



Perspectives of Blockchain Technology in the Development of the Agricultural Sector

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ABSTRACT

Agricultural production is a specific branch of economic activity, which is basic in the economy of the region and has a number of significant features that affect the efficiency of production sales.

The objective of the study is to examine the prospects of using blockchain technology in the field of agriculture and development of rural territories, based on the analysis of scientific publications, as well as domestic and foreign cases. At the moment, the experience of using blockchain technology in agriculture is insignificant. The blockchain-based agricultural system can simplify every stage of creation and distribution of products. The use of blockchain technology is quite practical in specific sectors of agricultural activity. They are described in step-by-step instructions for using blockchain technology for farmers created by the Emercoin team. The main advantages of blockchain technology for the agricultural sector are the following: exchange of products without the mediation of a third party; safety and reliability of transactions; high quality data; work with qualified users; process integrity; transparency and permanence of the system; simplified accounting system; efficient transactions. The potential for the use of blockchain technology in the agricultural sector is very high and will enhance the development of not only agricultural producers themselves, but also rural areas.

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INTRODUCTION

Agricultural production is a specific branch of economic activity, which is basic in the economy of the region and has a number of significant features that affect the production efficiency of product sales. The direct involvement of living organisms in the production process limits human control over the results of the production process. Biological features

of the development of living organisms determine the seasonality in the production of products and, accordingly, in the formation of cash flows.

The relationship of agricultural production with geolocation factors and climate of a particular territory is another significant feature. They influence the formation of the composition of products that is typical for a given territory and

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difficult to adjust, as well as the low mobility of production.

The sale of food products is accompanied by the formation of large-scale supply chains, the control of the movement of products in which is very difficult. At the same time, the quality of the product sold directly to the consumer can only be confirmed by the transparency of its movement along the entire supply chain.

Unfortunately, multilevel state control in this area does not guarantee an absolute result, since many markets, producers and intermediaries always assume the possibility of falsification of results. State regulation in terms of financing agricultural producers, as well as in the organization of sales of products in the present circumstances also shows low efficiency.

The above difficulties can potentially be solved in connection with the development of blockchain technology. Blockchain is a technological protocol that can work with all types of data and contracts. It is a continuous sequential chain of blocks. Each block contains different data: from transactions to financial statements. The new block is attached to the previous one using complex algorithms. Each next block stores information about the previous one. None of the elements in this interdependent chain can be deleted, changed, or overwritten. Each block contains a time stamp and a unique digital signature [9].

Traditional databases where important information is stored are too vulnerable. Somebody can pick up a password for them, hack, spoil the structure of the database, after which it will stop working correctly, or disable the server as a result of a hacker attack. The main advantage of blockchain technology is its invulnerability to outside interference, it is almost impossible to hack. All data in the blocks are encrypted with hacker-proof cryptographic algorithms.

Another important difference from traditional databases is that information is not stored in any one place. Everything is distributed among several hundred or even thousands of system client computers around the world. All these computers, independently of each other, must give the green light for this operation to connect a new unit to the system. All of them protect now its reliability and integrity. It is impossible to hack into the system, because it needs to simultaneously access the database copies on all the computers on the network.

AIM

The objective of the study is to examine the prospects of using blockchain technology in the field of agriculture and development of rural territories, based on the analysis of scientific publications, as well as domestic and foreign cases.

LITERATURE REVIEW

In the scientific environment, the subject of the use of blockchain technologies is discussed quite actively, however, most authors consider the need for the use of modern technologies, there are still not enough studies regarding the experience of the practical use of blockchain in modern conditions of the agro-industrial complex. Varzhapetyan A.G. considers the possibilities of using blockchain technologies to implement a life cycle management system. Varzhapetyan A.G. considers the possibility of using blockchain technologies to implement a life cycle management system. Bannikov A.A. describes the urgent problems of the agro-industrial complex of Russia and gives examples of their solution through the introduction of digital technologies. Mikheev M.A. pays attention to the introduction of a digital platform for monitoring the quality of farm products, as well as the implementation of the blockchain in the supply chain management from the producer to the final consumer.

RESULTS

At the moment, the experience of using blockchain technology in agriculture is insignificant. The blockchain-based agricultural system can simplify every stage of creation and distribution of products. The blockchain provides all involved in the process with a single source of information for the supply chain. Buyers of goods can contact the supplier directly and transfer funds instantly. This significantly speeds up making payments, producers save on agency fees and can receive most of the proceeds from the sale.

The supply process is often complicated by agreements indicating the terms of delivery and payment. These agreements may be replaced by smart contracts. In this format, contracts can be converted to computer code and reproduced in a network of peer devices on one of them. As smart contracts are increasingly used in agriculture, a farmer can sell his products directly to organizations or even individuals without intermediaries.

Blockchain allows to control the authenticity of the product supply chain. Agricultural producers enter the produced products (including organic) into the register. Consumers using a mobile application can check the product history in real time right in the store. Market regulators can more effectively control the admission to the market of low-quality and harmful products by determining the entire chain of product promotion (participants and processing processes).

In the modern agricultural sector, large corporations dominate. They control the markets, dictate to farmers the prices and range of products for growing this season. As a result, prices can fluctuate significantly, not only depending on weather and climate conditions and regional scales

of production that determine demand, but also on relations with intermediaries. Blockchain-based agriculture can make the prices of mass-produced goods more transparent to farmers and buyers. A blockchain-based market will allow buyers and sellers to compare the terms and conditions of the negotiations with information about recent

transactions. The more transparent food production becomes, the more information consumers will have to make a decision. At the same time, blockchain can make products cheaper and facilitate tracking of their origin (Fig. 1).

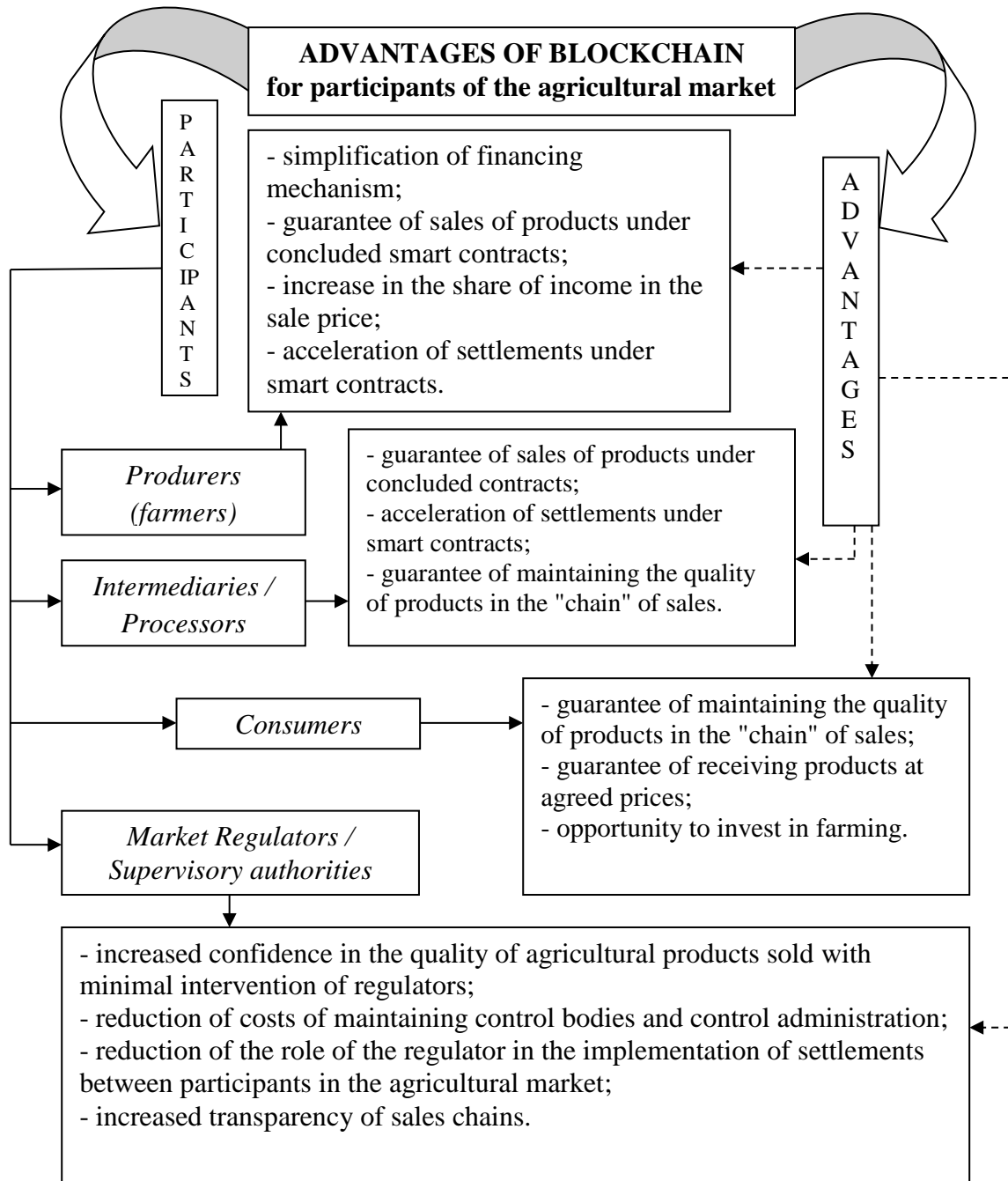


Figure 1: The advantages of blockchain for participants of the agricultural market.

The use of blockchain technology is quite practical in specific sectors of agricultural activity. Such options are discussed in Habr publications. They are based on step-by-step instructions for using blockchain technology for farmers created by the Emercoin team.

In particular, when growing and selling seedlings of trees and shrubs. Sales in this production are seasonal and take only a few months, the rest of the time is planting and caring for plants. At the same time, the need for funding is constant. Using the blockchain, an optimal system of settlements with

customers can be created: payment after purchase can be replaced by an advance payment. Such a calculation is beneficial for the customer, as it involves a discount and everyone calculates an installment system according to his or her own capabilities. Here, the blockchain guarantees the fulfillment of all conditions of the order without

additional legal support. A system in which every order is visible to all participants of the chain completely eliminates dishonest transactions. Currently, a number of blockchain projects in the field of agriculture have been implemented in practice (Table 1).

Table 1: Blockchain projects in the field of agriculture [26]

Name of the project or platform	Content/scope of use of the project
Alibaba with New Zealand Dairy Cooperative (Fonterra)	reduction of fraud in the food supply chain
Filament Platform	connecting physical objects with existing networks to “wider networks” to achieve more sustainable agricultural operation that combines technology with the control of the natural biological cycle of the product. The blockchain will allow in these projects to transmit data on climate changes, reportings via SMS, more accurate notifications about GPS positions and machine protocols
SkuChain Platform	monitors the origin of food, allowing consumers, retailers and producers of goods to be sure that they pay for a product that is truly quality
FullProfile Company	in Australia, under the protection of the state treasury, the agrotechnical industry uses the blockchain to eliminate the risks and inefficiencies of production chains. This is the creation of a payment network that reduces the risk for small buyers
AgriLedger Company	Australian company has developed a joint blockchain-based platform for managing goods related to the agricultural sector
Company CBH Group	the company adopted blockchain technology in order to track its supply chain, seeking to increase its productivity in the entire sector, as well as in potential producers' markets
Bext360 Application	uses artificial intelligence and blockchain to set grain prices in a safe, reliable and constantly updated form
SmartAgriFood Company	the company has developed an application in the blockchain system, designed primarily to track information about wines. It works with the support of blockchain technology after reading the QR code, which will be available on product labels
Arc-Net Company	the company collaborates with the PwC Netherlands anti-fraud division (intentional replacement, added products, changes, misinterpretations, food, ingredients or labeling)
Mercatrace Company	the company in Spain launches a platform to ensure traceability of the supply of products (their origin, processing, transportation)
Bart.Digitalagr Company	Brazilian company that provides reliable financial documentation for small producers
Greenspec Limited Company	a platform that records data on the origin and production of products, their warranty. The company has publicly recognized the potential of distributed accounting systems for agriculture and real-time asset and quality tracking management

As an object of the transaction, the farmer can offer not a specific type of product, but a kind of “share” or “wallet”, for the cost of which the buyer can subsequently purchase any product from the range offered by the farmer at a predetermined price favorable to the buyer [17].

Cryptocurrency-based financial instruments are now in demand. Traders will use such an asset as a speculative derivative. A derivative is a tool that allows investors or traders to trade an asset

indirectly, that is, not the asset itself, but any kind of obligations to transfer it or units of value created on its basis. Futures is the most common derivative. This is a contract for the purchase of goods in the future, at a price already fixed to date. This allows the buyers to insure themselves against excessive price increases, but it means additional costs if the prices of the goods are reduced.

The implementation of these projects allows to optimize production, settlements, sales, financing,

quality control in various sectors of the agro-industrial complex and for enterprises of different legal forms and scale of production.

In the Russian agricultural sector, the experience of using blockchain is very small. One of the most significant limiting factors is the lack of not only support from the state, but also the legalization of such settlements at the state level.

However, it was the Russian farmer Mikhail Shlyapnikov who became the pioneer in the use of blockchain in agriculture. "... this is one of the conditions for the survival of farming in Russia. The situation is very difficult, you cannot receive money at low rates for long periods from banks and the state. Therefore, we came to our money and released colions. Six months, while colions were working, our production volumes increased several times, we reduced production costs and attracted new customers. We even held several serious charity events," – this is how Mikhail comments on his experience in this area [23].

Own currency on the Emercoin platform was issued by the Kolionovo farm. Wallets on this platform are registered for free, in addition, Emercoin experts have prepared a step-by-step guide on the use of blockchain for farmers. In 2019, on the basis of the farming enterprise, the implementation of a reality project for the creation and development of farm production started. Here, the blockchain was already used in the transfer of land parcels previously purchased by Mikhail Shemyakin to shareholders for building houses and organizing their own production.

In August 2017, LavkaLavka farming cooperative also released its own cryptocurrency – biocoin. Biocoin was supposed to be part of a financial blockchain platform to which partners from all over the world can join, sharing the cooperative principles of responsible consumption, biodynamic agriculture and support for small family farms. It was planned to conduct an ICO (InitialCoinOffering – collecting funds from investors using cryptocurrencies, by analogy with the placement of securities on the stock exchange).

In total, it was planned to issue 1 billion biocoins, during the ICO – to sell 800 million biocoins and raise an amount of about \$ 15 million. However, even at the beginning of this startup, experts drew attention to the fact that LavkaLavka did not have an audience sufficient to raise the necessary amount exclusively among current and potential customers. Such a platform needs to be supported and promoted, and this requires significant additional costs. "Experts estimate starting investments for launching cryptocurrency and placement at \$ 150-200 thousand, further investments in marketing will be required as the platform develops" [22]. The project, indeed, turned out to be financially insolvent.

One of the founders of the cooperative Boris Akimov comments on the situation with his own cryptocurrency as follows: "Now we are moving away from the idea of creating our own blockchain platform and re-releasing biocoins on the Ethereum platform. Due to this, our costs will significantly decrease. We will exchange old biocoins for new ones. One biocoin will be equal to one point and one ruble" [25]. In addition, Boris Akimov is actively promoting the idea of crowdfunding to support the development of the social sphere of rural settlements.

CONCLUSION

Digitalization of most areas of life and processes in economic sectors is inevitable and represents one of the trends in business development. The state's wary attitude to this issue is understandable, since the blockchain technology itself is based on the work of a distributed registry, or on the cumulative liability of all users. Such a system, of course, does not allow administrative regulation of the implementation of control measures. Taking into consideration the objective reality of the introduction of such processes in the agricultural sector, the question of the effective implementation of the state function lies in the terms of official recognition of the possibility of using blockchain and cryptocurrencies.

In the near future, the development of the agricultural sector will be facilitated by such areas of use of blockchain technology:

tracking the origin of food products, guaranteeing their environmental cleanliness and proper labeling, preventing cases of unfair sale and violation of storage and transportation conditions; expanding access to financing for small farmers. The platform currently used for this purpose in African countries can be easily scalable in any other country; investments in agriculture. Blockchain crowdfunding will allow raising funds for agricultural production on conditions favorable to investors with a payback guarantee.

Thus, we can formulate the following main advantages of blockchain technology for the agricultural sector:

- exchange of products without the mediation of a third party;
- safety and reliability of transactions;
- high quality data;
- work with qualified users;
- process integrity;
- transparency and permanence of the system;
- simplified accounting system;
- efficient transactions.

The potential for the use of blockchain technology in the agricultural sector is very high and will enhance the development of not only agricultural producers themselves, but also rural areas.

REFERENCES

1. Andreas M. Antonopoulos. *Mastering Bitcoin: Programming the Open Blockchain* // O'Reilly Media; 2 edition. 2017. 410 p.
2. BATT Ico Review: holding of grain trades based on smart contracts // Coinworldstory – Best cryptocurrency blog: [website]. – 2019. – URL: <https://coinworldstory.com/batt/> (date of access: 20.11.19).
3. Blockchain technologies in agriculture // Local agriculture business platform: [website]. – 2018. – URL: <https://localagro.io/blog/blockchain-technologies-in-agriculture> (date of access: 21.11.19).
4. Brand N. *Blockchain for Agriculture: Improving Supply Chain Efficiency and Access to Finance for Smallholder Farmers* / N. Brand // NextBillion: [website]. – 2018. – URL: <https://nextbillion.net/blockchain-for-agriculture/> (date of access: 21.11.19).
5. Budweiser's Parent Company Invests In Blockchain For Farmers // Forbes: [website]. – 2019. – URL: <https://www.forbes.com/sites/michaeldelcastillo/2019/06/06/budweiser-parent-company-invests-in-blockchain-for-farmers/#7fcdeb764e89> (date of access: 10.11.19).
6. Cutting Edge Agriculture: How Artificial Intelligence, Satellites and Big Data are Transforming Farmers' Access to Finance // NextBillion: [website]. – 2018. – URL: <https://nextbillion.net/cutting-edge-agriculture-artificial-intelligence/> (date of access: 21.11.19)
7. Daniel Drescher. *Blockchain Basics: A Non-Technical Introduction in 25 Steps* // Apress; 1st ed. Edition. 2017. 276 p.
8. David Furlonger. *The Real Business of Blockchain: How Leaders Can Create Value in a New Digital Age* // Harvard Business Review Press. 2019. 272 p.
9. Don Tapscott. *Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies is Changing the World* // Penguin; 1st edition. 2016. 409 p.
10. Ge, Lan, Christopher Brewster, Jacco Spek, Anton Smeenk, and Jan Top, 2017. *Blockchain for Agriculture and Food; Findings from the pilot study*. Wageningen, Wageningen Economic Research, Report 2017-112. 34 p.
11. Jai Singh Arun. *Blockchain for Business* // Addison-Wesley Professional; 1st edition. 2019. 224 p.
12. Kevin Werbach. *The Blockchain and the New Architecture of Trust (Information Policy)* // The MIT Press. 2018. 344 p.
13. Stephen P. Williams *Blockchain: The Next Everything* // Scribner. 2019. 208 p.
14. Tim Hammerich *5 Potential Use Cases for Blockchain in Agriculture* // Future of Agriculture Listener Survey: [website]. – 2019. – URL: <https://futureofag.com/5-potential-use-cases-for-blockchain-in-agriculture-c88d4d2207e8> (date of access: 15.11.19).
15. William Mougayar. *The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology* // Wiley; 1st edition. 2016. 209 p.
16. Bannikov A. A. Solving the problem of the agro-industrial complex through the introduction of digital technologies / A. A. Bannikov, N. G. Shakhov, V. V. Sevenyuk // Materials of the I International Scientific and Practical Conference “Digitalization of the agro-industrial complex”. – 2018. – Oct. 10-12. – P. 229-231.
17. *Blockchain in agriculture: a guide for farmers* // HashFlare Company Blog. – 2017. – URL: <https://habr.com/ru/company/hashflare/blog/402205/> (date of access: 17.11.19).
18. *Blockchain: revolution in the agricultural sector or a reckless attempt?* // Main site about agribusiness: [website]. – 2018. – URL: <https://latifundist.com/cards/27-blokchejn-revoljutsiya-v-agrosektore-ili-avanytura> (date of access: 17.11.19).
19. Varzhapetyan A. G. Application of blockchain technologies in industry / A. G. Varzhapetyan, E. S. Belova, M. S. Smirnova // Multifactor challenges and risks in the context of the implementation of the strategy of scientific, technological and economic development of the North-West macroregion. – 2018. – Oct. 10-12. – P. 4-9.
20. Manelyuk O. *Agricultural blockchain: real examples of use* / O. Manelyuk // AgroPortal: [website]. – 2018. – URL: <https://agroportal.ua/views/blogs/blokchein-agrarnyi-realnye-primery-ispolzovaniya/#> (date of access: 18.11.19).
21. Mikheev M.A. Quality control of farm products using blockchain technology / M.A. Mikheev, Yu.A. Kryukov // Materials of the I International Scientific and Practical Conference “Digitalization of the Agro-Industrial Complex”. – 2018. – Oct. 23-24. – P. 344-347.
22. *Basic principles of BioCoin* // CoinRadio – information resource about cryptocurrencies and blockchain. – 2018. – URL: <https://coin.radio/2017/07/10/lavkalavka/#loading> (date of access: 18.11.19).
23. Privalov A. *Blockchain startups in agriculture* / A. Privalov // Cryptochill: [website]. – 2019. – URL: <https://cryptochill.ru/agriculture->

- blockchain-cryptocurrency/ date of access: 18.11.19).
24. Fresher than ever: how blockchain technology helps monitor food quality // AgriGeek: [website]. – 2017. – URL: <https://aggeek.net/ru-blog/svezhee-nekudakak-tehnologiya-blokchejn-pomogaet-sledit-za-kachestvom-produktov-pitaniya> (date of access: 19.11.19).
 25. Farm Secret: How the founder of LavkaLavka tries to save his business // TheVillage: [website]. – 2019. – URL: <https://www.the-village.ru/village/business/interview/351723-lavkalavka> (date of access: 19.11.19).
 26. Blockchain technologies in agricultural enterprises // Журнал AltCoinLog: [website]. – 2018. – URL: <https://altcoinlog.com/tehnologii-blokchain-v-selskohozyaistve/> (date of access: 18.11.19).
 27. Smart farming: A survey of leading producers and technologies // Geoline Technologies: [website]. – 2018. – URL: <https://geoline-tech.com/smartfarm/> (date of access: 20.11.19).