Digital Technology in Agricultural Sector

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Abstract. The digitalization of production in agriculture is a global trend, there is a great research and investment interest in digital technologies. The national priorities of present Russia to be determined by the program documents of the country's socio-economic development for the period up to 2030 imply the use of the wide possibilities of digital technologies to ensure the entry of the Russian Federation into the number of the largest economies in the world. Since the state has set a task to transform agriculture through the introduction of digital technologies, the issue of introducing information technologies in small and medium-sized enterprises that lack investment is very relevant. The purpose of the study is to analyze the positive experience of introducing digital technologies by farmers, in particular blockchain technologies, to determine the prospects for the process and justify the dissemination of positive experience. The promising areas of using digital technologies in farms are analyzed and substantiated. These technologies make it possible to simplify the sale of products, eliminate unnecessary intermediaries, provide investments in the development of production, logistics and certification, as well as the development of rural areas and infrastructure. ICO and crowdfunding can be a starting point for the development and upgrading of farms. Therefore, information on successful practices in the application of information technologies should be popularized among farmers for wider dissemination among farmers.

1. Introduction

The development of world agriculture is based on increasing the knowledge intensity of manufactured products; one of the effective tools to achieve this is the introduction of digital technologies into production. The digitalization of agricultural production is a global trend. Smart farming and precision farming programs operate in dozens of countries. With the introduction of digital technologies, production becomes more efficient and environmentally friendly, i.e. production resources are efficiently used with minimization of losses for the manufacture of products of consistently high quality and reduced environmental impact. Comprehensive and integrated application of information and communication technologies can improve the efficiency of decisions and business management, as well as simplify document flow. The rate of introduction of 'artificial intelligence' technologies in the agricultural sector is growing by 22.5% per year. According to Markets and Markets, a research company, the size of this market will be 2.6 billion USD by 2025 [1, 2].

Reputable international organizations in the field of food and nutritional security, such as FAO, World Bank, OECD, have been monitoring the level of digitalization of world agriculture for many
years and report the high potential of Agriculture 4.0 technologies in their recently published reports [3, 4, 5]. There is a great deal of research interest all over the world. Many studies performed by foreign and Russian authors are devoted to various aspects that solve the problems of digitalization of agriculture, issues of state support, positive experience of implementation in the conditions of individual farms and in the regional aspect, as well as experience in solving problems arising from manufacturers in the implementation of digitalization projects, etc. Large research and innovation programs for digitalization are being implemented, e.g. Internet of Food and Farming and Digital Innovation Hubs or SmartAgriHubs in the European Union, DigiScape Platform and Food Agility Hub in Australia, and #DigitAg in France [6, 7]. Large investments are being made in the development and implementation of digital technologies. Research institutes are also developing strategic investment programs to digitize agricultural production processes, such as University of Wageningen in the Netherlands, AgResearch in New Zealand, Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Consultative Group for International Agricultural Research (CGIAR), the world's largest global agricultural innovation network, are collaborating in digitalization initiatives [8].

2. Problem Statement
The current model of the technological development of Russia to be determined by national priorities, which are outlined in the program documents of the country's socio-economic development for the period up to 2030, provides for the advanced development and upgrading of the Russian economy through the widespread implementation of the basic innovations of the fifth and accelerated transition to the sixth technological order, the core of which is nano-, bio- and information and telecommunication (digital) technologies [9]. To accelerate the penetration of digitalization into production, the national program titled ‘Digital Economy of the Russian Federation’ is being implemented. This program is intended to help transform priority sectors of the economy, including agriculture, through the introduction of digital technologies and platform solutions and accelerate technological development, increase the number of organizations, which implement technological innovations, up to 50% of their total number, ensure the entry of the Russian Federation into the five largest economies in the world, and create in the basic sectors of the economy, primarily in the manufacturing industry and the agribusiness, a high-performance export-oriented sector that will be developing based on the state-of-the-art technologies and provided with highly qualified personnel [1].

However, information technologies are introduced mainly by large manufacturers, while the sector of medium and small agricultural production is involved in the processes of digitalization to a lesser extent due to the lack of free funds for investment in the production upgrading.

3. Research Questions
Are there examples in the world and in the Russian Federation of using blockchain technologies by medium and small farmers and how successful they were, why the manufacturers decided to use such technologies and what are the prospects for further dissemination of this experience?

4. Purpose of the Research
The purpose of the research is to analyze the positive experience of introducing digital technologies in agriculture by farmers, in particular blockchain technologies, to determine the prospects for the process within the framework of the tasks set by the state and to justify the dissemination of positive experience.

5. Materials and Methods
The material for the research was the departmental program titled ‘Digital Agriculture’, scientific publications on the problems of agricultural sector digitalization, data on Russian projects in the field of digitalization and the experience of using blockchain technologies. The monographic, comparative and systems analysis, idealization and mental modeling methods, as well as a logical approach, were used in this study.
6. Results of the Research

The efficiency of agricultural production in Russia is inferior to the economies of developed countries. Russia ranks 15th in the world in terms of the overall level of digitalization and 45th in the world in terms of penetration of information technologies into the agricultural sector. It is estimated that only 13% to 15% of manufacturers can implement digital technology and commercialize scientific and technological projects.

The information technology market in the agricultural sector is estimated at more than 360 billion rubles, the level of digitalization, according to forecasts, should grow five times by 2026, including that due to startups. The ultimate goal of the ‘Digital Agriculture’ program is the development and launch of replicable integrated innovative projects of end-to-end intelligent systems, such as ‘Country’, ‘Region’, ‘Agricultural enterprise’, ‘Field (Farm)’, based on domestic methods, algorithms, digital technologies and samples of systems and devices [1, 10].

The objective of the departmental project is the digital transformation of agriculture through the introduction of digital technologies and platform solutions to ensure a technological breakthrough in the agricultural sector and achieve a two-fold increase in productivity at ‘digital’ agricultural enterprises by 2024.

The total economic effect from the transition of farms to business models based on digitalization may amount to more than 4.8 trillion rubles in annual terms, the growth of labor productivity may grow three to five times, and the growth in consumption of information technology due to digitalization of the agricultural sector may amount to 22% [11].

As in the whole world [12, 13, 14], blockchain technologies are actively developing in Russia while providing transparent and interference data exchange protected against outside interference: fast, safe and transparent transfer of digital information, including money and intellectual property, along with effective data protection. A distinctive feature is that the information entered into the system cannot be distorted, and its storage is decentralized. All these properties in combination make blockchain technology the best tool for the transmission of information protected from forgery today.

The most famous use of blockchain technology became the creation of so-called cryptocurrencies as a means of payment, including those in agricultural production.

Traditionally, companies predominantly use three main investment mechanisms: bank lending, equity financing, and also using structured financial products such as mezzanine financing (a method of financing projects in which the investor provides funds in the form of debt financing with the possibility of obtaining stocks or shares in the borrower's company in future.)

A procedure for attracting funding through ICO is a type of attracting investment in the form of selling to investors a fixed number of new cryptocurrency units received by a single or accelerated emission. In order for investors to start investing cryptocurrency in a company, it is only necessary to prepare some small representation of the vision of its development, an official written message called ‘White paper’, which is an attribute of the initial placement of tokens, the equivalent of which can be, for example, the share of the harvest. The project company sells digital tokens that can be used as an internal currency on the project platform or can be traded on exchanges. This placement allows finding funding even for risky projects.

According to experts, Russian companies that are trying to complete ICO transactions can attract relatively small amounts, e.g. about 200,000 to 300,000 USD, which, according to the expert, is one of the disadvantages of cryptocurrency.

Nevertheless, the agricultural market already knows such examples, both successful and not very successful. The LavkaLavka farm cooperative became one of the first to adopt digital currencies. The company’s ICO started on November 1, 2017. At the end of the first day, about 500,000 USD were raised on its own biocoin.bio platform.

As of February 6, 2018, the company received over 11.8 million USD. The initial issue was 1 billion bitcoins, of which 800 million were in free sale. The tokens purchased by investors were supposed to be exchanged for farm products.
The ICO ended on February 18, 2018 and managed to raise the equivalent of 16 million USD. In fact, this amount was greatly overestimated. As it turned out, 90% of the collected funds were reserved in the form of options, which no one took advantage of. That is, the company managed to attract the equivalent of 80 million rubles in rubles and in the Siberian Chervonets, Ethereum and bitcoin cryptocurrencies. At the same time, the share of cryptocurrencies was 60%, and the company lost money after the fall in their rate. Following the results of the ICO, LavkaLavka managed to attract an amount ‘approximately equal’ to 50-60 million rubles. Thus, the funds collected for ICO were enough only for the implementation of part of the project [15].

However, according to experts, Russian companies that are trying to make ICO transactions can attract relatively small amounts, that is to say, about 200,000 to 300,000 USD, which is undoubtedly one of the disadvantages of cryptocurrencies. The second important drawback is manifested in the instability of the exchange rate due to the legal uncertainty of the status of this currency.

In recent years, the amount of funds raised through ICOs in the world has been declining [15]. At the same time, there is a growing interest in IEO, which is a type of crowdfunding that allows access to a global pool of investors with a very low entry barrier. The main advantage of IEO is that the cryptocurrency exchange facilitates the offering of tokens on its platform and subsequently lists this project, while within the ICO, the project management team is independently responsible for marketing, payments, etc.

In May 2019, funds raised through IEO projects exceeded a level of 1 billion USD, while the total amount of funds raised through such projects worldwide reached over 1.6 billion USD. Most of these funds, roughly 1.4 billion USD, were raised in 2019 [17, 18].

The development of information exchange technologies has led to the manifestation of new forms of interaction between producers and consumers using elements of joint use and crowdsourcing, which allow optimizing logistics with minimizing waste:

‘Crowdfarming’ is an outsourcing model in which the consumer invests in a specific fruit tree, a field or an animal, and the farmer ensures the production of customized products. At the same time, the consumer is given the opportunity to remotely monitor production processes, which also plays a role in ensuring product safety.

‘Food sharing’ is a social platform based on the environmental movement, which helps organizations with an environmentally friendly and high social effect to get rid of unsold food products, but suitable for consumption, by donating them to those in need. The area is actively developing in many countries and it has been existing in Moscow and St. Petersburg since 2015.

Many farmers who need funding, but do not want to deal with the preparation of a large amount of documentation, see crowdfunding as a way out, because it has a number of significant advantages, such as lack of registration (you can start the project as an individual), absence of the need to collect a large number of documents and bureaucratic influence on the result, a test of public interest in the product, and it is also possible to attract more funds than it has been announced at launch. At the same time, when launching a fundraising campaign through a crowdfunding platform, it is possible to attract potential buyers of products.

Successful examples of crowdfunding include such projects as the ‘Valley of the Goats’, which raised the necessary 352,300 rubles to organize the production of goat cheese, such as Chevre and Camembert, ‘We are building a rabbit farm in the Rostov region’, which received 585,500 rubles, as well as the Boomstarter.ru projects called ‘We are restoring the White Dew peasant farm’ (455,450 rubles) and ‘We are developing the White Dew peasant farm’ (915,690 rubles).

Projects for the development of small farms and villages often attract large sponsors, for example, the ‘Reviving villages – strengthening Russia!’ project, which raised 481,300 rubles to expand the economy and create jobs for women in the countryside.

However, the main potential of blockchain technologies is the ability to quickly confirm any transactions. Banks have recently begun to actively introduce blockchain technologies, however, their effectiveness is beyond doubt. The use of blockchain technologies can significantly speed up and simpli-
fy decision-making on financing and government subsidies for agricultural projects, and therefore increase the competitiveness and growth rates of agriculture in this country.

7. Findings
The production and sale of agricultural products at the present stage requires the organization of efficient logistics and financing of purchases, as well as quality control of food to be ensured by the reliability of origin. The use of blockchain technologies allows for the exchange of data in a single transparent space for organizing supply chains by establishing contacts between suppliers, carriers, buyers, and warehouse service operators. This is especially urgent for food products having a short shelf life. As world experience shows, the introduction of blockchain technologies in the agricultural sector solves an important problem for farmers: it simplifies the sale of their products as much as possible and allows them to exclude intermediaries from their chain.

The introduction of blockchain technology in the certification of food production and processing is a solution that makes it possible to effectively protect a bona fide supplier, and also turns out to be simpler, cheaper and more reliable than traditional certification systems. This is especially urgent for organic products, as well as products to be controlled by origin. Once a farmer has entered information about his product into the system, no one can change or duplicate it.

The blockchain technology can be represented as a system for accumulating and storing data on all operations to be carried out during the product life cycle. The blockchain technology can be applied to any other types of transactions, including those in the agricultural sector. It allows ensuring transparency of the product distribution chain all the way ‘from farm to plate’ while providing an opportunity to effectively combat counterfeiting, quickly identify low-quality products, model effective supply chains and optimize logistics, and, accordingly, reduce losses.

8. Conclusion
The development of world agriculture is based on increasing the knowledge intensity of manufactured products. One of the effective tools to achieve this is the introduction of digital technologies into production.

The national priorities of present Russia to be determined by the program documents of the country's socio-economic development for the period up to 2030 imply the use of the wide possibilities of digital technologies to ensure the entry of the Russian Federation into the number of the largest economies in the world. A large effect is predicted from the introduction of models based on digitalization, i.e. a total economic benefit will be more than 4.8 trillion rubles annually and the labor productivity will increase three to five times. However, the ability of manufacturers to commercialize scientific and technical projects is estimated at a level of 3% to 15%. It mainly concerns large enterprises that have the opportunity to invest in upgrading.

Providing food for a growing population requires solving the problems of organizing efficient logistics, financing procurement, controlling food quality and preventing product counterfeiting. The widespread adoption of blockchain technologies will solve these problems. A single transparent data exchange space for everyone allows effectively organizing the supply chain, which is especially important for food products with a short shelf life, protecting a bona fide supplier when introduced into the certification of food production and processing, this is relevant for organic products and products to be controlled by origin. The information entered into the system cannot be distorted, therefore, blockchain technology is the best tool for the transmission of information protected against forgery today.

For farmers, the introduction of blockchain technologies can maximally simplify the sale of products and exclude unnecessary intermediaries from their chain. The issue of financing farmers, including investing in the digitization of production processes, introducing blockchain technologies in certification and logistics, can be resolved through crowdfunding. ICO and crowdfunding can become a starting point for the development and modernization of farms. The launch of a crowd project can raise the initial amount to start up and attract the attention of a wide audience.
Projects aimed at the development of agriculture, especially in the field of small business, solve a large number of local problems requiring investment, such as development of rural areas and infrastructure, development and upgrading of farms, employment, retention of youth, manufacture of products according to classical recipes, development of supply chains, etc. Therefore, information on successful practices in the application of information technologies should be popularized for wider dissemination among farmers.

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