Prospects for application of blockchain technology in land administration

A G Beznosov¹, E A Skvortsov²* and E G Skvortsova¹

¹Department of Land Management, Ural State Agrarian University, Karl Liebknecht St. 42, Ekaterinburg 42620075, Russia
²Department of Competition Law and Antimonopoly Regulation, Ural State Economic University, 8 St. March, Ekaterinburg, Russia

*E-mail: 9089267986@mail.ru

Abstract. The application of blockchain is associated primarily with cryptocurrencies, however they are used in various spheres of the economy. The issues of the application of blockchain technologies in land administration are not sufficiently developed theoretically, which makes this study relevant. Since 2016, the application of blockchain technologies in land administration has been at various stages of implementation in different countries (USA, United Kingdom, Brazil, etc.). A model for entering data into the land information system using blockchain technologies is presented: data from users are received and added to the blockchain, they are replicated and the transaction is verified, a block with a transaction is formed, which is added to the blockchain of all system participants. A national land market system with blockchain infrastructure can increase the likelihood of exporting to international markets as compliance with international standards becomes a transparent and undeniable issue. The use of blockchain technologies can increase economic efficiency and security, reduce the risk of uncertainty in achieving sustainable development of land matters.

1. Introduction

The blockchain toolkit is much broader than the creation and maintenance of "bitcoin" and other digital currencies, the number of which now exceeds 1,900 and continues to grow [1]. This technology can be considered as an element of the 4th industrial revolution [2], as it forms the basis for the integration of cyber-physical systems with far-reaching consequences in the banking, insurance, and public sectors, in the sphere of personal data protection [3]. This technology has the potential to transform everything related to the exchange of values in all contexts and at all levels of society, and also raises the possibilities in the field of smart contracts, distributed applications, and autonomous organizations, fully mediated by cryptographic technologies.

The interest in blockchain technologies is primarily due to the fact that they provide an opportunity to make technologies for collecting and processing information that are used by all consumers (from private households to government organizations) efficient, verifiable, with a cryptographically guaranteed level of security.

2. Materials and Methods

The aim of the study is to determine the prospects for the application of blockchain technologies in land administration.

The research objectives are as follows:
- Identification of land administration problems and prerequisites for the application of blockchain technology;
- Generalization of world experience in the application of blockchain technologies in land administration;
- Determination of requirements to information sources in the context of the application of blockchain technologies;
- Building a model for entering information into the land cadastre.

“The bibliographic method was used as a methodological research tool. At the first stage, the content of publications on the application of blockchain technologies in various sectors of the economy was analyzed. At the same time, the Web of Science bibliographic database was analyzed for the content of articles for the period from 2010 to 2018 inclusive. The literature was screened, and the text of the articles was analyzed in order to clarify whether they are relevant to the research issues.

3. Results and Discussion

Government agencies around the world are looking for opportunities related to the application of blockchain technologies in the public sector” [4], especially when using secure, distributed, open, and inexpensive databases to reduce costs and bureaucracy, increase efficiency, for authentication of various types of permanent documents.

Thus, blockchain technologies are already being applied in a number of sectors of the economy. At the same time, the theoretical issues of the application of blockchain technologies in land administration are not sufficiently developed by both national and foreign science. The use of blockchain in land administration is hampered by the lack of solutions for this issue, insufficient knowledge of the feasibility of applying blockchain in land administration, and the absence of guidelines for the implementation of these technologies. There is no generalization of the world experience in the application of this technology in land administration.

The most significant problem in the development of the country’s economy is land administration, in particular, agricultural land turnover. These problems include:
- Withdrawal from agricultural turnover and degradation of land resources;
- Criminalization of the sphere of land matters regulation;
- Poor development of land market infrastructure;
- Lack of objective information on the state of land resources;
- Weak state control over the use and protection of land resources, especially for agricultural purposes.

There are a number of factors that are driving the application of blockchain technology in land administration at the international level. The existing forecasts of population growth up to 9 billion people by 2050 bring to the fore in terms of priority the solution of the problem of meeting the global needs of the population for food [5]. The growth of agricultural production at the international level, in turn, requires a coordinated solution to common environmental problems [6]. Blockchain is expected to play a key role in environmental management [7].

Certain elements of blockchain technologies in land administration have been implemented in a number of countries (Table 1).

| State          | Approval year | Experience                                                                 |
|----------------|---------------|---------------------------------------------------------------------------|
| Ukraine        | 2017          | The Ministry of Agrarian Policy of Ukraine, together with the State Agency for e-Governance and Transparency International, presented an updated State Land Cadastre based on Blockchain technology |
Continuation of table 1.

| Country   | Year | Description                                                                 |
|-----------|------|-----------------------------------------------------------------------------|
| Georgia   | 2016 | The National Agency of Public Registry of Georgia (NAPR), together with BitFury, has developed a very reliable solution to the behavior of the land cadastre in the republic using blockchain technology, which is designed to ensure data security, audit capability, and transparency of the system for citizens and government agencies by providing its citizens with a digital certificate of their assets with cryptographic proof that is posted on the Bitcoin blockchain. |
| United Kingdom | 2017 | In the United Kingdom, the Digital Street project was tested, which allows buyers to purchase property almost instantly, and the Land Registry – to store more detailed data. |
| Brazil    | 2017 | Brazil is testing the possibility of registering land plots by the American company Ubiquity using Blockchain Land Registry technology based on blockchain. |
| Sweden    | 2016 | Lantmäteriet, the Swedish mapping, cadastral and land registration authority, in collaboration with ChromaWay and a partner bank, launched a testnet for real estate management in the country based on blockchain and smart contracts. |
| USA       | 2017 | The city of South Burlington, Virginia, is starting a pilot project with Propy blockchain startup as a possible step in using technology to replace the city's real estate registration system. The state of Wyoming is integrating the blockchain system into the regional governance with retailer Overstock, integrating it into the land registration mechanism. |
| Ghana     | 2016 | The Bitland pilot project covered about 30 communities in the city of Kumasi in southern Ghana. Testing began in October 2016. The project aims to provide a foundation in unblocking land capital by democratizing property ownership using advanced technologies. |
| Honduras  | 2016 | The government of Honduras, together with Factom, has transferred the registration of land plots to a distributed blockchain ledger to combat fraud, thus planning to solve the problem of registering property rights that arose due to ineffective governance and corruption. |

The application of blockchain technologies in land administration is at various stages of implementation – from pilot projects to changes in the state cadastre. At the same time, the first projects using blockchain technologies began to be implemented in 2016. These technologies are gaining momentum in both advanced economies and developing countries. For example, in Ghana, the service uses online technology to include satellite images, GPS coordinates, landmarks, survey data, and other data that facilitate independent verification of the accuracy of any land plot. The system uses a modified Proof of Stake (PoS) approach, the security of the system is not only distributed, but also more energy efficient than Proof of Work systems. By reserving the title to the land for the owner of the land plot to the blockchain, a permanent, unchanging, transparent register with a time stamp is created, which makes it possible to ensure the stability of the system against manifestations of corruption and fraudulent transactions, prevent bureaucratic nepotism and illegal land seizure.

A model of a land administration system with a blockchain infrastructure is presented, in which data on operations and state of land resources are added to the blockchain. The user of this system can be a person carrying out transactions with land plots, including a miner. Data from the users of the system, which form the land information system, are received and added to the blockchain in real time when the provider's node creates a new block. At the same time, the database of the land information system may include data from the Unified State Register of Real Estate, materials of state land...
supervision, materials of soil surveys and geobotanical studies, materials of land control, materials of remote sensing of lands.

Requests for transactions with land resources are distributed over the network between ledger participants in such a way that each miner's node has only a part of all data on land resources; no node can access the data in full (Figure 1).

**Figure 1.** Design model for entering information on land resources using blockchain technologies.

The replication of the transaction occurs in such a way that the nodes of the distributed ledger can cross-reference the blockchain data with the backup data if the need arises. This improves the reliability of data storage. Mining nodes on the network provide their equipment, electricity, and computing power to test the blockchain, which results in complete information on land resources and operations with them, which is a reward for the "work" of each node. This work constitutes transaction verification and cryptographic operations. Then a block with a transaction is formed in the land information system, which is added to the blockchain of all ledger participants. Although a backup version of complete land data is stored locally off-chain, accessing the database requires issuing encryption and decryption keys based on their permission levels, which are also stored on the blockchain. The cryptographic key itself is a group of letters and numbers, which are calculated using a specially created algorithm called the hash function. At the same time, the user has only one key, which has two different qualities: having the key in hand, it will not be possible to find out the primary (initial) information. It is impossible to identify another data package that would create the same key. At the final stage, ledger participants are notified of the operation.

For example, the subject of land matters wants to make a transaction, i.e. make changes to the information on the state of the land plot. This transaction is forwarded to a peer-to-peer computer network (nodes). This is followed by the confirmation stage, where the network of nodes confirms the transaction and the user's status using known algorithms. A confirmed transaction may be associated with a change in the owner of the land plot, its cadastral value, agro-ecological characteristics, or contain other information. After confirmation, the transaction is combined with other transactions, thereby forming a new block of the distributed ledger. A new block is added to the blockchain, and the...
place of the block in the chain is unique and cannot be changed. After completing all these actions, the transaction is considered complete.

Land administration system with blockchain infrastructure can represent invariable and decentralized records management systems. This could fundamentally change the way all biophysical resources are recorded and tracked, from information source to its reuse in large-scale datasets, and can ensure the integrity of statistical reports and services. The initial link in this process is information sources. In the context of the application of blockchain technologies, they are undergoing a significant transformation.

At the same time, at the first stage (current state), the sources can be data coming from economic entities, federal departments, regional bodies, and local governments. However, at the next stage, a significant part of the information must come directly from electronic devices – transmitters, sensors, mobile devices, and can also be obtained through remote sensing. At the same time, the possibility of obtaining information from persons interested in its distortion should be excluded.

4. Conclusion

Land administration with the application of "blockchain technologies will make it possible to form a cadastral register with simultaneous verification and clarification of the information entered. Blockchain technologies will make it possible to carry out transactions with land resources without intermediaries, which will reduce the risks of implementing fraudulent schemes. The potential of this technology in land administration is also as follows. Many land owners are entitled to land allotments, but the property does not have established boundaries. As a result, the land is actually withdrawn from turnover. The real market price of real estate in the form of a land allotment is very difficult and costly for the owner to determine, which significantly hinders the development of the land market and contributes to mismanagement” [8].

One of the main areas of application of blockchain technologies is monitoring agricultural land; due to the speed of calculations, general availability and openness of information about land resources, the emergence of new latifundists is excluded. A new structure of land administration is being formed, in which "interagency interaction is characterized by a decrease in the costs of document circulation, a reduction in administrative barriers due to the openness of management bodies and the use of electronic document management systems using blockchain technologies that exclude the loss and distortion of the information provided” [9].

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References

[1] CoinMarketCap Cryptocurrency Market Capitalizations https://coinmarketcap.com/ 2017
[2] Schwab K 2017 The fourth industrial revolution (London: Penguin. Umstatter, C5th European Conference on Implementation of Precision Agriculture/ Precission Livestock Farming) pp 297-304
[3] Zyskind G, Nathan O and Pentland A 2015 Security and Privacy Workshops (SPW) pp 180-184
[4] Chiang C W, Betanzos E and Savage S 2018 Blockchain for trustful collaborations between immigrants and governments Proceedings – Conference on Human Factors in Computing Systems
[5] Crist E, Mora C, Engelman and R 2017 Science 356 pp 260–264
[6] Bodin and O 2017 Science p 357
[7] Saberi S, Kouhizadeh M, Sarkis and J 2018 Resources, Consery Recycling 130 pp 80–81
[8] Kulikov I, Semin A, Skvortsov, E, Ziablitckaia N and Skvortsova E 2020 Challenges of
enterprise resource planning (ERP) implementation in agriculture. Entrepreneurship and Sustainability Issues 7(3) pp 1847-1857

[9] Semin A N, Altukhov A I, Semenova E and others 2019 Agro-industrial complex of Russia in the conditions of "big challenges (M.: Fund "Personnel reserve) pp 118-14