Management of digital technologies development in agriculture of the Russian Federation

N S Kulyasov1,5, N N Grinev2, N Yu Nikolaeva3 and D N Klepikov4

1 Department of Economics and Management in Construction, State University of Management; Ryazansky Avenue 99, Moscow, 109542, Russian Federation
2,3,4 Department of Management and Marketing, D.Mendeleev University of Chemical Technology of Russia; Miusskaya Square, 9, Moscow, 125047, Russian Federation
5 E-mail: nkulyasov@gmail.com

Abstract. The article is devoted to managing the development of digital technologies in agriculture of the Russian Federation. The study analysed the current state of digitalization of agriculture, identified the main directions of development. During the work, factors and risks that impede the development of digital technologies in agriculture were identified, associated with the strong fragmentation of the Russian agricultural market, problems of confidentiality, security and regulation of data handling, and other factors. As a result of the study, a model for the interaction of smart agriculture objects in the Russian Federation was proposed, the implementation of which will provide a qualitative and quantitative transition to the use of digital technologies. The characteristic is given to the objects of smart agriculture in the Russian Federation in the framework of the interaction model and the indicators of digitalization of agriculture of the Russian Federation are determined. The study concludes with key findings and results.

1. Introduction
Today, special attention is required to problems associated with population growth and food shortages. To solve these problems, it will be necessary to radically change the methods and methods of agricultural production. By the year 2050, food supply for the world population will require 70% more products than today [1]. Food production will be hampered by climate change, energy price volatility, and a decrease in the quantity and quality of fertile land. In order for land productivity to grow and reduces another cost, it is necessary to apply the methods of the concept of smart, which is based on the use by farmers of various innovations in the field of digitalization and automation of production. The “analogue period” in agriculture ends, and the Second Green Revolution begins. According to experts, due to the application of precision agriculture technologies in conjunction with the Internet of things, a powerful surge in productivity can be achieved. This yield surge should be much larger than with the advent of tractors and machines, the invention of herbicides, complex mineral fertilizers and genetic engineering [2].

Recently, the level of information technology has evolved greatly, they have become cheaper and the agricultural industry could collect data on agricultural facilities, calculate and predict algorithms for making decisions using mathematical methods [3].
From agriculture, demand for high-tech jobs, IT services, Data Science, Big Data, robotics, analytics and mathematics began to grow sharply. This demand stimulates the development of science and higher education to meet the need for such specialists [4].

In turn, on the part of industrial and machine-building companies, there is a maximum involvement in the processes of digitalization and automation of agricultural production. Agriculture is a complex high-risk industry with its own production specifics, technologies, and implementation methods [5]. High risk is expressed in the high vulnerability of the business and a strong dependence on weather and other natural phenomena. In agriculture, unlike traditional industrial production, it is extremely difficult to structure business processes. The specifics of production is reflected in the long value chain of agricultural products (figure 1), which leads to a large number of unresolved industry problems that can be solved with the help of digitalization, the introduction of IT and automation, thereby increasing the investment attractiveness of the industry.

Figure 1. Agriculture Value Chain.

As can be seen from figure 1 above, the process of creating added value has a complex horizontal structure and is characterized by a vivid fragmentation of supply chains depending on the types of crops and products.

In the whole world, unlike Russia, the principles and technologies of smart agriculture are actively used to stimulate efficiency and productivity in agriculture. In the EU countries they are used by 80% of farmers, in the USA - 60% [6]. Impressive success was achieved by farmers in Brazil, Denmark, Japan, Argentina.

Smart agriculture is an integrated approach to farming in the 21st century. Figure 2 below shows the main trends and directions in the development of smart agriculture technologies [7].

In Russia, smart agriculture technologies are only being introduced and only 5-10% of producers are used. Today Russia is one of the second dozen countries in the world in terms of digital development in agriculture. Farm labor in the Russian Federation is 3-5 times lower in productivity compared to the USA and the EU [8].

The reason for low productivity is the slow adoption and adoption of digital solutions. Sown area in the Russian Federation totals 80 million hectares, and digital solutions and technologies are used only in 5-10% of the territories [9]. Russian agriculture is now facing an urgent task of increasing competitiveness. One of the main ways to solve the problem should be the transition to smart agriculture. However, this transition is difficult due to the insufficient number of techniques and approaches that describe the processes of digitalization and digital transformation in agriculture. Thus, the relevance of
the study lies in the development of an appropriate model, the implementation of which will integrate digital technologies to increase the competitiveness of agriculture, considering Russian specifics.

Figure 2. The main directions of smart agriculture.

2. Materials and methods
The purpose of this study is to analyze and assess the level of development of digital technologies in agriculture of the Russian Federation. To achieve this goal, the following tasks:

- analyze the current state of digitalization of agriculture in the Russian Federation;
- identify factors that impede the development of smart agriculture in the Russian Federation;
- build and describe a model for the interaction of smart agriculture in the framework of the digitalization of agriculture in the Russian Federation.

The study used methods of descriptive, historical, factorial, statistical, logical, comparative, economic analysis, which allowed the authors to solve the research tasks. The informational basis of the study was made up of data from state executive bodies, marketing reports, materials from various scientific studies, corporate reports.
3. Results
For Russian agricultural producers, the motivation to use smart agriculture methods is dictated by the desire to reduce dependence on market conditions and government subsidies. According to the Ministry of Agriculture of the Russian Federation, the market capacity of digital technologies for agriculture is estimated at 2026 at 360 billion rubles [10].

Farmers in Russia are interested in the development of smart agriculture, as technologies will help reduce fuel and fertilizers costs, learn to control all resources and optimally manage them. Now, Russia is actively developing a wide range of precision elements. Global satellite positioning, GIS, systems responsible for monitoring and control of equipment, as well as the quality of work performed are especially in demand. However, the following factors impede the development of smart agriculture in Russia [11]:

- Strong fragmentation of the Russian agricultural market;
- The secrecy of some aerial photographs;
- The lack of clear rules for the use of drones;
- The difficulty of obtaining government subsidies for the introduction of precision agriculture technologies;
- Weak development of venture investments in smart agriculture technologies;
- Strict rules and licensing policies for the use of GPS / GLONASS technology in agriculture;
- The problem of confidentiality and data security during the management of big data;
- Low level of data availability and quality;
- Lack of industry standards for aggregation and data management in digital agricultural solutions.

To solve these problems, it is necessary to create and develop an institutional ecosystem, expressed in combining the efforts of the Internet of Things Association, The Skolkovo Innovation Center, National Research University Higher School of Economics, the Ministry of Agriculture, and technology companies. This institutional ecosystem is necessary to form a center for the examination of new developments and providing access to data for farmers. A special analytical center has been created under the Ministry of Agriculture. Its functions are aimed at monitoring the condition of agricultural land. Active negotiations are underway with Roscosmos (The Roscosmos State Corporation for Space Activities) and Roshydromet (The Russian Federal Service for Hydrometeorology and Environmental Monitoring) on the creation of a single database of images from space and climate maps. In the future, a digital agricultural university will be created. Already, the largest agricultural universities are training specialists for digitalization of agriculture. The Skolkovo Innovation Center is engaged in investing and searching for investors in promising projects of digitalization of agriculture.

The above problems and possible solutions are becoming a serious prerequisite for the formation and description of the model (figure 3) of the interaction of the main participants in agricultural production in the framework of the development of smart agriculture in the Russian Federation [12].

4. Discussion
This model of interaction between the main objects of smart agriculture is built considering the Russian specifics of the introduction and development of methods of digitalization of agriculture.

The main management objects include smart garden, smart farm, smart greenhouse, smart field, smart enterprise, smart land use.

Smart Garden – the use of robotics and digital technology in the production processes of gardening products.

Smart farm – the use of control systems with changing parameters depending on the microclimate and the state of the animals.
Smart greenhouse – the use of intelligent technologies for growing agricultural plants in closed conditions.

Smart field – the use of parallel driving systems and digital technologies in the processes of crop production.

Smart enterprise – the use of an intelligent full-cycle decision support system.

Smart land use – the use of an intelligent system for planning and optimizing agrolandscapes.

Figure 3. Smart agriculture development model of the Russian Federation.

The interaction of objects of the model for the development of smart agriculture should be evaluated by a set of relevant indicators of digitalization of agriculture:

- The share of data on objects of agricultural resources (land, livestock, agricultural machinery in % of the total), included smart agriculture.
- The share of concluded smart contracts with recipients of subsidies (in % of the total number of subsidies).
- The number of regions of Russia that have introduced digital sectoral planning of agricultural production (units).
The coefficient of reduction of costs for the production of agricultural products and food (in%).

The share of material costs in the cost of a unit of agricultural products (fuel, lubricants, fertilizers, electricity, planting material, feed, etc.) (in% of the cost).

The growth rate of labor productivity in agricultural enterprises (%).

The share of investments in the purchase and implementation of digital technologies and digital products (in% of the total investment of agricultural enterprises).

The share of agricultural raw materials and finished products tracked and shipped for export by the intelligent smart agriculture system (in% of the total export volume of agricultural products).

From the above-described model of interaction between the main objects of smart agriculture and the analysis of indicators of digitalization of agriculture in the Russian Federation, we can conclude that the methods and forms of interaction should be applied integrated to increase the competitiveness of the industry.

Using the proposed smart agriculture model allows farmers to reduce costs and increase productivity. Fertilizer consumption and farm machine usage are optimized. In the crop production aspect, the application of the smart agriculture model will contribute to proper soil preparation, planting and harvesting at the right time. In the field of animal husbandry, the use of information systems and predictive models within the framework of smart agriculture can make the transition from incident management to proactive. Further measures for the development of automation processes within the framework of the model of smart agriculture, suggest building a higher level of digital integration [13]. This level of digital integration should provoke profound changes in the organization’s business processes, which, in turn, affect the profit and profitability of the organization. The data collected during this integration will have to be integrated with smart agriculture IT in real time, carrying out a fundamental paradigm shift in decision-making for the farmer. It should also be noted that many connected sensors are interconnected into a single network forms a self-learning information system that can provide more useful information for the farmer.

5. Conclusion

Thus, as a result of the study, a model was proposed for the interaction of the main objects of smart agriculture. The current state of digitalization of agriculture in the Russian Federation was analyzed. At the present stage of development of smart agriculture in the Russian Federation, the methods of global satellite positioning, geographic information systems, as well as monitoring and control systems for the use of equipment are most often in demand. The study describes the factors that impede the development of smart agriculture in the Russian Federation. One of the main obstacles to the development of smart agriculture in Russia is the lack of an institutional ecosystem for processing data flow. A model for the development of smart agriculture is proposed, its main participants and forms of interaction are described. The key indicators of the digitalization of agriculture in the Russian Federation are identified, which most strongly affect the implementation of the smart agriculture model. It is concluded that the use of this model of smart agriculture will allow integrating the forms of interaction of entities to increase the level of competitiveness of the industry.

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