

# Artificial intelligence in agriculture as a basis for increasing the competitiveness of Russian enterprises

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**Abstract.** Digital technologies ensure the competitiveness of agriculture and have the ability to attract investment. They are needed to increase milk yield and improve the quality of dairy products. "Smart Farm" is a fully robotic facility that analyzes the feasibility of production. For example, this analysis indicates the economic feasibility of breeding certain breeds of farm animals. Now milking robots are used all over the world. If the average milk productivity of cows is 5,000 liters per year, then due to the introduction of modern technologies, the result can be up to 12,000 liters per year. Another plus is the fact that the production process can take place without the presence of an operator. A smart farm is a fully automated process. Such a farm can independently calculate the economic profitability of its production, where the necessary digital technologies are used. Based on the analysis, a decision is made to optimize the production process.

## 1 Introduction

Currently, digital technologies are gradually being introduced into agriculture. Sensors have already been developed and are being introduced into production on farms that monitor the physiological state of animals and identify any problems in the early stages of the disease, when the animal can be provided with timely assistance. With the help of such sensors, the incidence of mastitis is reduced by at least 60%. The quality of dairy products also increases by about 30%.

A smart farm also involves automated fodder production, automated feeding, and microclimate determination. Feedback from consumers with the help of information and analytical blocks is also important.

But not only robots on farms are being actively introduced in agriculture. "Smart technology" is constantly being improved when sowing, irrigating, harvesting and sorting agricultural products. For this, precision seeding technologies are used. Sensor data helps to determine the quality of the soil, its density and the level of moisture and fertility. Therefore, the increase in productivity is guaranteed to a greater extent than without the use of new technologies [3].

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In the near future, one person will be able to sow several fields, watching the work of new agricultural machines via video broadcast with a digital control panel.

## **2 Materials and Methods**

For the results of the study, the article uses a statistical method to analyze data from the federal and regional levels. The method of environmental - legal analysis is used in the analysis of the improvement of technological processes in the production of the agrarian complex. The methods of analysis and synthesis are used by the authors in the conclusions when summarizing the results of the introduction of digital technologies in agricultural enterprises.

## **3 Results and Discussion**

Among the innovations in agriculture, innovations in the analysis of soil samples, yield maps, and satellite images are in great demand. But only large agricultural enterprises can afford smart technologies. And on the market, most enterprises are medium and small, which do not have enough free funds to re-equip production. But it is also important to choose the right automation tools that will generate income over time. Not all technologies are suitable for all agricultural enterprises.

A good example of the application of innovation in agriculture is the experience of Switzerland. In Switzerland, a demonstration farm was created from the state budget, which is under the control of the state. This is the first farm in Europe where new automated control is being tested, the impact of new technologies on economic growth in the country is being analyzed, and labor productivity is being analyzed.

In Ireland, the state program "Smart Farming" was introduced in 2014. Agricultural entrepreneurs are offered affordable automated controls to reduce costs and reduce harmful emissions. Thanks to new technologies, it was possible to reduce fuel consumption by up to 12% on average.

Now let's analyze each technology separately. In agriculture, they are not numerous. One such new technology is precision farming technology. These include satellite and computer technologies. Such technologies are used by the USA and Switzerland. One such technology is the parallel driving system, which was developed in Germany. It carries out automatic driving of agricultural machinery strictly according to the specified parameters. This system ensures the accuracy of driving vehicles from 5 to 30 cm. In addition, the equipment performs its functions in any visibility [2].

In Russia, the Azimuth-1 navigation console is used for this purpose, designed for parallel driving of vehicles across the field in order to identify uncultivated areas. You can also name the Atlas 730 apparatus, which ensures the passage of a tractor with a mounted unit across the field. And the Agronavigator system is designed to work in the fields at night.

The next development is a yield mapping system. Yield cartograms allow you to identify the heterogeneity of the level of yield in one field. Also, this system monitors the level of humidity in the fields.

Further it is necessary to note such innovative technologies as telemetry systems. They are designed to improve the performance of agricultural units. Among Russian manufacturers, such a system was created by Rostselmash. This system is designed for the operation of equipment with remote control. The Russian company GLONASS Telematics provides services for the maintenance of satellite monitoring systems [1].

The next system of innovations in agriculture is geographic information systems (GIS). Domestic developments of such systems include Panorama AGRO, GeoPlan and others. The essence of these developments is that information is received from various sensors in real time.

Differentiated fertilizer application technologies are used using satellite navigation with remote control of equipment. To determine the required amount of fertilizer in the areas, sampling is done, and when analyzing the results, field maps are compiled. For this, agricultural robots are also used, which help to reduce the overspending of fertilizers and chemicals. In addition, unmanned agricultural machinery with a computer vision system also belongs to robots. Such equipment is being developed by the manufacturers Rostselmash and the agricultural holding Soyuz-Agro [3].

Next, we consider automated systems for the vegetation of agronomic crops. These include touch sensors for measuring soil properties. Sensors also help determine the yield of crops in certain areas, since with a precise positioning system they determine how much fungicides and growth stimulants plants need. Sensors help determine the amount of nitrogen in plants. In order to increase yields, sensors are used to apply fertilizers and pesticides across the field in order to accurately determine the amount of fertilizer and increase yields.

About automated control systems for dairy farms, the following should be noted. Having these systems, you can significantly reduce labor costs and eliminate possible errors in the processing of information. The most popular system in the world is the Afimilk system from S.A.E. Afikim, developed by Israel. This is an automated cow movement control system, an automatic weighing system when moving, an accurate measurement of cow milk yield when determining a pedometer. There is also a device that determines the comfort status of cows.

AIoT projects allow you to automate the entire cycle of agricultural operations for growing plants or animals. Mandatory components of such solutions are: sensors and sensors, satellite communications. The main application of such projects is for crop and soil monitoring for precision farming and animal monitoring. Such systems allow for the management of the agricultural machinery fleet by tracking the location of the machines and their working condition. The Russian developers of AIoT projects include Component JSC, where you can monitor agricultural machinery, as well as analyze the storage and processing of agricultural products, as well as monitor agricultural land [6].

The tractor is the backbone of any farm, and it is clear that with the trend towards the development of unmanned vehicles in the world, tractor drivers will also be the first to leave their cabs on farms. They will either have to go home or retrain as specialists who enter cartographic data and set field boundaries, as well as learn how to program the trajectory of movement using special programs and determine other parameters of the operation of unmanned tractors.

Subsoil drip irrigation is also not a new technology now, although it is not yet used in all farms. IoT - sensors monitor the level of soil moisture and the condition of plants. This process is also automatic without the intervention of workers.

Significantly advanced new technologies in agriculture, where the BoniRob field robot moves into the field with the help of a satellite, where there are built-in cameras. This robot removes weeds and evaluates young seedlings. Destroys weeds and the Smart Farm automated cultivator. It distinguishes agricultural crops from weeds and destroys the latter. Such robots allow farms and agricultural organizations to do without a large number of workers.

With the help of machines and robots, it is now possible to harvest fruits and vegetables. Panasonic has developed a tomato picking robot. With the help of cameras and a color

algorithm, the robot recognizes ripe fruits. There are also robots for picking apples, where, with the help of computer vision, the robot also recognizes ripe fruits.

As for drones, they are being used more and more not only in agricultural enterprises, but also in farms. Drones recognize the quality of the soil, assess the condition of crops. With the help of field shooting, you can plan planting on certain plots of land, plan irrigation work. Drones are now acting as good helpers when sowing plants and irrigating them. Teams of scientists are now working on drones that can use compressed air to scatter seed and fertilizer capsules. Such drones will play a huge role in forest restoration. In addition, drones will help to plant plants in suitable areas on favorable soil, where there are conditions for rapid growth and good yields [7].

In China, drones are now actively used for spraying plants. But drones have one drawback. They can stay in the air for no more than one hour, and then they need to recharge the battery. And drone prices are quite high, which is the second negative. Each of them costs at least 15 thousand dollars. And cheaper types of drones do not perform the high-quality field shooting that farmers need [10].

Artificial intelligence is being increasingly used in agriculture. If in 2010 there were no more than 20 firms in the world that supplied new technologies for agriculture, now the number of such firms has increased tenfold. The United States is recognized as the most advanced country where new technologies are being actively introduced. This country occupies more than 45% of the use of new technologies in agriculture in the world market. American farmers are actively using drones that analyze soils and use satellite images. Countries such as Germany, India and China are no less actively using new technologies. In Russia, the smart farming market is only 1.5% of the world market.

Of course, not all farms will be able to afford a complete re-equipment with modern technologies. Only large organizations can do this. For example, in Ireland in 2014, the state program "Smart Farming" came into effect. More than 2,000 farms are participating in this program. The program provides for various scenarios for the use of new technologies and the reduction of environmental pollution from the activities of agricultural enterprises [9].

Now let's focus on new technologies in the field of precision farming. Precision farming technologies are based on navigation and telemetry systems, land remote sensing, and differentiated fertilization. In Russia, the domestic navigation console "Azimuth - 1" is used. It is designed to measure the cultivated area of the field. There are also agronavigators for night processing in the fields. The advantage of such innovations is that relatively little fuel is consumed and there is no manual labor involved in applying fertilizers and chemicals to the fields. They also help in risky farming areas [5].

Geoinformation systems are firmly embedded in our lives. Domestic geographic information systems include GIS "Panorama AGRO", "Geoplan", "GEO-Agro" and some others. These companies are engaged, in particular, in the modeling of sensor sensors that are designed to measure soil properties. Sensors detect weeds and pests, as well as plant diseases [4].

CropX Ltd, an Israeli agricultural company, develops cloud-based software solutions to increase crop yields. Built-in sensors monitor the condition of the soil and transmit data to analysts. Among domestic companies, one can single out Component JSC, which monitors vehicles, analyzes agricultural land and manages livestock.

All countries are now developing innovative equipment for agricultural organizations and farms. Farmers, using smartphones, receive accurate information about field activities - when to water, fertilize and harvest. But not every farmer has access to the Internet.

The use of clean water for agricultural purposes is now also acquiring great importance. In the world, more than 65% of clean water is used in agriculture. And more than half of that figure is wasted. Innovative systems solve this problem by alerting farmers to leaks.

Already, the Ocean Reef Group is experimenting with growing agricultural products under water. Specialists plant cabbage, lettuce, beans and strawberries underwater. And these innovative inventions also need to be conveyed to our farmers so that they know about the existence of such technologies. Of course, now in the Sverdlovsk region in the near future we will not be able to grow strawberries under water on our farms. But in the future it will be quite possible [8].

Currently, the Ural State Agrarian University provides farmers with such programs as "Improvement and optimization of feeding of highly productive cows. The program is designed for 72 hours and includes such issues as the characteristics of the forage base, the rationing of feeding cows, the importance of nutrients for milk productivity and the chemical composition of feed. Also, farmers need to know about the sanitary and hygienic indicators of dairy products. And these issues are implemented by the program "Assessment of physico-chemical and sanitary-hygienic indicators of milk and dairy products." The program is also designed for 72 hours, where during the lectures and practical exercises questions about the physical and chemical properties of milk are considered, recommendations are given for the storage and transportation of dairy products. Describes the sampling of dairy products. There are also a number of other programs implemented at the university, which highlight the issues of milk production technology in modern conditions, get acquainted with the Selex program for organizing breeding work at enterprises. Students are also introduced to the functions of accounting.

The innovative program is the program on the technology of production of pheasants and ostriches. Here, much attention is paid to the environmental aspects of poultry farming. The program for the production of cheeses in the conditions of small forms of management is also relevant at the moment, where acquaintance with the technology of rennet cheeses takes place, technologies for the production of cheeses are studied and then master classes for the production of cheeses are held. A program has also been developed for advanced technologies for organizing machine milking. Here they are introduced to the methods and methods of milking cows, talk about the care and preparation of milking equipment.

In crop production, a program has been developed and is being implemented to maintain a highly aesthetic and productive orchard. The program introduces the timing and methods of planting fruit plants, the life and annual development cycles of perennial plants, as well as environmental factors such as light, soil, temperature and water supply of fruit trees. In addition to this program, the university implements a professional retraining program in modern technologies in agronomy. The program provides for the study of such issues as soil composition, phytopathology and chemical plant protection products, breeding and seed production, as well as crop cultivation technology.

The program for the production of organic products is currently becoming the most relevant. It deals with the effectiveness of organic farming, biological methods of plant protection, fertilizers in organic crop production.

## **4 Conclusion**

The innovative development of digital technologies in agriculture continues to develop. Currently, in all developed countries, milking robots - automatic machines are used on farms. For our country now a necessary condition is the development of automated systems in agriculture. These systems set certain operating parameters and determine their changes depending on the microclimate and the condition of animals on farms. It is in such farms that it is possible to ensure the high quality of dairy products and improve the quality of milk to the "extra" class.

On the basis of digital systems, databases of the dairy herd are now being created. They are necessary for studying the physiological state of animals. Such devices also determine

the quality of milk at milking machines. Also, digital systems provide for the introduction of automated feed production management systems, information systems for feedback from consumers and analytical blocks for assessing product quality to the production of agricultural enterprises.

Automated technologies for forage harvesting allow not only harvesting feed efficiently and on time, but also determining the desired ration of feed mixtures. New technologies are constantly being improved and introduced into agricultural activities. This will increase the volume of agricultural products and improve its quality. Robotization of agricultural activities will also affect the use of human resources in the agro-industrial complex. With fewer human resources, highly efficient specialists will be needed to manage new systems.

If we analyze the state of implementation of the smart farm elements in the agricultural enterprises of the Sverdlovsk region, then it must be said here that new technologies have been used in the advanced farms of the region for several years. These include robotic milking and animal feeding, energy-saving ventilation systems and automated indoor climate control.

Such systems as "Mercury", which is intended for veterinary control, the "Selex" pedigree accounting program for managing a pedigree herd, and programs for calculating the feed ration, have been introduced into production. In crop production, 48 agricultural organizations of the Sverdlovsk region use GPSGLONASS systems for precision farming.

You can also cite as an example enterprises that produce finished food products from raw materials. The LLC "Molochnaya Blagodat" enterprise in the city of Kushva, using the GPSGlonass system, controls the company's vehicles. CJSC Food Plant Khoroshiy Vkus uses production modules of the MSAxapta 4 system to control production processes.

Unmanned aerial vehicles for studying the condition of crops and the quality of work performed in the fields are also already being actively introduced into production at the leading enterprises of the region. Now it is planned to introduce a cloud service program for the effective management of agricultural production.

What has already been done and is planned to be done by the Ural farmers for the period up to 2025:

- a) introduction of the latest scientific achievements, agricultural technologies and projects of "Smart" agriculture (smart field, smart farm, etc.) into production.
- b) digital technologies and other areas of intellectualization of agricultural production.

In the Sverdlovsk region, advanced farms use elements of digitalization. These include robotic milking and feeding, energy-saving ventilation systems. Lighting automation. In addition, automation of production processes is carried out at large enterprises using programmable controllers.

- c) ecologization of agricultural activities through the organization of the production of organic agricultural products, raw materials and food, excluding bacterial, chemical and physical contamination of food.

On the territory of the Sverdlovsk region, there is a Strategy for the management of production waste until 2030. The objective of this strategy is to solve environmental problems in the region.

- d) obtaining new types of food products for general and special purposes using enzyme preparations and biologically active substances for consumption by various age groups of the population.

2. Stimulate the involvement in the production of agricultural products and food of unused agricultural land on agricultural land and increase the soil fertility of agricultural land.

3. Together with local governments:

- a) Involve personal subsidiary plots in food production.

In the Sverdlovsk region, there are on average up to 300 thousand personal subsidiary farms, which produce up to 65% of potatoes and vegetables from the total production in the region. But the production of milk and meat products in personal subsidiary farms is declining every year. This also depends on the aging of the population of villages and villages, and is associated with problems in the sale of their products. These reasons, in turn, make it difficult to accelerate the process of regional food security, since the main share of dairy and meat production belongs to large farms and agricultural holdings. Therefore, it is necessary to help private farms in the sale of their products. For this, wholesale distribution centers have been created that are engaged in the purchase of crop products and wild plants from the population.

b) to promote the formation and development in rural areas of agricultural cooperatives and subdivisions of the consumer cooperation system that produce procurement and purchase of food forest products.

There are several types of cooperative activities on the territory of the Sverdlovsk region. First of all, these are agricultural production cooperatives. These include SPK "Kilachevsky", "Zavet Ilyich", "Glinsky". There are also SKhPK, which are located on the territory of the urban district of Pervouralsky - "Pervouralsky" and "Bitimsky". For a limited liability company, let's take the agricultural firm "Irbitskaya", "Uralskaya" as an example. Examples of CJSC are the agricultural firm "Patrushki", "Novopyshminskoe". PJSC includes the Pamenskoye enterprise.

c) organize the activities of farms and agricultural cooperatives for agricultural fish farming (aquaculture).

There are about 400 peasant farms in the region. In 2016, the peasant farms of the Sverdlovsk region were recognized as the best in the country. But peasant farms are also experiencing certain difficulties due to insufficient state support and competition from large agricultural enterprises.

4. Assist in the development of a system of training, advanced training and retraining of personnel capable of implementing an innovative model for the development of regional agriculture and agro-industrial complex that ensures food security.

Currently, the Ural State Agrarian University has resumed the project for the revival of agricultural classes, which has ceased to operate in the last decade. Therefore, now it is important to pay attention to those rural areas where the shortage of highly qualified personnel is especially noticeable. Currently, the Center for Professional Development of Youth at the Ural State Agrarian University is working with a number of schools, where agricultural classes are being created on the basis of schools.

Therefore, an increase in the level of automation and mechanization, as well as the introduction of innovative developments in the production of agricultural enterprises, will lead to an increase in labor productivity, to an increase in the competitiveness of Russian agricultural enterprises and to reduce the gap in product productivity from developed countries.

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