Conceptual approaches to planning and forecasting agricultural production transformed by digitalization

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Abstract: The article considers transformation trends of conceptual approaches to planning and forecasting agricultural production in the context of the digitalization of the economy. The features of modern information and communication technologies applied in the farm production management have been studied. The implementation of “smart” technologies in Russian agriculture has been revealed to be not large-scale. It has been substantiated that digital technologies based on artificial intelligence, analysis of large data arrays, and a fundamentally new interaction interface—virtual and augmented reality—transform current methodological approaches to economic planning. Particular attention was paid to transformed conceptual approaches in the methodology of economic planning of domestic agricultural production. The Internet of Things and measuring elements equipped with microprocessors and sensors, as well as special platforms and applications for monitoring have been proved to change the prevailing concept of the organization of planning and forecasting activities in agriculture. Special attention was paid to the implementation of the departmental project “Digital Agriculture” that is creating a model for the transition of the strategic planning system to a digital format. The model reflects the integration trends of modern information and communication technologies with agribusiness and authorities.

1. Introduction
The digital transformation of the economy is the formation of a new economic environment and involves technical and methodological transformation of key functions in all areas of management. The fundamental technologies of the revolutionary breakthrough include the Internet of Things, smart technologies, cloud servers, artificial intelligence, collection and processing of global data, and others. Industrial technologies are being replaced by information technologies that become a core of the developing modern global economic space and bring individual states, regions, and industries to a new trajectory of economic development, paying special attention not only to quantitative, but also to its qualitative characteristics.

The purpose of the research was to study the transformation trends of conceptual methodological approaches to planning and forecasting agricultural production in the context of the digitalized economy.
2. Materials and research methods
The theoretical and methodological basis of the study was the fundamental research presented in the works of Russian and foreign scientists on the transformation of planning and forecasting methodology for the agricultural sector of the digitalized economy.

The study object was the transformation mechanism of the methodology for strategic planning of the agricultural sector of the digitalized economy. The methodological basis of the research on the stated problem includes monographic, abstract-logical, and comparative analysis methods.

3. Results and discussion
At present, the digital transformation of agricultural production involves not only a complex informational support for processes that belong to the category of “Enterprise resource planning (ERP systems),” but also digital economy tools for solving production and technological problems associated with the satellite navigation and control systems, artificial intelligence, Internet of Things, elements of small-scale mechanization, and others (figure 1) aimed at developing mathematical models and algorithms to optimize decisions made in virtual and augmented reality at all levels of management [4, 5, 9, 10].

Departmental project “Digital Agriculture” for 2019-2024 determined a new trajectory of economic development in the agricultural sector of the Russian economy aimed at creating a qualitatively new environment for the functioning of agribusiness, analytics, economic planning, and unification of centralized decision-making at all levels of management [6].

![Digital economy tools applied in agriculture in Russia, 2019](image)

**Figure 1.** Digital economy tools applied in agriculture in Russia, 2019 [7].

The chosen course of digitalization in the agricultural sector of the economy opens up new opportunities for diversifying agricultural production and creating added value by reducing cost of production. In particular, the implementation of the Precision Farming Concept will reduce the current costs of agricultural commodity producers by 10-15% by stimulating an increase in crop yields by more
than 10.0% due to the high precision of sowing and effective fertilization and irrigation systems. According to experts, the average cost savings under the Digital Farm Concept will amount to 15-20.0%, with a tendency to reduce the mortality of farm animals by more than 15.0%. The current economic conditions make it possible to increase the number of farm animals by 10% and more.

Digital management technologies in agriculture are based on key strategic planning tools widely implemented in the agricultural sector of the economy. The main of them are technologies for intelligent analysis of large data arrays (data mining), statistical methods of predictive modeling (predictive modeling), machine learning and others. The data obtained are used to analyze current indices, identify cause-and-effect relationships and dependencies between them, predict and plan future results and necessary activities.

Digital solutions due to the Internet of Things (IoT), measuring elements equipped with microprocessors and sensors, as well as special platforms and applications for online monitoring allow collecting detailed information for planning agricultural work at all levels of management [4, 5].

Under the current conditions, ideas about approaches to management, logic, horizons, methods, principles, content, and organization of planning and forecasting activities in agriculture are changing. The mass adoption of digital technologies in the agricultural sector of the economy forms a new model of the system of strategic planning and forecasting the development of the industry at all levels. Methodological approaches to planning and forecasting in agriculture are based on advanced analytics and scenario forecasting that provide flexibility and quick response to market demands and take into account the uncertainty and high dynamism of the external environment and the ability to quickly adapt to changing economic conditions.

Widespread use of information and communication technologies and electronic services contribute to new conceptual approaches formed in the methodology of strategic planning. Thus, the methodological basis of modern cyber economics involves the development of a digital approach based on artificial intelligence, bio- and nanotechnology, and cyber-physical systems (figure 2).

Figure 2. Transformation of the concept of planning and forecasting the agricultural production in the context of digitalization.

Technologies for the intellectual analysis of large data arrays in a virtual space (figure 3) that has become a “new norm” in current industrial and economic relations change the traditional ideas about the mechanism for developing plans and forecasts. The mechanism involves complete displacement of the human factor from the production process, using a fundamentally new interaction interface, and the adjustment of the main planning and forecast indices in real-time mode [1, 2, 3].

The digital format of functionally complete solutions based on modern methods of analyzing large data arrays (figure 4), cloud technologies, design and three-dimensional modeling of business processes in the agricultural sector of the economy, using IoT platforms and applications (figure 5), allows high

![Concept](image-url)
speed of reaction to changes in the internal and external environment, flexibility of targets and objectives of multivariate scenario forecasting and maximizes the productivity of managerial solutions.

**Figure 3.** Composition and structure of analytical data sets required for online planning and forecasting in agriculture.

**Figure 4.** Calculation and analytical tools for substantiation of planning and forecasting in agriculture.
The implementation of digital methods of analysis and forecasting involves not only mastering skills of using new generation software, but also reengineering business models, improving forecasting, analytical, service, and logistics processes and creating a variety of information platforms, such as Digital Land Use, Smart Field, Smart Garden, Smart Greenhouse, and Smart Farm.

Technological innovations pose difficult challenges in the management of agriculture in the digital space and are characterized by the predominant use of medium-term and short-term plans and forecasts aimed at anticipating the near future, instant adaptation to environmental conditions due to the widespread communication and high speed of information exchange, providing the development of recommendations for efficient allocation of resources.

The implementation of digital solutions is changing the prevailing understanding of the logic of economic planning. The traditional approach to collecting, analyzing, and exchanging data is complemented by cognitive technologies, their convergence with nano- and biotechnologies, and predictive descriptive models that recommend the optimal set of actions.

At the same time, new technologies blur distinctions not only between different hierarchical levels of management, but also between spatial constraints.

4. Conclusions
Currently, the departmental project “Digital Agriculture” implemented at the state level is creating a model for the transition of the strategic planning system to a digital format. The model will reflect the integration trends of modern information and communication technologies with agribusiness and government authorities. Building digital platforms will ensure the integration of the industry into the global information space in the medium term. The focus of the digital transformation of the agricultural sector of the economy at the state level is to create prerequisites for the large-scale distribution of end-to-end digital solutions for production and logistics chains that unite agricultural producers, their suppliers, representatives of retail chains, and logistics organizations. The prerequisites will stimulate...
economic growth, systemic accumulation of trade relations in the field of agricultural exports, and systematic and sustainable development of agricultural production in general.

From the methodological point of view, the toolkit of communication servers in virtual and augmented reality will reformat the vector of agricultural development. Its key element is a digital strategic planning system that forms additional value due to new algorithms applied for agricultural production.

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