*Review*

# Blockchain-Based Land Management for Sustainable Development

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**Abstract:** In recent years, many papers have been published on the topics of the blockchain (BC) and blockchain technology (BCT). Some papers put BCT in the context of land registries (LRs), land cadastres (LCs), land registration, land administration (LA) and land management (LM) and its implementation benefits. Some eight years later, from its beginnings in 2014, the question of the future of the proposed concept and whether it has one, has been raised. The Scopus database was analysed using bibliometric analysis methodology and Rstudio software with the Bibliometrix R-package and the Shiny package environment. Based on this research, significant interest and growth in the topic was found in both technical and land-governance directions. Different approaches to the topic have been established in the global north and global south. From today's perspective, the future of BCT in both worlds is guaranteed.

**Keywords:** bibliometric analysis; blockchain; land administration; land cadastre; land management; land registration; land registry

## 1. Introduction

Defining the blockchain (BC) and blockchain technology (BCT) is not an easy, but rather an extremely complex and challenging task. There are many definitions written in the literature. Any of them could be written here. However, the question is whether it would get at the core of what blockchain is and not leave out something of importance. There are many approaches to do this. Here, two different but important approaches will be used for the remainder of this paper.

Firstly, what blockchain history can show us will be listed. The year 2014 is the most important for our further research of blockchain, as this is when blockchain technology became separated from the currency (Bitcoin). Blockchain 2.0 was born, referring to applications beyond currency [1]. That is the blockchain that interests us.

Secondly, the purpose of blockchain will be emphasized. Its goal is to allow information (in digital form) to be recorded and distributed, but not to be edited. Blockchain records of transactions cannot be changed, deleted, or destroyed [2].

Subsequently, this paper will deal with land. Land management, land administration, land registries, land registration and land cadastres are different terms with different meanings, different concepts, different goals, etc., but in this paper, they will be processed in the same way. All the topics mentioned are an important segment of sustainability and sustainable development. Why these terms and not others? According to the United Nations Economic Commission for Europe [3], land administration (LA) is the process of determining, recording and disseminating information on the ownership, value and use of land when implementing land-management policies. On the other hand, in ISO [4], LA is described as the process of determining, recording and disseminating information about the relationship between people and land. Thus, LA and LM will be analysed from the

point of view of definition. Vos et al. [5] point out that the ISO [4] definition of LA includes land registries (LRs) and land cadastres (LCs). Therefore, LR and LC will be analysed in this paper. The fifth term used was 'land registration'. This is important due to its connection with the ownership of real estate [6].

The matter of ownership became an important topic in the early stages of human development. Buying and selling, ownership registration, registers of rights and the management of land arose from land's significance to people. This is the era of new technologies and inventions in science. The digital world is virtual, but is more prominent today than anything that could be imagined only some decades ago. A part of that virtual world is blockchain technology. Thus, connecting the old world of land and new world of technology is one of the most challenging tasks of our contemporary era. The research gap is wide in the field. Firstly, BCT and LM should more often be considered in the context of sustainability. Secondly, so far no research of this kind has been presented. All the research conducted and presented so far has been based on individual experiences and solving technical issues. There was no global outcome of the theoretical and practical research in the field, nor a global policy on how to proceed with the issue. Additionally, there is no legislation or standardization on the issue. This research should give a better insight into the combination of BCT and LM throughout the world and all that should be put into the concept of sustainable development. This is why developed and non-developed countries have been treated separately.

### 1.1. Research Focus

One of the authors of this paper (Ivana Racetin) came across the topic of the blockchain in the context of land cadastres and registries in Amsterdam in 2016 while working on a different project. It was presented as solving all our problems in land cadastres and registries and got her attention. Analysing the scientific database Scopus, the first scientific research was published on the topic in the same year. The main research question is whether BCT will be a part of LM in the long run and whether it will help world sustainability. Based on the context of sustainable development, it should. LM issues and sustainable development are closely related. Land governing is a prerogative of sustainability in the contemporary world. The aim of the paper is to explore, based on research that will be conducted, the current status of papers published by the scientific community, as well as their growth in the last eight years in the Scopus database. Another aim is to determine whether research on these topics is stagnant or progressive and also what could be learnt from the experience of different countries. The answers to the question of whether the BC and BCT have a future in the context of LM should be obtained, as stated at the beginning of the paper as a part of developing sustainability.

One could conclude that the research frame from 2016 to the first half of 2022 is quite narrow. However, some questions could be answered based on that research period.

The goal of this paper is to answer (within the Scopus scientific community) the following questions:

1. What are the trends of researching blockchain technology in the contexts of LR, land registration and LC, and LA and LM?
2. Is it developing through time or not?
3. If it is developing, how rapid is its growth and in what direction is it developing?
4. Of which states are the scientists involved in its development and in what proportions?
5. What will be its likely future development?

These outcomes could be considered a possible solution for further strategies in the context of sustainable development. We need to know the trends in the domain. It is important to see the findings on every continent. Examples of different states and their research activities will have to be explored. Developed and non-developed countries will be treated separately. The search area will be divided into Global North and Global South. The findings of both will be treated differently, since they have different roles in environmental

and social governance. Special attention will be given to the countries that are developed and have formed their LM, but whose data are not accurate enough to be used in BCT.

*1.2. Literature Review*

In the last few years, there have been some papers published on the topic of BC and BCT using bibliometric analysis [7–9]. Later in this chapter, the research focus will be on papers that were published concerning the combination of BC and land issues (LA, LR, LC, LM and land registration).

A very important term on which everything else concerning land (in the context of this paper) relies on is good governance. By analysing its eight major points (rule of law, responsiveness, equity and inclusiveness, accountability, participation, transparency, consensus orientation and effectiveness and efficiency) [10], it can be concluded that it is the basis to which a BCT can very easily fit in. One of the issues of the modern world is the improvement of LM and existing land registries. In many countries around the world, existing land systems are not fully trusted. Fraud, corruption and lack of quality are some of the problems that can be solved by introducing a BCT [5]. Blockchain, just like the LR, contains information about who owns something at a certain point, ensures the ownership and knows at what moment a certain transaction took place. On the other hand, compared to the LR, it provides additional security resulting from cryptography, decentralization and backups, which is why it can be considered an alternative to the traditional approach. An additional advantage of introducing BCT into the existing system is cost reduction and transparency. Although the initial costs of implementing BCT could be high, such technology could increase efficiency via distributed processing and reduce costs related to human resources in the long run. Since the register is publicly available, blockchain technology also ensures the transparency of all data, so any unauthorized manipulation of land information is automatically recognized [11].

The review is divided into two components, Global North and Global South findings, since the approach to the BC and BCT topic is different in different parts of the world. Sometimes, Global North countries deal with topics of Global South to help them with technology and progress, but usually Global South deals with their own problems, due to the numerous issues that they have and that could be solved by BC and BCT.

1.2.1. Global North Findings

One of the earliest papers by Vos [12] on the topic of BC explains that BCT should develop trust in LRs, prevent corruption and create order in the system. He compares BCT and LR systems, their pricing and their simplicity. In the conclusion, he is positive about introducing a new technology. One year later, there is a clearer picture on the topic written by Vos et al. [5]. They explain when the LR system is successful. They connect that with trust in the LR system. In some (developing) countries, people do not always trust the system. In the case of some states, there is fraud and corruption, and in other cases, there is just not enough quality. Furthermore, they write about the importance of involving a Trusted Third Party in the BC process. This is needed so that the parties in the procedure trust in the procedure itself. Later in the paper, they listed BC projects that were ongoing at the time in Ghana, Honduras, Sweden, Georgia and the State of Illinois, USA.

Lemmen et al. [13] dealt with Land Administration (LA) standardization in the context of preparation for BCT implementation in LA. They recognized the problem of the European Union (EU) in not having a unified approach on the topic of LA. Each EU country is functioning on its own which is not a good long-term solution. A possible solution could be the European Land Registry Association (ELRA) and its European Land Register Document.

As a result of his PhD thesis, Verheye [14] explains his research on blockchain usage in the LR of Germany, Belgium and France. He also explains Swedish and Georgian pilot projects. His position on BCT and LR is neither over optimistic nor over pessimistic. Another thesis dealing with real estate transactions using BCT was written in Sweden by Hermansson [15]. He describes in detail BCT and its possible application on the real estate

market through real estate transactions. The real estate sector of the EU and its security and speeding up using BCT is the subject of research by Garcia-Teruel [16]. She listed BC benefits and challenges while renting a property, purchasing a property and while purchasing it with a mortgage loan.

The paper of Dešić and Lenac [17] is an overview of the fundamental BCT features from the position of a jurist in Croatia. In the paper overview of the project, results in Georgia, Dubai, Honduras, Brazil, Sweden and especially the application of BCT in Estonia are given. Authors emphasize that Estonia is a good example of possible BCT application in Central European countries and explain obstacles and the possible application of BCT in Croatia. They explained that the problem of the Croatian Land Registry is the fact that, among other issues, it is not up to date, and that is one of the first demands in BCT application. There is no legislative frame ether. In Serbia, interest in studying the BC issue has been shown through papers by Sladić et al., Stefanović et al. and Stefanović et al. [18–20]. All three papers analyse Serbian LA in the context of possible BCT implementation in Serbian Land Information System (LIS). Stefanović et al. and [19,20] approach the topic in a more theoretical way. On the other hand, Sladić et al. [18] focus more on solving technical issues. After explaining the Serbian cadastral system, they gave some technical solutions—a so-called roadmap on securing transactions in real estate properties. They stated that in Serbia, which we find really important, there is a legislative frame for BCT adapting in the process of being developed.

Müller and Seifert [21] consider BCT application in the case of LR in Germany (one more Central European country). They analysed case studies of Brazil, Dubai, Georgia, Honduras, India, Japan, Russia, Sweden, the United Kingdom and the USA. They also raised the question of whether BCT should be used in German cadastre or not and found it not to be necessary at this moment, as most developed countries do. However, in the long run, they find the usage of BCT useful in terms of faster transferring of the ownership from today's 5–6 months to 1–2 weeks. They recognized some other weaknesses of the current processes of German LR and LC, such as the so-called black box feeling, and of insufficient transparency in the process users that could benefit from using BCT. Sweden is from the same basin of well-developed countries with well-organized LA and LR. Yet, they spent some time and resources studying the topic and testing. As in Germany, in Sweden the system is functioning at a high level, compared with most countries of the world, but there is always some space for improvement to the existing system. Lantmäteriet et al. [22,23] are two projects carried out by Swedes. They stated that having not good enough transparency and a 3–6 months long transaction process are problems for LR. Another problem is that a lot of documents are still printed on paper (contracts, for instance), which results in inefficiency of the whole system. The last "paper" problem can produce possible mistakes and errors in the process. To avoid that, they recommended complete document digitalization and ID signature, including procedures that include banks, if selling or buying a real estate property. They expect to shorten the mortgage deed time for resolving the problems from four months to a few days. The result is a fast and confidential digital ownership agreement. This is already applicable. The problem of improving the LR system and its transparency is much more complex and includes a lot of changes in legislation.

According to Shang and Price [24], not a long time ago in Georgia there was a large possibility of frauds in land records changing. To solve the problem, in 2016, they started a pilot project (1st Phase) on BCT implementation in their LA and LR. It lasted for one year and the outcome was that in Georgia a time to register property lasted one day at a cost of 0.1% of the property value. It was a good solution for all the participants. The 1st Phase was a great success, so they started a 2nd Phase. Georgia is the first country in the world to use BCT in LR. Rodima-Taylor [25] states that Georgia was the first country with national BC-based land registration. Graglia and Mellon [26] listed Ukraine as a country following in the footsteps of Georgia, but it has not reached a similar outcome yet.

Estonia is a good Central European state example using BCT. Even before BCT, they had a well-organized but slow online public notary to LR communication [27]. Involving

BCT, they left an obligatory public notary in the system. All the data are digitized and public. They shortened the land registration time from 3 months to 10 days and found the system useful [28,29].

### 1.2.2. Global South Findings

In this part of the world, there is not that much activity at the state level. The exceptions are Ghana, Dubai, India, Honduras and Brazil. The others have individual research and paper publishing.

Indian scientists publish a large number of papers on the topic. In this paper, some of them are explored [11,30–43]. They are very active and obviously interested in the topic, since it can be applied to their country, improving today's LA significantly. Their papers could be categorized in a certain context, although they are of significance individually, and the issues (problems) that Indians deal with could be noticed. A large number of them [32,38,41,42] deal with technical aspects and technical issues, algorithms, programming, etc., that will help them integrate and improve the system. Some of them write about healthcare system problems and a possibility of solving them using LR and BCT. Real estate issues were dealt with by Tomar et al. [33], and poverty solving issues in the context of BCT were analysed by [35,37]. A lot of focus is placed on fraud issues and how to solve them by [34,36,39,40,43]. The last stated problem could explain why BCT is of such huge interest in India. From the paper of Müller and Seifert [21], it can be seen that some actions were initiated at a state (Andraha Pradesh) level too, dealing with LR and transparency.

Ghana is an African state that is rather open to implementing BCT since they have around 80% of not registered rural landowners. By using the BCT concept, they could solve the problem by registering ownership electronically using a BCT. Thus, the pilot project started in 2017 and an IBM company got involved, but no concrete results came out of it [25]. Since there has been some new research published on the topic [44,45], it could be presumed that Ghana has not given up on the BCT implementation yet. There were also some pilot projects in Honduras and Brazil, but the outcomes were not put in official usage due to obstacles in the method of implementation. Dubai, on the other hand, implemented BCT successfully. In their case, BCT is used in a secure database which records all contracts related to rights on real estate, including real estate lease agreements. According to their plan, they should achieve the complete digitalization of state administration soon [17].

In many papers [5,14,17,18,21,25,26], it can be seen that overviews of the experience of the BCT in combination with LA, LR, LC, LM and land registration in different countries was given. It shows us a trend of learning from other countries' experience. Therefore, the need was recognized, by the authors of this paper, to get an overview (a bigger picture) of what is going on inside the scientific community throughout the world on the topic. It is important to say that no previous research of this kind, in combination with BC and land issues, was carried out to the authors' knowledge.

## 2. Materials and Methods

Going through all the available references, several things could be concluded. Firstly, at a state level (projects initiated by the states), it looks like there is not as much enthusiasm as there was at the beginning of the "BC-land" story. There are many obstacles, financial or with existing data quality, or in matters of legislation, and sometimes there is no will by the inhabitants to implement the model. Yet, it could be said that, all in all, looking at the long run, it looks like a good solution that should be implemented. The second conclusion is that obviously the scientific community recognizes the importance of the topic, and more and more papers are published all over the world on the "BC-land" theme. The exact numbers will be displayed and analysed in this chapter.

Initially, analysis was performed for ISI WoSCC and Scopus databases separately. With regard to the topic that has flourished in the last few years and where the real potential is still being examined in the scientific, but also in the practical, professional area, the initial research of the authors of this paper was quite broad. As surveyors, one of the

main business tasks is determining the position of administrative boundaries and the boundaries of public and private parcels of land, including the registration of these parcels with the competent administrations, which is a particularly interesting way of connecting blockchain technology in the regulation of land rights. This was exactly the central point of this research. Two scientific databases, Scopus and WoSCC, were studied, and considering the number of papers that were found in each, the Scopus database was chosen due to the number of papers on the observed topic being four times bigger. The ISI WoSCC database included 118 titles related to research and review articles, proceeding papers, etc. The Scopus database included 489 research and review articles, conference papers, book chapters, etc. Obtained data were analysed in the bibliometric data analysis software Bibliometrix with Biblioshiny application.

Bibliometric research is divided into the following phases (Figure 1): (1) research area selection; (2) database analysis; (3) software analysis; (4) results and visualization and (5) conclusion.
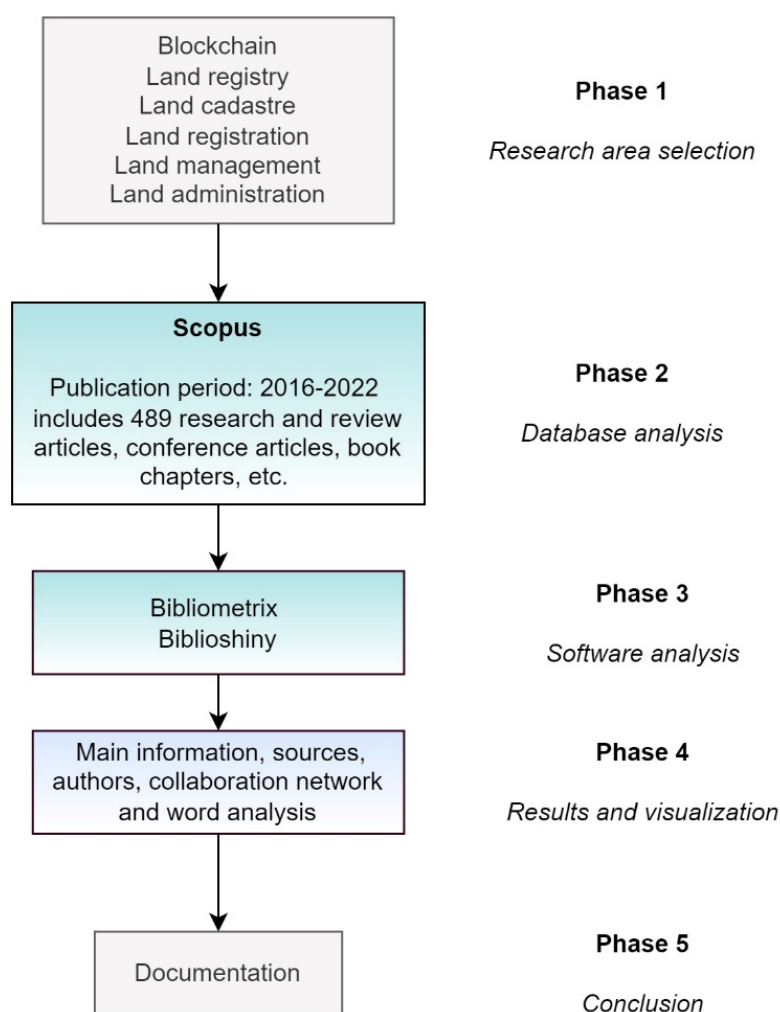


**Figure 1.** Flow diagram of bibliometric evaluation methodology on blockchain related to the land issues.

*2.1. Phase 1*

The first phase included defining the direction of the research and the selection of keywords by which the existing databases of scientific articles will be searched. The application of blockchain technology is interesting in many ways, but what certainly raises many scientific questions is how to fit it into existing land management systems and what advantages and disadvantages it would have. The improvement of land management and land management systems are topics that are often represented in scientific and

professional literature. While more developed countries mostly work on automating and speeding up the process of implementing changes in land registers, less developed countries, as well as a large number of developing countries, still struggle with inefficient and non-transparent systems and systems which its users do not trust. In response to such requests, various recent research can be found that are based on examining the possibilities and ways of using blockchain technology in land management, which also includes the management of land registers. By comparing traditional land registry systems with those based on blockchain technology, it was determined that blockchain systems can provide some additional advantages, such as the impossibility of unauthorized changes to already entered data, data transparency and the reduction or complete exclusion of centralized decision-making, all for the purpose of building a system in which citizens will have confidence. At the very beginning of consideration of the advantages and ways of implementing blockchain technology into the existing systems of a country, it is necessary to determine how the introduction of new technology would improve existing processes and whether it is necessary at all, especially referring to already-established user trust systems. Countries with up-to-date land registers noticed the advantage of the automation of existing systems that reduce the time required to manage a dynamization of land systems, as well as reducing the costs in existing administrative bodies. In the case of undeveloped countries and some parts of developing countries, the disorganization of existing data on land is particularly noteworthy. The inconsistency of cadastre and land registry, non-uniformity of recorded and real time data, inefficiency and sluggishness of the system, corruption, manipulation and lack of quality are some of the key facts that indicate that the current situation requires radical changes [45]. The research is a review of the existing scientific literature in the Scopus database, on the mentioned topic. The objectives would include the research of the direction and dynamics of the implementation of blockchain technology in existing systems, with advantages and disadvantages highlighted.

### 2.2. Phase 2

As stated in the description of Phase 1, the Scopus database was analysed for the time period from 2016, when the first scientific article on the topic of BC in land context was published, until the middle of 2022. Queries for searching bibliometric titles were performed using the following expression:

$$\text{ALL (“land registry” blockchain) OR ALL “land administration” blockchain OR ALL “land management” blockchain OR ALL “land registration” blockchain OR ALL “land cadastre” blockchain} \tag{1}$$

The expression ALL was used so that all the available data would be collected for future analysis. The Boolean operator "OR" was used to expand the research area and to be inclusive.

The data were filtered by subject area (data related to "Medicine", "Arts and humanities", "Chemical engineering", "Biochemistry", "Genetics" and "Molecular Biology" were excluded, and so were document types "Editorial", "Note" and "Short survey").

### 2.3. Phase 3

The obtained data was analysed for bibliometric indicators using Rstudio v.4.1.2 software with Bibliometrix R-package [46]. Its web-based application, Biblioshiny, was used for final analysis and data visualization. Biblioshiny combines the functionality of the Bibliometrix package with the easy use of web-apps using the Shiny package environment [47,48]. Below are the results of the analysis.

### 2.4. Phase 4

Later in the paper, a visual analysis of the terms "land registry" blockchain, "land administration" blockchain, "land management" blockchain, "land registration" and "land cadastre" blockchain is obtained in the Bibliometrix software package. Figure 2 shows an

insight into the annual scientific production for the term "blockchain" related to named land issues. In Figure 2b, we can see an exceptional annual growth rate of the scientific paper publishing in the Scopus database by the amount of 108%. That information is extremely valuable and shows year after year the growth of scientists' interest in the mentioned concept, which indicates a great potential for the later application of scientific guidelines in professional practice. During the analysis (only for Figure 2a,b), the year 2022 was not included because otherwise the results would not be properly displayed. The average number of citations per document is 11.51, which is an extremely high number. There are 65 single-authored documents that refer to 57 different authors. The average number of co-authors per document is 3.14. In the Scopus database, there are 163 research papers listed, together with 130 conference papers and 37 review papers.
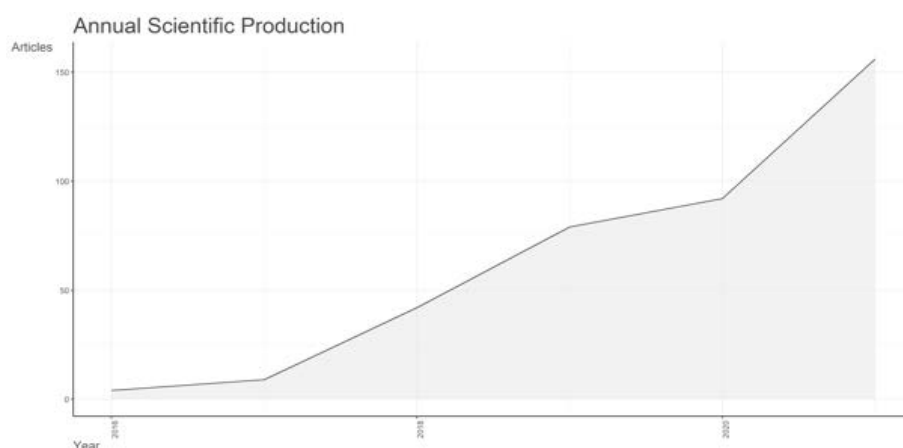


| Description | Results |
|---|---|
| MAIN INFORMATION ABOUT DATA | |
| Timespan | 2016:2021 |
| Sources (Journals, Books, etc) | 260 |
| Documents | 382 |
| Annual Growth Rate % | 108.07 |
| Document Average Age | 2.13 |
| Average citations per doc | 11.51 |
| References | 1 |
| DOCUMENT CONTENTS | |
| Keywords Plus (ID) | 1613 |
| Author's Keywords (DE) | 1014 |
| AUTHORS | |
| Authors | 1067 |
| Authors of single-authored docs | 57 |
| AUTHORS COLLABORATION | |
| Single-authored docs | 65 |
| Co-Authors per Doc | 3.14 |
| International co-authorships % | 23.3 |
| DOCUMENT TYPES | |
| article | 163 |
| book | 9 |
| book chapter | 30 |
| conference paper | 130 |
| conference review | 5 |
| editorial | 4 |
| note | 3 |
| review | 37 |
| short survey | 1 |

(**a**)　　　　　　　　　　　　　　　　　　　　　　　　　　　　　(**b**)

**Figure 2.** Bibliometric statistics of the publications on keywords of blockchain related to the land issues: (**a**) annual scientific production; (**b**) articles statistics.

Figure 3 shows the keyword cloud of blockchain-related land issue terms. The most frequent keywords are highlighted in the figure, and referred to "blockchain", "land registries", "internet of things", "digital storage", etc. The ones that are at least equally important and found their place in the word cloud are "decision making", "e-government", "smart contract", "land management", "registration systems", etc. All the mentioned terms refer to the goals of scientific research related to the improvement of existing land data registration systems. The above points to previous efforts to highlight the need to improve existing land systems, in this particular case by applying BCT, as well as finding the most adequate way to achieve that goal. Old structured systems usually require more time and money to do the job. It is certainly very important to highlight the term "decision making", which would be applied in all steps prior to and during the implementation of blockchain technology in existing systems. It is primarily important to find a way that would enable an objective approach to problem solving, and by organizing goals and sub-goals, creating favourable conditions for all future actions. Likewise, the methodology based on BCT should be "open" for combining with artificial intelligence methods, i.e., with multi-criteria methods, to obtain new data necessary for the establishment of an improved and sustainable land management system.

**Figure 3.** Keyword cloud of blockchain related to the land issues.

Figure 4 shows the same set of most frequent keywords as Figure 3 with their percentage dominance in relation to the total number of keywords to the subject of blockchain related to the land issues. Along with blockchain, which is the most represented (36%), there are also land registries (6%), digital storage (5%), e-government (4%), internet of things (4%), etc.



**Figure 4.** Word tree map.

Figure 5 shows two elements (clusters), red and blue, which define the interconnection of individual keywords. The bibliometric method Metric Multidimensional Scaling (MDS) was used to define the conceptual structure of the terms used in the papers on blockchain related to land issues. Using k-means clustering, two elements are defined which include keywords that appear simultaneously in different papers. The results are interpreted based on the position of keywords; words that are more similar in distribution are shown closer to

each other on the map. Thus, the blue cluster includes the keywords "land management", "land use", "smart contract", "information system", "information management" and "information use". The above can be interpreted as mutually close concepts in the scientific literature that refer to land management procedures, defining the land management system, which is based on the information and data system. On the other hand, the red cluster is more diverse in terms of related keywords. Out of the general blockchain-related keywords, such as bitcoin, cryptography, authentication, internet, current, decentralized and commerce, a smaller number of blockchain-related ones that specifically refer to land systems are visible, such as e-government, land registries, registration systems and cadastre.
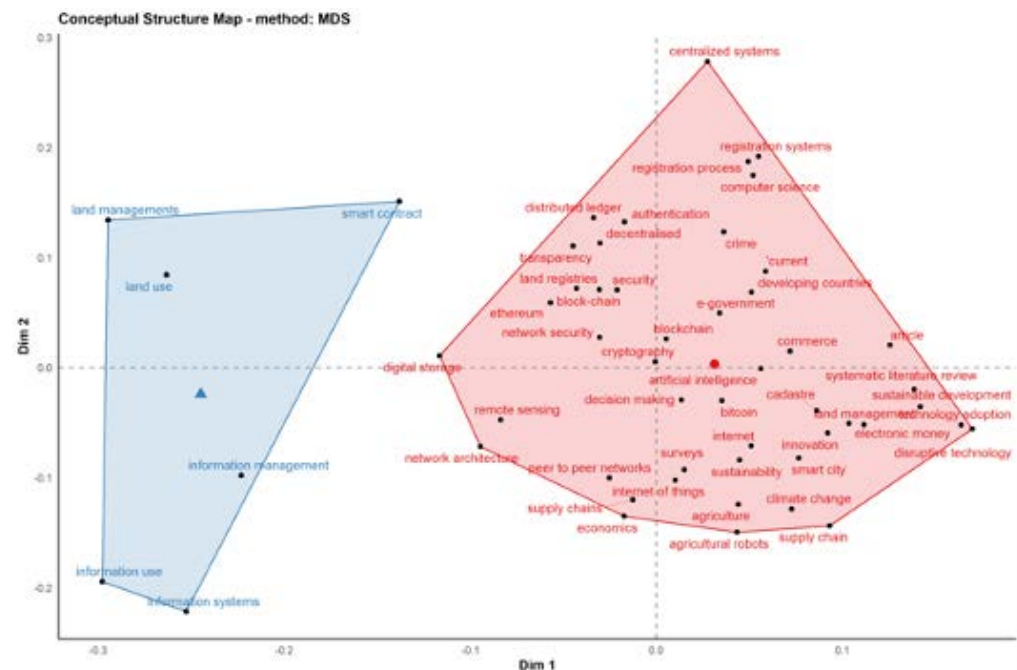


**Figure 5.** Conceptual structure map of a scientific field using Metric Multidimensional Scaling (MDS) and clustering of a bipartite network of terms extracted from keyword blockchain related to the land issues.

Figure 6 shows the evolution of the BC term related to the land issues over time. Until 2019, BC was associated with "bitcoin" and "electronic money" and similar terms, and from the year 2020, the term "land registries" entered the top 12 terms associated with blockchain.
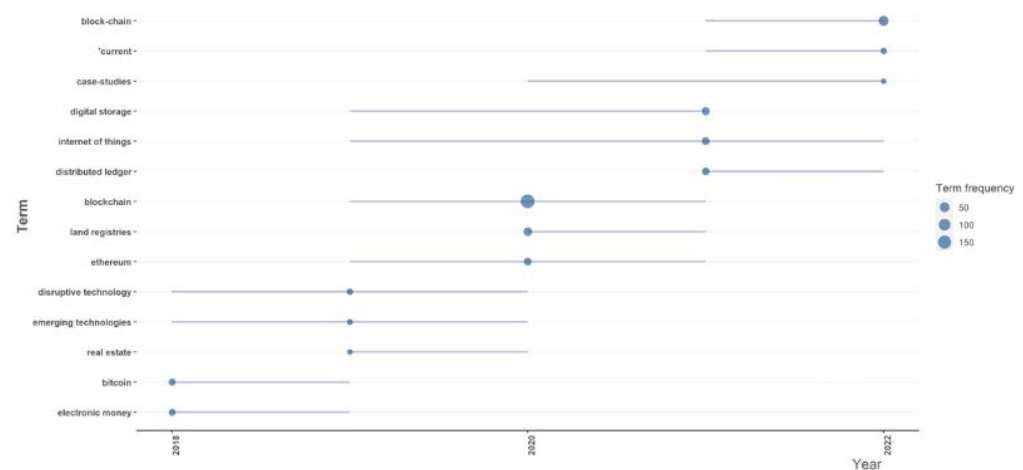


**Figure 6.** Topic trends in the blockchain context.

Figure 7 shows the scientific production of countries around the world. Colours were displayed based on the number of scientific papers published (in the Scopus database) per country. Productivity is defined by a colour scale, from dark blue, which refers to the most productive countries, to grey, which is the colour of countries where no scientific productivity has been recorded on the analysed topic. Countries with the highest productivity rates are India, the UK, the USA, Australia, China, Germany, the Netherlands, Italy, Spain, Canada, etc. On the map, Russia (27 papers published) and Vietnam (5 papers published) should also be coloured in blue, but due to the differently written names in the Scopus database and inside the Bibliometrix software, the software did not recognize them and so they are wrongly marked in grey. We could not change that inside the Bibliometrix software itself, so we were obliged to give an explanation on what happened. In Scopus, the names of the countries are Russian Federation and Viet Nam, but the Bibliometrix software recognizes the names Russia and Vietnam.
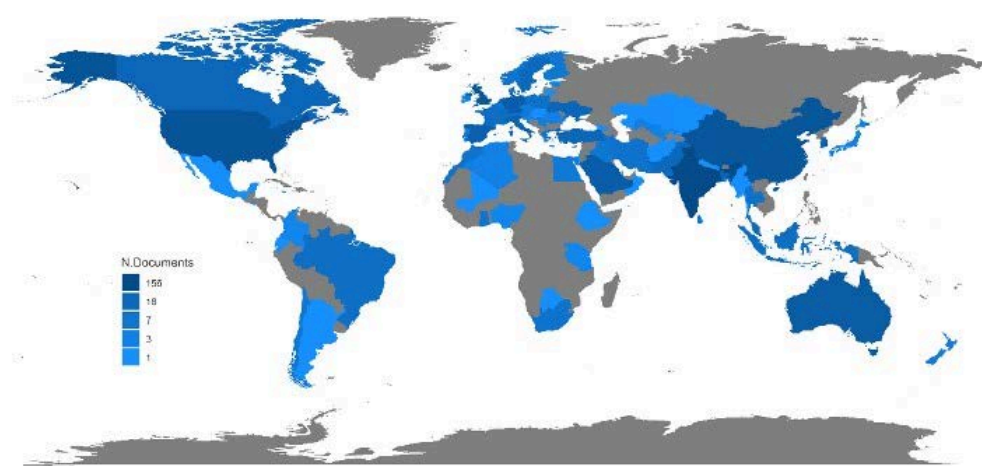


**Figure 7.** Scientific paper production by country using term BC related to the land issues.

Table 1 shows the total number of papers per country, published in Scopus scientific database, in the period from the year 2016 to the year 2022.

**Table 1.** Total number of papers per country.

| Country | No. of Papers | Country | No. of Papers |
|---|---|---|---|
| India | 89 | Turkey | 12 |
| US | 50 | Pakistan | 11 |
| Australia | 36 | Sweden | 11 |
| UK | 35 | France | 10 |
| China | 32 | South Korea | 10 |
| Russia | 27 | Denmark | 8 |
| Germany | 26 | Iran | 7 |
| Saudi Arabia | 20 | Norway | 7 |
| Canada | 19 | Switzerland | 7 |
| Netherlands | 18 | United Arab Emirates | 7 |
| Spain | 18 | Hong Kong | 6 |
| Bangladesh | 15 | Indonesia | 6 |
| Italy | 14 | Iraq | 6 |
| Malaysia | 14 | Ghana | 5 |

*2.5. Phase 5*

Based on the conducted research, several things could be pointed out. First and foremost, the annual growth of scientific paper publishing is surprisingly good, and it could be concluded that our colleagues are quite active in the field. According to the choice of words surrounding BC, research of the topic is progressing in two major directions. The

first direction is dealing with technical problem solving and new technologies applied to the BCT field. The second direction is solving problems in land governing using the BCT. The trends of topics is also quite interesting. A rise in land registries topics can be seen in the top 12 words close to BC.

Another issue to be pointed out is the fact that the topic of the BCT in land context is spreading throughout the world on five continents, with the exception of the Arctic and Antarctica. Even in Africa and South America, more and more countries are occupied with a topic, at least in the scientific community through paper publishing. India is showing a special interest, obviously, due to the many problems they have in land governing. Most of the highly developed countries are showing an interest in how to improve their solutions in BCT usage too. Looking at the number of papers published, we can only analyse some trends. For instance, the USA has published 50 papers on the topic, Australia has published 36 and the United Kingdom has published 35, but there is no real outcome of that research at the state level. Looking generally, most of the papers are dealing with some segments or some aspects of the topic. The limitation of this research is the fact that the topic development is not exclusively in charge of scientists. On the other hand, it cannot be denied that scientific research is important in LM development in theory and practice. The importance will be even more visible in the future in the context of sustainable development. BCT will improve the LM of every state in which it is applied, as can be seen with the example of Georgia, but the prerequisites must be met.

## 3. Discussion and Conclusions

The scientific novelty of the research is the global insight in the Scopus database, looking from a sustainable point of view, dividing the world into developed and non-developed countries, Global North and Global South. A different approach was established on both halves of the Earth, with comparison of what the results and expectations are in both domains. Up until now, scientific research on the topic was managed based on the experience and the results of the previous authors' writings (many papers explain research findings in certain countries), or it was conducted based on the individual projects and research results. So far, there has been no research that has analysed the results of the whole scientific database on a "BC-land" theme.

The results are quite interesting. The annual growth rate of 108% of scientific paper publishing in Scopus on the topic gives us information on yearly trends and on the percentage of interest in the topics inside the scientific community. The numbers are good, and they increase optimism for the future of the topic and its further development. According to the selection of words, based on their repetition in the scientific papers, it can be concluded that the topic is developing in two main directions. The first one is solving, expanding and consolidation of the technical issues and aspects of the BC itself and integrating it with other old or new technologies. The other is solving the issues of land and analysing or preparing it for BCT implementation in land governing.

By the disjunction of the states between Global North and Global South, several trends could be noticed. A different interest in topics is shown in Global North and Global South.

A Global South state, India, has the most papers published (89) of all countries. That number is almost double that of the second country, the USA (50). In India, there is a significant increase in interest in the topic at the scientific level. According to Müller and Seifert (2019) [21], it could be seen that they are trying to implement it, in some form, at a state level also. Other Global South countries are not even close to India's activities. Saudi Arabia has 20 papers published. This is followed by Bangladesh, Malaysia, Pakistan, Iran and the United Arab Emirates, a country that looks closest to BC implementation at a state level, at least in Dubai. Ghana has a few papers and is reporting still some activities at a state level, etc. The main topics needed to be solved in Global South are fraud and a lack of transparency, and also in some countries, there is almost no documentation of the real estate at all (for instance, the Ghanaian case of 80% of property not being registered).

Global North countries are showing different activities. They could be divided into certain categories. Those countries that are well developed, with well-organized LR and LC, are looking for improvement of what they already have. Speeding up the processes, making them even more transparent and independent is their main goal. One of the outcomes would be further economic development as the indirect result of faster real estate property transfer. Their main obstacle is legislation and standardization, and a lack of it in the BCT sector. Those countries are, for instance, Sweden, Germany and the United Kingdom. The other group of Global North countries are those that have an established LR and LC, but they are not completely accurate and for certain reasons are not up to date and there is an increased possibility of data manipulation. They also have, as an obstacle, insufficient regulation and legislation on the BCT topic. The primary need of BCT establishment is accurate data input. Therefore, the problem of those countries is much bigger than in countries with developed LR and LC. Things that could be done, in those states, today is attempting to raise the quality of real estate data and developing in parallel legislation and regulations on BCT. They could also initiate pilot or any other kind of projects in their countries.

The main result of our research is that the scientific interest in the "BC-land" topic is increasing and it is increasing throughout the world. In a few years' time, the whole map of the world will be painted in blue. Maybe this is a wakeup call for the governments of more countries to get involved in projects concerning BCT. Different countries have a different approach or different speed on the topic, but most of them are involved in the topic in some way. None of them have some kind of a global solution. Another important outcome of our research is that there are some positive examples of successful implementation of BCT in a small but relevant number of countries such as Estonia and Georgia and partially Sweden.

Future research could go in a few directions. It should be treated differently for developed and non-developed countries. Matters of legislation and standardization should be considered in developed countries. In non-developed countries, LR and LC should be established. This is the prerequisite that must be met. It should be developed in parallel with digitalization throughout the country. It is one more segment that needs to be established and developed. From our research, it can be concluded that BCT, in contests of land governing, for a large number of countries of the world, has its future. Maybe not tomorrow or the day after tomorrow, but in some years, with the creation of an appropriate environment, it will be a tool that could bring a greater good to society, and that should be one of our goals in the development of our nearest surroundings. As it can be seen, BCT's time is yet to come.

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