increase of technical and technological level and increase of production volumes;
- improving the quality of products and the level of their competitiveness;
- growth of investment attractiveness, activation of capital turnover;
- improving the organizational and economic mechanism, increasing the efficiency of production and economic activities, etc.

Among the measures aimed at ensuring the economic growth of agricultural enterprises based on the intensification of land use, a significant place should belong to agro-industrial integration (at the same time, an important role is played by optimizing the size of raw material zones of processing enterprises, transport flows of raw materials and technological waste processing, improving the use of by-products, facilitating the processes of specialization and concentration of agricultural enterprises, the solution of their social problems) and the reasonable implementation of their cooperation (which ensures the receipt of maximum production per unit of costs and subject to state regulation and support for its development) [9].

Innovation-intensive development of agricultural enterprises depends on the effectiveness of the organizational and economic mechanism, which is based on a comprehensive system of scientific, technical, economic, technological research and development and depends on organizational, legal, economic, legal and technical levers to increase the efficiency of activities. Therefore, the most complete comprehensive intensification of agricultural production occurs under the condition of increasing the efficiency of the use of natural resource and production potential in the process of economic activity.

In turn, the organizational and economic mechanism for the introduction of innovation-intensive production technologies ensures the process of developing sectoral and regional innovative development programs, the introduction of appropriate standards and determines the order of interaction of agricultural enterprises and organizations, as well as their departments involved in the innovation process. It is aimed at the implementation of consistent performance of work, the formation of appropriate organizational structures within which innovative activities are carried out. At the same time, it is necessary to coordinate the activities of all participants in innovation processes and to balance material and labor resources

Simultaneously with high-tech innovations, it is necessary to introduce on a large scale "... organizational and innovative developments related to land reform and the introduction of land value into economic circulation, the creation of new market mechanisms for credit support for long-term innovative projects, as well as the formation of market infrastructure" [10].

The mechanism of introduction of innovation-intensive technologies in the agricultural sector of the economy and its effectiveness directly depend on a number of methods, including:

- identification of proposals in the industry innovation market (demand for innovation is initiated directly by the manufacturer of products);
- transfer of innovation (high-tech technology, a new variety, etc.) to an economic entity under a license agreement;

- introduction of a new kind of technology under the scientific guidance of an innovation developer;
- justification of the economic efficiency of innovative developments and their implementation [11].

Accordingly, an assessment of the efficiency of economic activity should be carried out properly, namely in the specified sequence:

- at the enterprise level: analysis of the economic efficiency of innovation, determination of the level of competitiveness of financial support at the expense of own funds, cyclical production, etc.;
- at the level of an innovation project: analysis of the effectiveness of decision-making and determination of basic performance indicators for a specific innovation project;
- at the planning level: identification of the main impact factors to achieve the desired result and assessment of compliance of the actual state of innovation activity with forecast indicators.

At the present stage of the development of the innovation sphere, the intensification of cooperation between agricultural producers and research institutions is of particular importance, creating objective conditions for the introduction of a comprehensive form of production intensification and ensuring the competitiveness of agricultural products on regional and international markets [12].

Currently, alternative models of intensification need to be developed, so scientists are investigating the following types: resource-saving, biologized, eco-innovative, etc., aimed at activating the biological capabilities of crops, producing immune-resistant properties and creating on their basis an agrotechnical system with an improved approach to the use of material and technical means, the organization of an effective system of agricultural production.

In addition, methods aimed at ensuring the innovation-intensive formation of the agricultural sector are developing due to:

- development of a database intended for implementation in research institutes;
- modernization of the market of innovative products;
- organization of forums, expositions, recommendations, advertising in the media space
- consultations and training of managers of different levels and specialists to study innovative support for economic development in regional centers of scientific support.

Based on the results of the research, the scientific foundations for the development of various areas of agricultural science are being developed, taking into account the future innovative component in a number of areas, including:

- "...the introduction of intensive technologies for growing agricultural crops and the use of environmentally friendly methods of using land, water and biological resources;
- modern technologies for the use of organic, biological and mineral fertilizers, as well as chemical meliorants of a new generation, taking into account soil and climatic conditions and crop characteristics;
- the latest technical means for converting solar and wind energy into energy suitable for use in production" [13];
- methodological recommendations on the formation and organizational forms of effective use of the machine and tractor fleet and the provision of services for the performance of mechanized work;
- technological processes and technical means for maintaining the machine and tractor fleet in a workable condition, which will be based on the latest methods of diagnostics and restoration of agricultural machinery;
- technologies for the use of nanomaterials for the restoration of parts, working bodies and assemblies subjected to significant loads;

- measures to ensure break-even production of agricultural products and the financial and credit policy of the state, which will contribute to the expanded reproduction of agricultural production.

The implementation of these measures will allow the creation of new agro-industrial production facilities with more advanced technologies aimed at reducing costs and improving product quality.

The main prerequisites for the implementation of support measures should be identified as reaching a new level of cooperation between science and production, the dynamization of new technologies, the involvement of representatives of small and medium-sized businesses in scientific processes, the availability of a set of programs for advanced training in order to train specialists capable of implementing innovative and active tasks of intensification of the agricultural production sector.

## 5 Conclusion

As a way of economic growth, the innovation-intensive type of development is based on the qualitative renewal of all the components of the production and economic system and provides for a significant increase in the productivity of its functioning, increasing the competitiveness of products, creating competitive advantages and expanding sales markets by expanding the boundaries of the introduction of new knowledge for the most complete and rational use of available material, natural, labor and financial resources.

In order to increase the efficiency of agricultural production, the activation of innovative activity plays an important role, and innovation-intensive formation will ensure not only the competitiveness of representatives of the agricultural sector, but also create prerequisites for the strategic development of related sectors of the economy.

The intensification of agricultural production based on the introduction of advanced innovative developments underlies the formation of a new type of production and is a prerequisite for expanded reproduction, acts as the main and objective process of sectoral mapping of modern globalization processes and an adapter of social and economic transformations. The effective functioning of innovation-intensive production in agriculture depends on the effectiveness of the organizational and economic mechanism, which provides for a comprehensive system of scientific, technical and technological research and development, which is based on organizational, economic, legal and technical levers to increase the efficiency of its activities, where the formative nature of innovation determines the accelerated development of branches of the economic complex and spheres of production, which as a result, it contributes to economic growth.

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