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WAYS FOR DIGITAL AGRICULTURE DEVELOPMENT IN THE REPUBLIC OF BELARUS BASED ON CHINA'S EXPERIENCE IN THE FIELD OF INTELLIGENT TECHNOLOGY IMPLEMENTATION

The article discusses the prospects of using China's experience to accelerate the digital transformation of agriculture in the Republic of Belarus.

The analysis of the legislation of the Republic of Belarus in the field of digital development of the agro-industrial complex was carried out, a conclusion was made about the current state of electronic agriculture, the main problems hindering the activation of the introduction of intelligent technologies were identified, and the existing positive experience of agricultural digitalization projects was noted. Based on the successful experience of China, the main aspects of the digitalization of agriculture are highlighted.

Selected ways of introducing intelligent technologies in the Republic of Belarus in the short and long term are proposed based on the experience of developing digital agriculture in China.

Key words: digitalization; agriculture; agro-industrial complex; intelligent technologies; agricultural business; rural areas; cooperation; Internet.

Fig. 1. Ref.: 8 titles.

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ПУТИ РАЗВИТИЯ ЦИФРОВОГО СЕЛЬСКОГО ХОЗЯЙСТВА РЕСПУБЛИКИ БЕЛАРУСЬ НА ОСНОВЕ ОПЫТА КИТАЙСКОЙ НАРОДНОЙ РЕСПУБЛИКИ В ОБЛАСТИ ВНЕДРЕНИЯ ИНТЕЛЛЕКТУАЛЬНЫХ ТЕХНОЛОГИЙ

В статье рассматриваются перспективы использования опыта Китайской Народной Республики для ускорения цифровой трансформации сельского хозяйства Республики Беларусь.

Проведен анализ законодательства Республики Беларусь в сфере цифрового развития агропромышленного комплекса, сделан вывод о текущем состоянии электронного сельского хозяйства, выявлены основные проблемы, препятствующие активизации внедрения интеллектуальных технологий, отмечен имеющийся положительный опыт проектов по цифровизации сельского хозяйства. Опираясь на успешный опыт Китая, отмечены основные аспекты цифровизации агропромышленного комплекса.

Предложены отдельные пути внедрения интеллектуальных технологий в Республике Беларусь в краткосрочной и долгосрочной перспективах на основе опыта развития цифрового сельского хозяйства Китайской Народной Республики.

Ключевые слова: цифровизация; сельское хозяйство; агропромышленный комплекс; интеллектуальные технологии; аграрный бизнес; сельские территории; сотрудничество; Интернет.

Рис. 1. Библиогр.: 8 назв.

Introduction. The introduction of innovative technologies is a modern trend in the development of agriculture worldwide. This makes it possible to increase the efficiency of business processes, manage resources, and reduce production and sales costs. Given that agriculture is the basis of food security in any country, and its efficiency is often very low, special attention should be paid to the digitalization of agriculture. The importance of introducing intelligent technologies is also reinforced by the need for agriculture to adapt to gradual but constant climate change, as well as to achieve sustainable development goals.

Materials and methods of research. The methodological basis of the research was based on theoretical methods: system analysis, synthesis, structuring. Within the framework of this study, an analysis of the current legislation of the Republic of Belarus in the field of digital development of the agro-industrial complex, as well as an analysis of China's experience in the field of digital economy development and the introduction of intelligent technologies was carried out.

The results of the study and their discussion. According to [1], currently Belarus does not adhere to a systematic approach to the development of a national strategy for electronic agriculture and is just beginning work in this direction. The agro-industrial complex of Belarus lags behind the leading world powers in the development of highly intelligent technologies and needs to increase investments and improve its technical level. Since the state of the agro-industrial complex of the Republic of Belarus, as well as the national economy as a whole, is characterized by an extremely low level of digitalization, the authors identified the main problems that hinder the activation of the introduction of intelligent technologies should be noted.:

1. *Insufficient funding.* Projects in the field of intelligent agriculture require large investments. Insufficient funds for the development and implementation of expensive information and communication technologies are associated with a shortage (and often lack of) own financial resources from agricultural and processing organizations, and lack of government assistance due to the limited state budget;

2. *Low investment attractiveness of the agricultural and industrial complex,* especially agriculture: agricultural organizations cannot provide high income and profitability. This means that the introduction of intelligent technologies is not economically efficient due to the high costs of their acquisition and implementation and the disproportionately small increase in income.;

3. *An incomplete system of regulatory and legal regulation in the field of information technology;*

4. *Production management "the old-fashioned way".* The use of modern approaches to managing business processes of enterprises would make it possible to clearly define control points and parameters, regulate the scheme of production processes, and establish areas of responsibility for accurate monitoring and management of business processes.;

5. *Lack of specialists and sufficient experience in the development and implementation of appropriate software.* However, special attention is currently being paid to the development of the IT industry, so the training of appropriately qualified personnel is possible, you just need to learn from the experience of other countries in using suitable technologies.;

6. *The low level of development of agricultural technologies and insufficient Internet coverage in rural areas,* which severely limits the possibilities of using modern information technologies.

Currently, the Republic of Belarus has a State program "Agrarian Business" for the current five-year period — 2021—2025, the implementation of which will contribute, among other things, to the digitalization of the agro-industrial complex, aimed at the introduction of innovative technologies, as well as the formation and appropriate infrastructure development. The program also outlines the main directions for the implementation of measures for the integrated "project of the future" implantation — the Precision Agriculture: the creation of a unified digital map of arable land; equipping existing agricultural machinery with precision farming elements and purchasing new ones; introducing the necessary software and computing equipment [2].

In May 2024, the Council for Digital Development Projects under the Ministry of Communications and Informatization of the Republic of Belarus decided to implement the event "Creation of the Digital Platform for Precision Agriculture Information and Analytical system (first stage)", which clarified the main directions for the implementation of the action system [3].

In addition, the State Program "Digital Development of Belarus" for 2021—2025 provides for the development of digital economy tools in various sectors of the national economy, providing for the use of advanced technologies in production and foreign economic activity, the formation of necessary conditions for maintaining and increasing the competitiveness of Belarusian enterprises on the world market [4].

In accordance with the State Program of Innovative Development of the Republic of Belarus for 2021—2025 [5], projects will be carried out within the framework of the Agroindustrial and Food Technologies direction to create precision farming complexes; introduce robotic systems and form a disease monitoring system in animal husbandry; and organize high-tech full-cycle agro-industrial production.

Thus, the government has clarified the implementation direction of precision agriculture projects, including the creation of a unified digital map of cultivated land, the provision of precision agriculture equipment, and the introduction of relevant software and computer technology. These measures will provide legal and technical support for agricultural digitalization.

It should be noted that a number of smart technology implementation projects are currently being successfully implemented in Belarus, among which are:

1. The Voskhod State Enterprise of the Office of the President of the Republic of Belarus has implemented a digitalization project based on elements of Agriculture 4.0, including a GPS monitoring system that analyzes the efficiency of using vehicles, a digital precision farming platform “Field History” and the M-Complex system for precision animal husbandry [6].

2. Many agricultural enterprises have implemented some elements of a precision farming system, for example, the use of equipment equipped with elements of a precision farming system: yield monitoring, autopilots, fertilization in crop production; animal feeding and milking cows, climate control in animal husbandry.

3. Blockchain-based traceability systems are being implemented. This is a mechanism that allows you to track products using unique identifiers throughout the entire production and logistics process — from the start of production to sale to the end user [7].

According to the authors, that the degree of these agricultural digitalization projects implementation is extremely low and doesn’t allow us to characterize the agricultural and industrial complex of the Republic of Belarus as high-tech and corresponding to leading countries in the field of digitalization.

China has significant experience in the field of digital agriculture. This knowledge and technology can be applied to stimulate the development of intelligent technologies in the agro-industrial sector of the Republic of Belarus. Using the Chinese experience will accelerate the introduction of innovations and increase the agricultural production efficiency in Belarus.

Drawing on China's successful experience in digital rural construction and smart agriculture, it is recommended to start from five aspects [8—11]:

- strengthening rural digital infrastructure construction;
- improving agricultural science and technology;
- promoting Internet popularization;
- cultivating digital talents;
- promoting the application of information technology.

The analysis of the main problems hindering the activation of the intelligent technologies introduction in Belarus and the experience of Chinese experts in the field of intelligent agriculture allowed the authors to formulate the main ways of developing digital agriculture in the Republic of Belarus (Figure 1):

1. International cooperation that promotes the introduction of modern technologies and capacity building:

1.1. The transfer of China’s modern solutions in the digital agriculture field can be implemented:

– Using the example of South-South cooperation under the Belt and Road initiative: intelligent irrigation systems and “Beidou” agricultural navigation equipment, and the cost of trial and error is reduced through localized technology adaptation;

– Participation in the EU’s Digital Europe program in order to gain experience and, possibly, financial support in developing standards for intelligent agriculture.

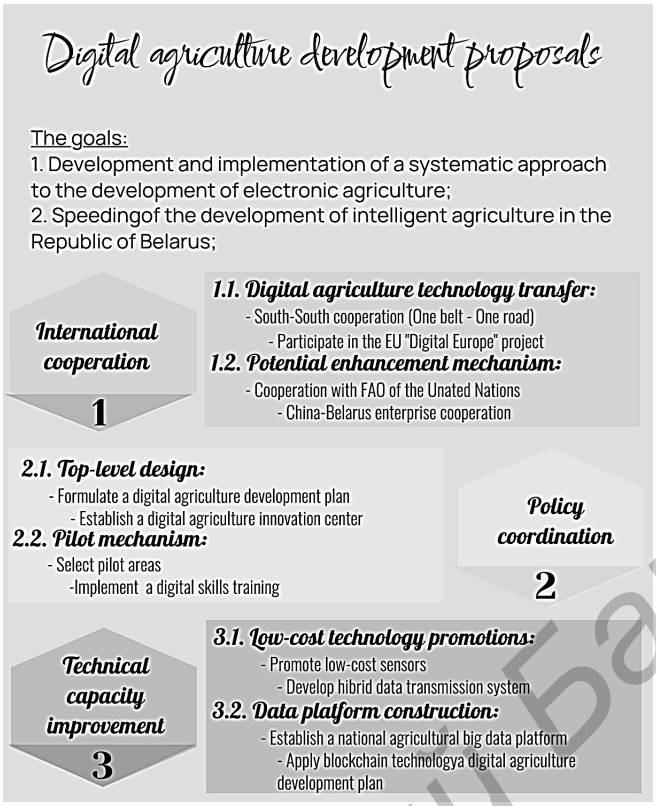

Figure 1. — The main ways of digital agriculture development in the Republic of Belarus

1.2. The capacity building mechanism will be implemented by:

– Collaboration with the Food and Agriculture Organization of the United Nations (FAO) to create an “Eastern European Center for Digital Agriculture” for technical training and knowledge exchange;

– Promote the participation of Chinese and Belarusian corporate consortia in digital agriculture projects (such as expanding cooperation in agricultural science and technology in the Chinese-Belarusian Industrial Park) to create a dual circulation of technology and market.

2. Policy coordination: institutional safeguards and pilot innovations:

2.1. Top-level design:

– To develop a “Plan for the development of intelligent agriculture in Belarus” within the framework of the Agricultural Business program for the coming period, to clarify the ratio of the distribution of fiscal costs between central and local authorities (for example, the central government will bear 50 % of infrastructure investments) and create a special fund to support research and development in the field of digital agriculture;

– To create a “Digital Agriculture Innovation Center” and collaborate with universities and enterprises to introduce local technologies (such as intelligent greenhouse management systems that are resistant to cold).

2.2. The pilot mechanism:

– Select 3—5 major agricultural producing states to implement the Digital Agriculture Special Zone pilot project and provide supportive policies such as tax incentives, equipment subsidies, etc. to verify technical and economic feasibility. Resource focus strategy: within the framework of the Star model, priority will be given to supporting the digital transformation of large farms and agricultural cooperatives in order to create a demonstration effect and reduce marginal costs;

– Implement the Digital Skills Certificate training program and train farmers in skills such as smart equipment operation and data analysis.

3. Technology empowerment: low-cost data adaptation and integration:

3.1. Implementation of simple and affordable technical solutions:

– Promote low-cost sensors (such as equipment for monitoring soil moisture and meteorological conditions) and open source agricultural management software (SaaS) to lower the access threshold for small and medium-sized farmers;

– To develop a hybrid offline and online data transmission system that will allow areas with unstable networks to connect to data through offline collection and regular downloading.

3.2. Building a data platform:

– Create a national big agricultural data platform, integrate interagency data such as land, weather, market and logistics data, and provide government services such as pest and disease prevention and price fluctuation analysis;

– The introduction of blockchain technology ensures the reliability of agricultural traceability data and increases export competitiveness.

Planning for the digital agriculture development should be carried out on several levels. The phased implementation involves:

– *Short-term perspective (1—3 years):* give priority attention to covering the main areas of agricultural production, use the hybrid network technology "optical fiber + satellite" to quickly fill in the blind spots of the network and at the same time create a basic geographical information database (for example, the Belarusian version of the "Map of agricultural land").

– *Long-term perspective (more than 5 years):* Promote deep integration of 5G and agricultural scenarios and focus on supporting the deployment of high-bandwidth, real-time applications such as intelligent agricultural machinery and environmental monitoring in areas where valuable crops (such as flax and potatoes) are being produced, blockchain technology, and data exchange.

Conclusions. With a global focus on environmental protection and sustainable development, intelligent agriculture will become a trend of future development. The support of the Belarusian government will provide reliable guarantees for the development of smart agriculture.

The conducted research allowed the authors to conclude that Belarus has taken important steps towards the digital transformation of agriculture, but the overall level of implementation, compared to China, is still in its infancy, facing multiple challenges such as insufficient funding, low investment attractiveness, an inadequate legal and regulatory system, a shortage of skilled personnel and a limited level of agricultural science and technology. Nonetheless, through the implementation of the National Programme "Agricultural Business" and the National Programme "Digital Development of Belarus", Belarus has clearly defined the direction of digital development in key areas such as precision agriculture and blockchain traceability systems, and has achieved some initial results.

Drawing on China's successful experience in digital agriculture, Belarus can further accelerate the digital transformation of agriculture. Specific measures include: strengthening international cooperation and technology transfer to introduce low-cost and high-efficiency digital agriculture technologies; establishing a training system for digital agriculture to cultivate local technical talents; improving the legal and regulatory system to ensure the standardisation of information technology application; promoting enterprise cooperation and technology sharing to reduce the cost of technology application; and gradually promoting mature digital agriculture models through pilot projects and demonstration areas.

In the future, Belarus should continue to deepen policy support, increase financial investment, optimise the structure of the agricultural industry, and enhance the intelligence of agricultural production. At the same time, through the phased implementation of the digital agriculture development plan, Belarus is expected to fill in the network blind spots and upgrade the level of agricultural infrastructure in the short term; and in the long term, it will promote the in-depth

integration of 5G technology with agricultural scenarios and realise the deployment of high-bandwidth real-time applications. Eventually, Belarus will gradually narrow the gap with leading countries in the field of digitalisation, improve the overall competitiveness of the agricultural industry and achieve the goal of sustainable agricultural development.

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