Main factors of scientific and technical development of Russian agricultural industries

I S Sandu1*, V I Nechaev2 and F S Chukin3

1Doctor of Economic Sciences, Professor, Honored Scientist of the Russian Federation, Head of the Department of FRCAESDRT RRIAE, Moscow, Russia
2Doctor of Economic Sciences, Professor, Honored Scientist of the Russian Federation, Head of the Department of FRCAESDRT RRIAE, Moscow, Russia
3Postgraduate, FRCAESDRT RRIAE, Moscow, Russia

E-mail: sandu.ntr@vniiesh.ru

Abstract. The modern world market for agricultural products is a highly competitive environment and requires suppliers to improve constantly the quality of products and the efficiency of production processes. This becomes possible by using the achievements of scientific and technological progress in production. Scientific and technical development of the agricultural sector, first of all, implies the technical and technological renewal of economic entities and the introduction of knowledge-intensive forms of labor organization, management, marketing, etc. Such modernization has a positive impact on the resource intensity and development of means of production, increases the economic potential of farmers and improves the characteristics of products. Moreover, the results of scientific progress contribute to solving socio-economic problems facing society. The combination of factors of scientific and technological development determines the pace, volume and depth of dissemination of research results in the industry. Consistent and rational interaction between science and the production sector, taking into account the variety of factors of scientific and technological development, will allow solving such strategic tasks of the agricultural sector as the emergence and growth of national production of certain types of agricultural products, and ensuring food security of the country. The relevance of the study of the above-mentioned processes is supplemented by the moral and physical obsolescence of the material and technical base of the Russian agro-industrial complex and the weak innovative activity of farmers. The paper will review the list of key factors of scientific and technical development of the agro-industrial complex and analyze the results of innovative activities in the industry.

1. Introduction
The last decade of development of the agricultural sector of the Russian economy cannot be described clearly. There are a number of positive trends: the production of national agricultural products, including those previously imported from abroad, is increasing, record harvests have allowed agriculture to take a leading position among the sectors of the economy in terms of growth rates, and Russia’s position as an exporter of agricultural crops to the world market has significantly
strengthened. At the same time, the industry continues to have negative features due to low stock availability of commodity producers, insufficient funding for agricultural science, weak integration of the research sphere and the real sector of the economy. This is the reason for one of the most acute problems of the Russian agro-industrial complex – the limited use of knowledge-intensive means of production and advanced technologies by agricultural organizations.

Consistent implementation of scientific achievements in the production processes of the agricultural sector will significantly increase production indicators, reduce resource consumption, and increase profitability. In the process of transition of the national agro-industrial complex to an innovative development model, the fundamental role should be given to the implementation of scientific and technical potential. In an effectively functioning innovation system, science creates high productive, high quality and efficient products, taking into account the requirements of the production side.

However, the current state of the facts in the field of innovative renewal of agricultural industries can be assessed as a crisis. Due to many socio-economic and biological reasons, there is a situation in which both the suppliers and consumers of advanced solutions show little involvement in innovative development. Agricultural producers are not interested or have no opportunity to modernize their enterprises, and science in the conditions of an inefficient organizational and economic mechanism has almost completely lost the motivation and ability to create developments that are in demand on the market. In this regard, we consider it necessary to conduct a study of the factors of scientific and technical development of the agricultural sectors, which, on the one hand, are the cause of the current negative trends and, on the other hand, determine the steps to enter the path of growth.

2. Methods
The research used such general scientific research methods as: monographic, theoretical generalizations, abstract-logical, statistical, analysis, synthesis, and others.

3. Results
Scientific and technological support of agricultural sectors is an interconnected activity of a wide range of structures. They include research organizations, government agencies, consulting firms, various financial and investment companies, and agricultural entities. The initial stage in the process of technological modernization of production is the development of innovative solutions as a result of R&D. The intensity and effectiveness of research activities, the demand for scientific developments among agricultural producers depend on the state of scientific and technical development of the agro-industrial complex.

Scientific and technical development of the industry affects all aspects of research: fundamental and applied research, creation of samples of new equipment and agricultural products, creation of advanced production technologies, probation and testing of experimental developments. Factors of scientific and technological progress “determine the root cause and the need for the development of this process, and its implementation is carried out in a variety of ways, which are usually called directions” [2]. Comprehensive consideration of such factors will allow setting priority vectors for the development of the scientific sphere, establishing sustainable reproduction of high-tech products and activating the introduction of innovative solutions in the activities of agricultural organizations.

In the context of the agro-industrial complex, it is customary to distinguish the following main groups of factors of scientific and technological development: biological, technical and technological, economic, organizational, and legal.

The key factors that determine the totality of characteristics of both the entire agricultural economy and its scientific and technological development are biological factors. Due to the fact that the main means of production in agriculture are land and animals, in the production of crop and livestock products, in addition to the laws of economics, it is necessary to take into account the laws of nature. The use of scientific achievements is expressed in the biologization of existing forms of farming, production, processing and storage of agricultural products, protection of plants and animals. This
helps to increase the output and quality of products, and reduces the volume of resource consumption. Consistent development of genetics, biotechnologies and genetic engineering will allow introducing new plant varieties and animal breeds into the activities of farmers, and the creation of progressive methods of selection and variety renewal will ensure a qualitative expansion of the range of national products in the agricultural sector. However, it should be noted that the potential of biological factors of scientific development of the agro-industrial complex has a very limited degree of implementation. There is an extremely sluggish activity to improve the genetic component of the processes of variety exchange and selection renewal of biological individuals.

The next important component of the scientific and technical development of the industry is to improve the technical re-equipment of production processes and technologies used. The first includes a high-quality update of technical means through the use of modern materials and energy sources. Such an update can occur in two ways: evolutionary, which implies a gradual improvement in the characteristics of production equipment, and revolutionary, which is based on a radical increase in the level of technical equipment of the industry through the use of “fundamentally new technology and the use of automation and computerization of production” [2]. The implementation of a revolutionary development scenario is possible if there is an effective scientific infrastructure, represented primarily by a complex of scientific organizations, design bureaus and management bodies. The transformation of the technical component is particularly relevant in our country, as the obsolescence of the material and technical base is an acute problem in the national agro-industrial production. Outdated equipment is characterized by low performance indicators, high resource consumption, and products produced are inferior in quality to their world counterparts.

Technological improvement of the agro-industrial complex combines the results of biological and technical development, “as it includes all the achievements of science in the biology of plants or animals and the technical equipment of the production process itself. These technologies significantly enhance the realization of the genetic potential of plants and animals, increase productivity, ensure more rational use of resources, and reduce labor costs for the production of a unit of agricultural products” [2].

Economic factors of scientific and technological development of the agricultural sector are a set of measures of state incentives and support for producers and research organizations, improving the investment climate, creating organizational and economic conditions for attracting foreign investment to the sector, providing farmers and innovative companies with affordable credit resources. Improvement of economic mechanisms is of paramount importance in the context of scarce funding for agricultural science, high debt burden and limited availability of financial resources for agricultural entities, and weak interest of private business in the scientific and industrial spheres of the agro-industrial complex. The improvement of the economy of the complex and a stable inflow of funds to the agricultural sector will make it possible to produce intensively high-tech products in Russia and increase the demand for them from the production side. The main and most effective tools for economic support of scientific and technological development are budget allocation of science and farmers, interest rate subsidies, preferential leasing programs, financing of enterprises through the mechanism of public-private partnership, and providing tax incentives to innovative entities.

An organizational resource is understood as a set of information, consulting, and regulatory organizations. On the one hand, they can initiate the activation of scientific activities, draw up the necessary regulations, program documents, plans and forecasts of various urgency. On the other hand, such structures provide the necessary information support to science and commodity producers, and form a channel for transmitting scientific and technical achievements to agricultural production. An effectively functioning organizational infrastructure implies the formation of a market for high-tech products “will increase the interest of the production side in the process, will help attract additional funding for science and accelerate the innovative development of the industry as a whole” [6].

A fundamental element of any process related to scientific and technological development is the legislative framework. The group of legal factors should also have a stimulating effect on the innovative activity of the agro-industrial complex and represents a wide range of legislative, bylaws
and regulatory documents of various levels, local government resolutions, orders of relevant departments, target programs and development strategies. Together with fiscal and financial instruments, the results of legislative activity constitute the key levers of state management of innovation and scientific activities in the agricultural sector of the economy. The regulatory framework determines the priority directions of the state scientific and technical policy, coordinates production, management, and economic aspects in the interaction of participants in the innovation process.

Among other factors of scientific and technical development of the agro-industrial complex, socio-psychological and environmental factors can be distinguished. The social component includes reforming the system of training agricultural personnel, working to ensure acceptable working and recreation conditions, increasing the level of wages, motivating employees and “stimulating them for the effectiveness of their activities” [3]. The propaganda and explanatory work among population in order to enhance the prestige of science and employment in agriculture, fixing in the minds of citizens the idea of the need for the development of agricultural industry by means of scientific and technological progress is no less important.

The last group of factors to consider is environmental factors. In modern conditions, they “represent the combined specific areas of land and environment protection in order to preserve it as much as possible and organize the production of high-quality, environmentally friendly products. Underestimation of environmental factors of STE in agriculture has already led to a number of negative consequences, the development of erosion processes and a significant decrease in the efficiency of land use and other natural resources”[1]. The main environmental directions of scientific development in the field of agriculture are the introduction of a system of anti-erosion and security measures, the organization of production of environmentally friendly products [2].

Thus, we can say that the scientific and technical development of the agro-industrial complex forms a multi-factor process. Each of the above-mentioned factors sets a certain direction for the progressive movement of agricultural science. The industry can achieve stable growth rates and increase the efficiency of agro-industrial production due to qualitative changes in the technical and technological basis of the agro-industrial complex only if all these factors interact in an integrated manner.

Further, we consider it necessary to analyze the impact of the indicated factors of scientific and technological development on the dynamics of agricultural production. Some results of technical and technological development of the agricultural sector and data on changes in the relevant indicators can be found in the National report “On the progress and results of the implementation in 2018 of the State program for the development of agriculture and regulation of markets for agricultural products, raw materials and food”. The dynamics of individual indicators of scientific and technical support for the development of the agro-industrial complex is presented in Table 1.

Table 1. Dynamics of indicators of scientific and technical support for the development of agricultural sector. Source: [1].

| Indicator | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|-----------|------|------|------|------|------|------|
| Number of new agricultural machinery sold by manufacturers of agricultural machinery to agricultural producers, units | 765 | 3 053 | 6 405 | 17 483 | 26 366 | 17 639 |
| Breaking ground for plant genetic resources for long-term storage with safe duplication (cumulative total), thousand units | 14.3 | 15.1 | 15.6 | 20.3 | 29.3 | 30.0 |
| Increase in the Russian collection of genetic resources of cultivated plants (cumulative samples), | 2.8 | 2.6 | 2.8 | 3.5 | 4.6 | 4.8 |
In general, the study of Federal target programs in the field of scientific and technological development of the agro-industrial complex has shown that the state innovation policy is quite thorough and involves a set of measures to support the scientific and technological modernization of the industry for most of the previously defined factors. The implemented measures to boost the growth of the agro-industrial complex demonstrate good results in terms of the main target indicators. However, the innovation process in the agricultural sector has some ambiguous features, which will be discussed later.

Firstly, we should consider the growth rate of production of key agricultural products in the period from 2013 to 2018, calculated on the basis of Rosstat data (figure 1), and for which there is information on the number of newly built and modernized facilities. This information reflects the results of the use of high-tech products in the agricultural sector.

| Indicator | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|-----------|------|------|------|------|------|------|
| thousand units |      |      |      |      |      |      |

Source: compiled by the author based on data [7].

Figure 1. Growth rates of livestock and poultry production for slaughter in live weight in farms of all categories in 2014-2018.

The diagram shows that most of the observations show an increase in production over the specified period. This dynamics is explained, on the one hand, by the policy of import substitution, and on the other, by global trends in the growth of white meat consumption and reduction of red meat consumption.

The National report on the state program also contains data on the number of new and reconstructed facilities commissioned, the volume of production received at such facilities, and the share of production in total production. Information is available for pork, poultry, cattle and milk production. The dynamics of the three indicators in 2013-2018 for pig farming is of particular interest from the point of view of analyzing the relationship of indicators and is shown in figure 2.
Figure 2. Dynamics of indicators of production of pigs for slaughter (in live weight) at new and modernized facilities in 2013-2018.

The diagram, on the one hand, shows a constant increase in new and reconstructed complexes and pig farms (an average of 35 annually). This is a positive sign and indicates the presence of technical and technological renewal processes in the industry. On the other hand, the instability and decline in production volumes at such facilities and its share in the total volume is a negative characteristic of the scientific and technical development of the agro-industrial complex. The observed situation of reduced production at modernizing facilities with their steady growth becomes more paradoxical, taking into account the increase in pig production in the study period (see Figure 1). This led to a significant drop in the share of products produced at the sites under review, from 4% in 2013 to 1% by 2018. It is difficult to talk about the causes of this phenomenon, but, in any case, it indicates a limited use of the capacity of new and reconstructed complexes.

In the other three sectors of the agro-industrial sector, this phenomenon is not observed, and we can only talk about the instability of the growth of new and modernized facilities and the increase in additional production at them. But the decrease in their share of production in the total volume took place, as a rule, only with a decrease in their number from year to year.

This ratio indicators in pig production can be regarded as a sign of ineffectiveness of expenses for technical re-equipment of production, projects, and subprograms of the State program of development of agriculture and regulation of markets of agricultural products, raw materials and food, aimed at scientific and technical development of agriculture in particular, and how the lack of a large-scale activity in all areas defined by factors of scientific and technological development of the industry in general. As a result, the authors of the study proposed some steps to activate the complex action of these factors:

- Creation of an innovation system aimed at supporting not only the generation of high-tech products, but also providing for the interaction of a wide list of stakeholders involved in the “creation, transfer and adaptation of innovations” in the agricultural sector [5]. Such an innovative system in Canada provided a technological transformation of the national agricultural sector and contributed to its competitiveness and sustainability;

- Development of the scientific and technical development management system based on Federal and regional agreements, joint management of initiatives and projects in research and implementation areas; involvement of scientists and industry representatives in the management of innovation processes;
4. Summary
In modern conditions, sustainable growth of the agricultural sector is possible only through the introduction of high-tech products and innovative solutions in the activities of manufacturers. The intensity of scientific and technical development of the agro-industrial complex is determined by a complex of factors: biological, technical and technological, economic, organizational and legal. These factors set specific directions of scientific and technological progress in the industry.

Analyzing the current state of innovation activity, the authors came to the conclusion that despite a thorough state agricultural policy, the technical and technological renewal of some branches of the agro-industrial complex is characterized by instability and imbalance.

In this regard, in the final part of the study, the authors formulated a list of measures necessary for sustainable and intensive scientific and technological development of the sector. The proposed measures, first of all, provide for improving the system and infrastructure of the innovation process, mechanisms for information support and state financing of agricultural producers.

5. References
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