

Analyzing dynamics of the introduction of the innovative Russian and foreign technologies in the agro-industrial complex

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Abstract. As of today, the agricultural industry does not lag behind modern trends, and more and more often we can observe the development and implementation of innovations in the agro-industrial complex (AIC). One of the most important strategic directions to develop innovation in the agriculture is innovation processes, as well as research progress that provide continuous development. The article analyzes the dynamics of the introduction of innovative technologies in the agro-industrial complex, deals with the problems that impede the introduction of innovative technologies in the agro-industrial complex. As a part of the uncovered problems, measures have been proposed to improve the mechanism for the development and implementation of innovations in the agriculture.

1 Introduction

Innovations in the agro-industrial complex are new or well-known, but the scientific ideas of Russian and foreign researchers have not yet implemented in the domestic agro-industrial complex and the use of which in the development and implementation of technical-technological and engineering projects will significantly increase the efficiency of agro-industrial production [2].

Nowadays, there are a lot of motives to develop innovation in the agro-industrial complex, but the main driver is market competition. Agricultural facilities incur losses when using outdated equipment and technology, so they are forced to reduce costs through the introduction of innovations. The enterprises that managed to master innovations and introduce them into their activities noticeably and rapidly strengthen their positions in the competitive struggle [3].

The smooth implementation of innovative activities in the agriculture implies the emergence of certain specific features and characteristics. [5]

In addition to the features of innovative activity in the agriculture, it also has its own classification characteristic of the industry.

The classification of agricultural innovations includes [10]:

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- Technological (technological re-equipment of the agro-industrial complex, introduction of new technologies).
- Marketing (introduction of various marketing tools and methods that promote more efficient development of agricultural enterprises).
- Organizational (more efficient organization of all management processes, organization of workplaces, etc.).

Thus, the innovation in the agriculture is a very multifaceted aspect that can be viewed from different angles. Today, there is a huge range of concepts, classifications and features that help characterize this term, at first glance they may seem ambiguous, but this is not so, each of them has common components that enable to understand the whole picture.

2 Materials and methods

The work contains the results identified in the framework of published reports and analytical materials of international organizations, specialized analytical publications, data from foreign and Russian news agencies, as well as interviews and articles by leading analysts and experts. Research methods:

- Theoretical and empirical methods.
- Description methods.
- Method of graphic illustration of data.

3 Results

Nowadays, analyzing the dynamics of the introduction of innovative technologies in the agro-industrial complex by various countries, we can observe about 150 undertakings in this industry, which, within the time of their existence, were able to grow into a large, successfully developing business.

However, it should be noted that these projects are not limited to the scale of innovative technologies development. Every day there are new startups and new projects that set the task to improve the agro-industrial complex and activities as a whole.

Analyzing the dynamics of the introduction of innovative technologies in the agro-industrial complex, there is a situation where even rapidly developing countries are not in the same position (Table 1).

Table 1. Innovative technologies in the agriculture of the BRICS countries [9].

Innovative technologies	Brazil	Russia	India	China	South Africa
Unmanned aerial vehicles	+	+	+	-	+
The latest software and databases	+	+	+	-	+
Online platforms for trading agricultural products	+	+	+	+	-
Satellites и GPS	-	+	+	-	+
AI to increase yields	-	-	+	+	-
Genetics and selection	-	+	-	+	-
Wind and solar energy	-	-	-	-	+

It should also be noted that today specialists in the field of innovative developments in the agro-industrial complex of Russia are increasingly raising the issue of the need to develop and implement innovative technologies that will be aimed at using alternative energy sources, such as wind and solar energy. This direction is considered by experts as very promising and necessary [6]. The most popular areas of innovative development of the agro-industrial complex of Russia are such technologies as unmanned vehicles and geopositioning systems.

Let us dwell on each the directions of innovations development in the agro-industrial complex. Unmanned vehicles are increasingly being introduced into the activities of individual agricultural enterprises in Russia in the form of drones, unmanned tractors and combines.

As for the effectiveness of unmanned vehicles, 84% of scientists and experts believe that it is very promising for Russian business. At the same time, the introduction of such technologies may face a number of problems (Figure 1).

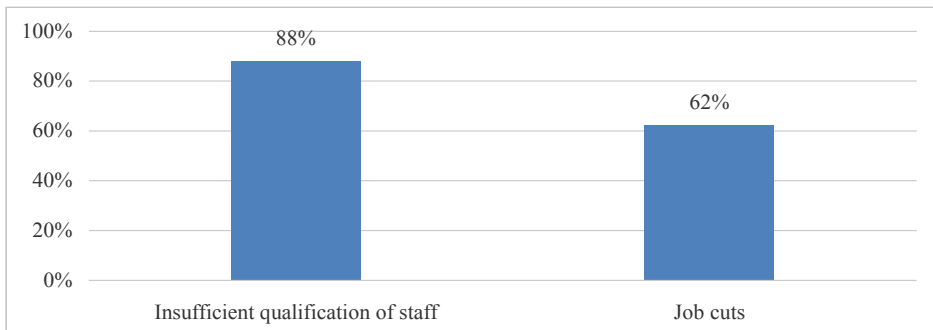


Fig. 1. Implementation related problems of unmanned vehicles.

The Figure 1 shows that the introduction of unmanned vehicles in the agro-industrial complex in Russia is a fairly long-term process that involves the problems presented. Since 88% of workers are not qualified, it will take time to retrain them, but we may encounter a new difficulty such as the unwillingness of workers to improve their skills. It is necessary to carry out more activities aimed at familiarizing people in order to avoid such problems, including agricultural workers, with innovative developments in this area, stipulating all the advantages.

As 64% of experts noted another obvious problem is job cuts. However, this issue is quite controversial, since these unmanned vehicles must be serviced, and it also requires specialists.

At the same time, there is another positive opinion. The use of unmanned aerial vehicles will significantly minimize the risks related to the human factor. As well as:

- Reduce the outflow of specialists from the agricultural sector.
- Analyze soil, seeds, crops without human assistance.
- Tillage.
- Forecast yields. In general, the first ever application of rice cultivation technology using drones in 2021 made significant importance in the development of the agro-industrial complex of Russia. Agronom-Sad also tried production tracking technologies, which consists in displaying all information about the harvested crop on a tablet. By the end of 2021 in livestock farming the number of farmers using technologies such as devices to control the amount of milk has increased [7].

These activities have a greater economic effect, as the wages cost, production costs, and time costs are significantly reduced. Since the robot does not have flaws in calculations and there is no over-expenditure of raw materials.

On a global market scale, unmanned vehicles are the most commonly used in the agro-industrial complex of many countries of the world. The figure 4 shows the dynamics of global sales and deliveries of agricultural robots from 2015 to 2024.

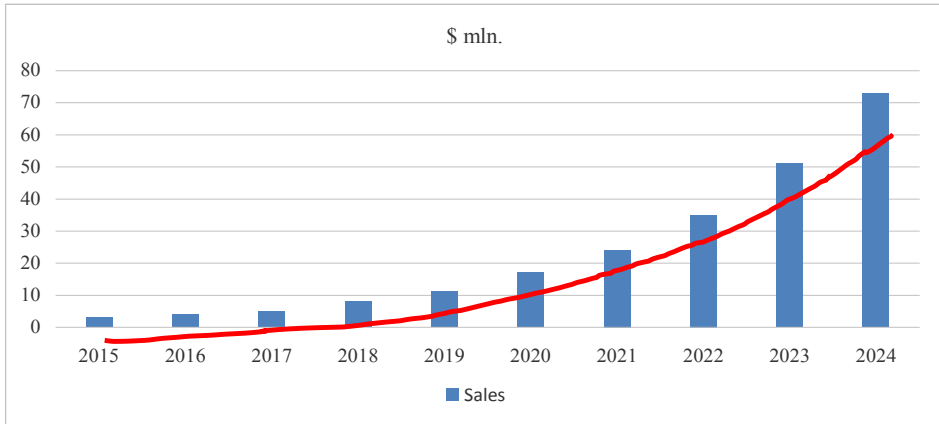


Fig. 2. Global sales and deliveries of agricultural robots in 2015-2024 [4].

The Figure 2 reflects the dynamics of sales and deliveries of agricultural robots over the past reporting periods, and also examines the prospects for the future. As we can see from the presented figure, until 2019, the volume of global robot sales in the agriculture did not exceed \$10 million. Gradually, the sales volume increased and in 2021 it exceeded \$ 20 million, according to experts, sales volumes will continue to increase in the future. According to the forecast estimates, global sales and deliveries of agricultural robots will exceed \$70 million by 2024, which is almost \$60 million more compared to the same figures at the end of 2019.

4 Discussion

Geopositioning systems are rapidly developing in Russia and the world. As of today, the agro-industrial complex of Russia uses equipment operation sensors, locators and sensors. These geopositioning systems allow you to track information such as: humidity, air and soil temperature, plant health, and the presence of various pests.

Russia is the manufacturer of Agronavigator Campus, which is also used in other countries. Such a navigator includes [8]:

- Night vision modes and brightness adjustment.
- Uploading work fields to Google maps for viewing on a computer.
- Visualization of the treated area.
- Measurement of the area and display of the processed area.
- Automatic calculation of per hectare or hourly pay for the machine operator.

To date, the agro-industrial complex of Russia also uses laser sensors that allow you to understand how much sunlight is reflected by plants, as well as measure the reflection of laser beams. Sensors are also used to measure the properties of soil and plants, display weeds, pests and sensors that track the storage of the harvested crop.

As for the introduction of innovative technologies in the agro-industrial complex of foreign countries, by 2025 China plans to make a number of significant developments in this direction and achieve a number of indicators. Thus, the digital economy of agriculture should account for 15% of the value added of the agro-industrial complex of China, the share of agricultural products sold on the Internet is 15%, and on top of that, it is necessary to provide Internet access to 70% of rural areas by the appointed date. The state wants to see more new agro-industrial robots that will perform tasks in crop production, livestock farming and fishing.

Four main trends highlight in the activity within the entire global scale to analyze the dynamics of innovative technologies development in the agro-industrial complex by 2022 [1; 11-13]:

- Precision farming, which can be a powerful incentive for the development of agriculture 4.0.
- 5G technology. As 3.64 million are not equipped with high-speed Internet out of 5.07 million rural facilities, this technology will help make a powerful impetus in the development of the global agro-industrial complex.
- Electronic commerce. This type of trade already exists in a number of countries, but is not used effectively.
- ESG agenda. In this context, technologies serve to improve and replace agricultural practices in order to replace the use of non-renewable fuels and biomass with renewable resources and reduce greenhouse gas emissions.

Innovative developments of a similar level can have not only a positive economic effect, but also a social one, since in recent years the agro-industrial complex has attracted increasing interest from young people, and there has been an increase in employment in this area.

Thus, after a short analysis, we can conclude that the innovative sector of the agro-industrial complex, both in Russia and in foreign countries, has a positive development trend, every year new improved technologies appear that improve this industry.

In order for the innovative sector of the agro-industrial complex of Russia to overcome significant gaps in comparison with developed countries in the implementation of introducing and developing innovations in this sector, a number of activities should be introduced that will be used to support the development of this industry. Today it is difficult to imagine the implementation of such measures without investment, financial, material and other measures of state support.

The analysis allows us to conclude that the innovative development of the agricultural sector in Russia has a number of prospects, new measures of state support are emerging, action plans are being developed, and predictive assessments of the agro-industrial complex will be conducted by 2025-2030.

As the main measures aimed at improving the mechanism for the development and implementation of innovations in agriculture in Russia, it is proposed:

- To create a grant program to support the development of innovative technologies in the agro-industrial complex for small businesses in the Innovation Promotion Fund.
- To finance research and development in the agro-industrial complex through the regional support programs using soft loans from 10 to 200 million rubles with a reduced rate of 2-3%.
- To provide grants of up to 300 million rubles for developers of fundamentally new world-class agricultural technologies at the expense of the federal budget, the Ministry of Agriculture of the Russian Federation.
- Providing large agricultural enterprises and start-ups (small enterprises) with tax holidays from 3 to 5 years for the development and commercialization of innovative developments in the agro-industrial complex. The term of tax holidays depends on the novelty level of the innovation: 3 years for a new agricultural technology for the region, 4 years for fundamentally new developments on a national scale, 5 years on a global scale.
- Increase the number of higher education institutions providing both basic training and advanced training for specialists in the field of innovation management for agriculture.

5 Conclusion

Thus, the development and implementation of innovations in the agricultural sector today is one of the most important tasks of both the state as a whole and some enterprises in particular. The innovative development of the agro-industrial complex is important not only to stabilize and improve the economic situation of the country, but also an important factor to strengthen its position in the world market.

The analysis allows us to conclude that the innovative development of the agricultural sector in Russia has a number of prospects, action plans are being developed, and predictive assessments of the agro-industrial complex by 2025-2030 are being carried out.

The activities proposed in the work will not only stimulate innovation in agriculture in the Russian Federation, increase its efficiency, increase labor productivity, but also increase the prestige of agribusiness among young people, a technological breakthrough in the agro-industrial complex.

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